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FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Contemporary management. Presented papers contain result of researches conducted by various universities. The number consists of 45 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: innovation management, crisis management, public management, marketing, project management, technology management, leadership, human resource management, quality management, financial management, Industry 4.0, supply chain management, logistic, the impact of CIVID-19 pandemic on management, the impact on management, Corporate Social Responsibility, economics and business analytics.

Radosław Wolniak

THE MEDIATING ROLE OF JOB SATISFACTION BETWEEN ORGANIZATIONAL AGILITY AND INNOVATION: A RESEARCH ON NURSING MANAGERS

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Purpose: The aim of the article is to draw the relationship between organizational agility and the innovation process in healthcare organizations and to examine the mediating role of job satisfaction in this relationship.

Methodology: The quantitative study was conducted on a research sample determined using the convenience sampling method, consisting of 470 nurses managers working in healthcare organizations in Turkey. For statistical analysis of the data, we used the PLS-SEM approach to analyse the data, testing the hypotheses of current study.

Findings: Nursing managers play an important role in the mechanism of shaping an innovative work environment based on organizational agility. Organizational agility contributes to innovation in healthcare organizations. Job satisfaction is one of the factors influencing this relationship, therefore organizations should strive to increase it.

Research limitations: The survey was limited to health care nursing managers in Turkey. Although the number of responses is high (n = 470), limiting the sample to a specific geographical region may hinder generalisations. Therefore, future research could include nurse managers from other countries.

Practical implications: The empirical results of the current study confirm the research model developed. The results provide guidance for healthcare managers. Through to this study, attention has been drawn to the need to develop all determinants of organizational agility and employee satisfaction in order to foster innovation in healthcare organizations.

Originality/value: Nursing managers should develop the competences and knowledge necessary for organizational agility. Proper formulation of challenges and tasks (for managers and for nurses' teams), in line with Expectation States Theory (EST), will increase job satisfaction and have a positive impact on the innovation process.

Keywords: organizational agility, innovation, job satisfaction, healthcare organization.

Category of the paper: research paper.

1. Introduction

Healthcare institutions and their employees play a key role in addressing health needs. In addition, these organizations must provide high-quality services that are accessible to patients who need them, while being competitive at efficient the same time. Managing this organization is particularly difficult, because achieving the organization's goals economically and efficiently should simultaneously meet the changing needs of patients.

Therefore, one of the desirable features of modern healthcare organizations is organizational agility and the implementation of innovations. Organizational agility is a necessary skill that enables companies to quickly react to changes in the operating environment that appear on the market (Akkaya, 2021). Organizational agility makes it easier for organizations to respond to environmental changes (Tamtam, Tourabi, 2020) and, at the same time, may constitute a potential for innovative processes and activities. The implementation of innovative solutions is becoming an inevitable trend in improving the quality of services provided and improving medical productivity (Lv et al., 2021). As a result of innovations in the nursing field work of nurses, it is currently possible to improve efficiency and introduce new solutions. The source of innovative processes in healthcare organization is primarily employees (Shin et al., 2017; Yan et al., 2020). Nurses that provide up to 80% of primary health care (Hughes, 2006) and their managers are a special group of people whose behavior and abilities can influence the creation and implementation of innovations. The research conducted so far highlights the role of innovative behaviors of nurses (McSherry, Douglas, 2011; Zhu et al., 2014) in the innovation process. Moreover, they emphasize the essence of an innovation-friendly organizational climate, thanks to which employees are willing to transform their creative ideas into innovative products (Emiralioglu, Sönmez, 2021). Job satisfaction is of particular importance in motivating nurses and their managers to undertake innovative activities. Knowledge, experience, and teamwork of healthcare professionals are catalysts to develop the necessary innovative solutions for many global health problems, while also serving as a source of job satisfaction in the healthcare industry.

Expectation States Theory (EST) is not only considered one of the interactive theories relating to cooperative activities and job satisfaction in social groups, but also used as a framework to develop an understanding the relationship between organizational agility and the innovation process in healthcare organizations (Wagner, 2007; Roth et al., 2012). The main assumption of this theory is that employees are in a task relationship with each other, and based on the available information, their expectations are formulated about the actions of others in relation to specific tasks (Berger et al., 1977). Therefore, in line with the EST, the join activities of nurses and their managers, especially regarding organizational agility in responding to change, as well as in the implementation of future innovative tasks, perfectly fits into the dynamics of such relationships.

Due to the enormous benefits of innovation in many organizations, research is also being undertaken in the healthcare sector (Żukowicka-Surma, Fritzsche, 2023; Glover et al., 2020). Contemporary research identifies factors for the development of organizational agility in healthcare organizations (Prashar, 2024; Akkaya, Mert, 2022), and ways of adapting to change (Zeid et al., 2024). However, there is a lack of research that assesses the relationship between organizational agility and the innovation process in healthcare organizations. Therefore, the current study aims to investigate the relationship between organizational agility and the innovation process in healthcare organizations and the mediating role of job satisfaction in this relationship.

Organizational agility and innovation process

Organizational agility is defined as the company's ability to react quickly to both expected and unexpected changes occurring in its internal and external business environment (Akkaya, 2021). The organizational agility model for business developed by Sharifi, Zhang (2001) has four main elements: i) responsiveness, ii) flexibility, iii) quickness, and iv) competency. These are used to determine whether the company is organizationally agile or not.

The involvement to continuous transformation and agile strategies causes changes at many levels of the organization, from its structure, through leadership to the skills and interpersonal relationships of co-workers carrying out an agile mission (Appelbaum et al., 2017, Gardner et al., 2023). This allows organizational agility to provide the framework necessary for the innovation process. Putting agility in the foreground of innovation supports not only the ability to respond quickly and flexibly to changes in the business environment, but also the ability to proactively generate change, whether technology or customer driven (Brand et al., 2021). Research conducted in other industries indicates that organizational agility increases the efficiency of radical innovations both in a specific situation and in an environment with technological turbulence (Puriwat, Hoonsopon, 2021). Therefore, we hypothesized that

H1: There is a positive relationship between nursing managers' perceptions of organizational agility and innovation process.

Organizational agility and job satisfaction

Organizational agility is necessary in healthcare settings due to the complexity and interdependence of their systems, which include many services and relationships (Motwani, Katatria, 2024). Agility suggests to managing an organization creates the conditions necessary to create innovation. These include openness to new ideas, technologies and solutions resulting from the market needs or the interests of the organization. The innovative climate has a positive impact on job satisfaction (Demircioglu, 2021). The motivators of job satisfaction include relations with colleagues and leaders (Alrawahi et al., 2020; Yu et al., 2018), and the nurse's work environment (Kagan et al., 2021). Formulating by managers and nurse's expectations

regarding actions to improve the implementation of various processes based on new information will increase job satisfaction. Therefore, we hypothesized that

H2: There is a positive relationship between organizational agility and job satisfaction of managers of nurses in healthcare institutions.

Job satisfaction and innovation process

Studies to date shows that job satisfaction is a key indicator of well-being and mental health in the workplace (Hünefeld et al., 2019). Satisfaction with work affects commitment, achieving better results and creativity (Demircioglu, 2021). Moreover, job satisfaction positively influences individual innovative behavior of employees (Niu, 2014; Xerri, 2014). Due to the fact that the innovative climate stimulates initiative behavior (Kagan et al., 2021) and encourages to be active, promotes innovation, we hypothesized

H3: There is a positive relationship between job satisfaction of nurse's managers and innovation process in healthcare institutions.

Job satisfaction, organizational agility and innovation process in healthcare institutions

The literature emphasizes that nurses are of fundamental importance for high-quality in healthcare (Jackson, Kozłowska, 2018), as well as for the implementation of new innovative solutions and practices (Hughes, 2006; Mcsherry, Douglas, 2011). Nursing managers, on the other hand, are the frontline leaders who manage wards and influence the staff's ability to deliver quality care (Trus et al., 2012; Alharbi et al., 2021). Research emphasizes the role of employees in creating innovation (Weng et al., 2013), because it turns out that the most innovation is created inside the organization thanks to employees. That is why it is so important to learn about the factors supporting employees in being innovative. Work satisfaction is the determination of creativity (Wang et al., 2021) and openness to change (Satuf et al., 2018). Moreover, job satisfaction in relation to immediate superiors and relations in the workplace influence employees' involvement in innovation (Tsai, Yen, 2020). Formulating specific expectations regarding tasks by nursing managers, depending on the changing conditions of functioning, increases, in accordance with EST, job satisfaction. Furthermore, the basis for a safe and stable work environment can be organizational agility (Walter, 2021). Accordingly, we hypothesized

H4: Job satisfaction of nursing managers has mediating role between organizational agility and innovation process in healthcare institutions.

The hypothesis model is presented in Figure 1.

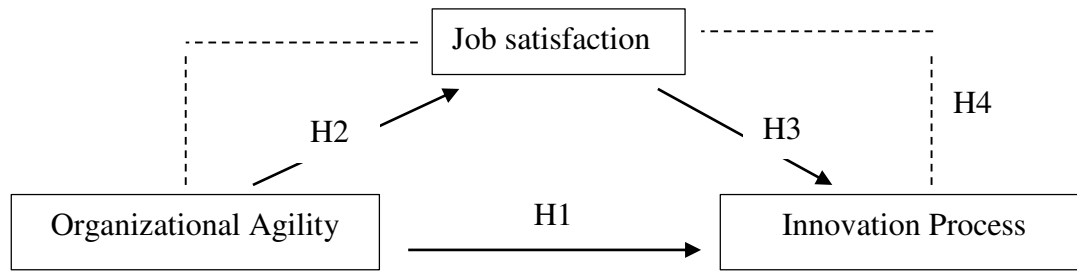


Figure 1. Research Model.

Source: own elaboration.

2. Materials and Methods

The present study used a quantitative approach to test the recommended hypotheses. A convenience sampling technique was used to collect data (Etikan et al., 2016). The survey was conducted among nurses working in a city located in the west of Turkey. To obtain the largest possible sample size, probabilities of 0.5 were used. Achieving a 95% confidence level (with $\alpha = 0.05$), it is acceptable for the frequency of the examined event (p) to fall 5% below or exceed the actual population rate (P), implying a sampling error of $d = 0.05$ amidst around 3849 studies (www.manisa.gov.tr). The size of the universe is 3849, and as a result, the sample calculation was computed using the formula provided.

$$n = \frac{Nt^2pq}{d^2(N-1) + t^2pq} \quad (1)$$

where:

N - Number of individuals in the target audience = 3849,

n - Number of individuals to be sampled,

p - Frequency of occurrence of the event examined (probability of occurrence) = 0.5,

q - Frequency of occurrence of the examined event (probability of not occurring) = 0.5,

t - At a certain level of significance, the theoretical value found according to the t table = 1.96,

d - It is the \pm sampling error accepted according to the frequency of occurrence of the event. = 0.05.

According to the prescribed formula (1), the minimum sample size required was found to be 307 individuals. 505 participants were recruited for the study and surveys with incomplete responses were omitted from the analysis. Therefore, 470 sets of data were utilized in the research.

470 nursing managers in Turkish healthcare organizations have participated voluntarily in the current study. The sample size is appropriate, consisting over 300 respondents (Comrey, Lee, 2013). The profile of respondents consists of 30.0% males and 70.0% females. Relating to work experience, 64.3% worked less than ten years, and 37.7% worked more than ten years. About the healthcare organization, most organizations (85.6%) were public, while 14.4% were private. Regarding employee number, 24.7% were from the healthcare organization having 100 and less employees, 75.3% were from the healthcare organization having more than 100 employees.

The questionnaire consisted of two parts. The first part was about demographic information of nursing managers. The second part of the questionnaire contained constructs to examine the variables in the study: organizational agility, innovation processes and job satisfaction. The first section in this part of survey was about nursing managers' perceptions of organizational agility. Organizational Agility (OA) scale was developed by Sharifi and Zhang (1999) and adapted to Turkish by Akkaya and Tabak (2018). It presents 17 items. The second section is about Innovation Process (IP) developed by Wang and Ahmed (2004) and has 4 items. The last section was Job Satisfaction (JS) developed by Judge et al. (1998) and adapted to Turkish by Başol and Çömlekçi (2020). It has 5 items. A standardized five-point Likert scale was used to organize the scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Demographics, descriptive statistics, and the test of normality were determined using SPSS. For confirmatory factor analysis, internal accuracy and validity estimations, hypothesis verification, and mediation testing, Smart PLS version 3.0 was applied. We used the PLS-SEM approach to analyze our hypotheses based on several parameters. According to Fornell and Larcker (1981), PLS avoids many of the limiting assumptions that drive maximum likelihood techniques while still protecting against imprecise solutions and factor indeterminacy. PLS-SEM does not imply any distributional assumptions on the indicators or error terms (Hair et al., 2014) and PLS can address both reflecting and formative constructs (Hair et al., 2006). PLS is a latent variable modeling technique that involves a large number of dependent variables and specifically detects measurement error. Furthermore, unlike covariance-based SEM approaches, PLS is unaffected by sample size limits and may be used with any sample size higher than thirty (Fornell, Larcker, 1981). Thus, SmartPLS was used for the examination of causal relationship among variables.

3. Results

First, we used correlation analysis to determine the link between variables in the study. The outcome indicated that there is a strong connection between variables as presented on Table 1.

Table 1.
Validity, Correlations and Descriptive Statistics

Variables	C	F	IP	JS	Q	R
C	0.750					
F	0.571	0.722				
IP	0.586	0.449	0.797			
JS	0.644	0.467	0.669	0.785		
Q	0.450	0.585	0.354	0.390	0.767	
R	0.663	0.582	0.399	0.454	0.526	0.863
CR	0.910	0.760	0.874	0.889	0.810	0.897
AVE	0.662	0.621	0.635	0.616	0.688	0.744
A	0.887	0.721	0.807	0.844	0.767	0.830

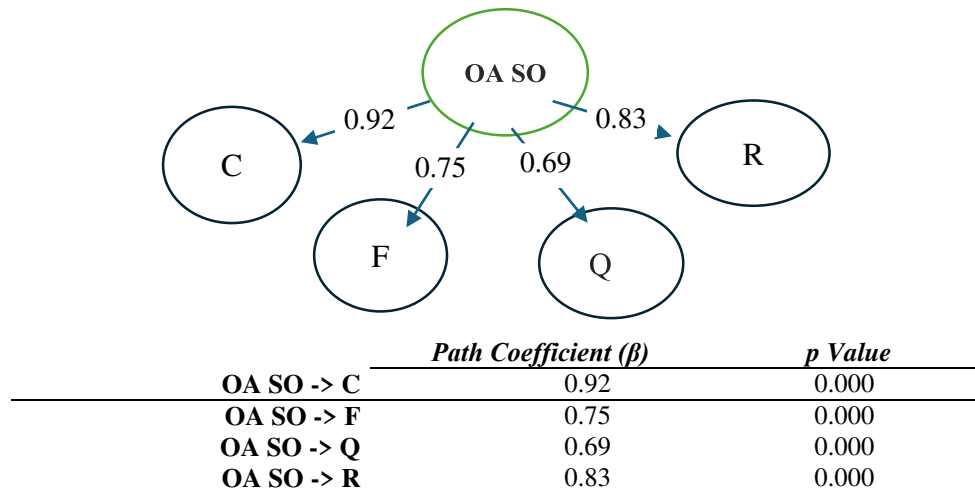
Note: C – Competency, F – Flexibility, Q – Quickness, R – Response, IP– Innovation process, JS – Job satisfaction; CR = Composite Reliability; AVE = Average Variance Extracted; α = Cronbach's Alpha.

Source: own elaboration.

To test reliability, the composite scale reliability (CR), Cronbach alpha, and average variance extracted (AVE) were applied. PLS-based CR exceeds the value of 0.70 for all first order constructs, Cronbach alpha exceeds the value of 0.70, and AVE is above the value of 0.50. Furthermore, we investigated convergent validity by examining the standardized loadings of the measures on their respective constructs, and we observed that all exceeded 0.60 (Fornell, Larcker, 1981).

Moreover, as a second order variable, OA was estimated through a secondary factor analysis yielding four latent constructs: Competency, Flexibility, Quickness and Response. Figure 2 shows the standardized regression loadings of those constructs.

T-statistics were calculated for all coefficients based on their consistency across sub-samples in order to identify statistically significant relationships and the path coefficients associated with t-values showed the direction and impact of each hypothesized relationship. For assessing the indirect impacts of factors, the Preacher and Hayes (2008) technique was used. The mediation process works as follows: Y is a variable impacting as a mediator if X affects Y, X affects Z, and Y significantly influences Z while controlling for X, and the effects of X on Z decrease considerably when Y is added in the model concurrently with X as an interpretation of Z (Preacher, Hayes, 2008).



Note: C = Competency; F = Flexibility; Q = Quickness; R = Response, OA SO - Organizational Agility Second Order.

Figure 2. Second Order Factor Analysis of Organizational Agility.

Source: own elaboration.

Table 2 displays the hypotheses' outcomes, including pathways, betas, and significance levels. In terms of the direct impacts of JS, the results showed that JS was significantly and positively associated with IP ($\beta = 0.50$; $p < 0.01$). Thus, H1 is supported. The findings, on the other hand, provide empirical evidence in favor of a direct link between OA and IP. Therefore, H2 is also supported ($\beta = 0.26$; $p < 0.01$). Furthermore, the results showed that OA was significantly and positively associated with JS ($\beta = 0.63$; $p < 0.01$), Hence, H3 is supported, too.

Moreover, we also performed mediation analysis to assess the mediating role of JS on the relationship between OA and IP. With the inclusion of mediating variable JS, the impact of OA on IP ($\beta = 0.58$; $p < 0.01$) become significant. However, the indirect effect of OA on IP decreased ($\beta = 0.32$; $p < 0.01$) but was still significant. These findings indicate that the relationships between OA and IP is partially mediated by JS, supporting H4 (Table 2).

Table 2.
Results of Hypothesis

Relationships			Path Coefficient (β)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	Hypotheses	Results
JS	→	IP	0.503*	0.505	0.051	9.827	H1	Supported
OA SO	→	IP	0.263*	0.263	0.048	5.542	H2	Supported
OA SO	→	JS	0.632*	0.636	0.035	18.060	H3	Supported
Total effect								
OA SO	→	IP	0.581*					
Direct Effect								
OA SO	→	IP	0.263*					
Indirect Effect								
OA SO	→	JS→IP	0.318*					

Note: IP – Innovation process, JS – Job satisfaction, OA SO – Organizational Agility Second Order, * $p < 0.01$

Source: own elaboration.

To validate the PLS-SEM approach, several quality scores such as the coefficient of determination (R^2), Q predictive validity (Q^2), and SRMR (standardized root mean squared residual) are applied. Innovation process ($R^2 = 0.49$) and job satisfaction ($R^2 = 0.40$), both having significant impact. The Q preDIsTive validity of all of our endogenous notions was similarly acceptable. This finding implies that the preDIsTors of the models may explain the variation in the dependent variable. Moreover, SRMR should be equal to or less than 0.08 (Hu, Bentler, 1998), and Table 3 and Figure 3 indicate that SRME for our model is 0.053, which meets this criterion.

Table 3.
Structural Model

Endogenous Constructs	R Square	SSO	SSE	$Q^2 (=1-SSE/SSO)$	SRMR
IP	0.399	1876.000	1308.723	0.302	0.053
JS	0.490	2345.000	1776.486	0.242	

Note: IP = Innovation Process; JS = Job Satisfaction.

Source: own elaboration.

In the same time the structure model, confirm the values included in the Table 3.

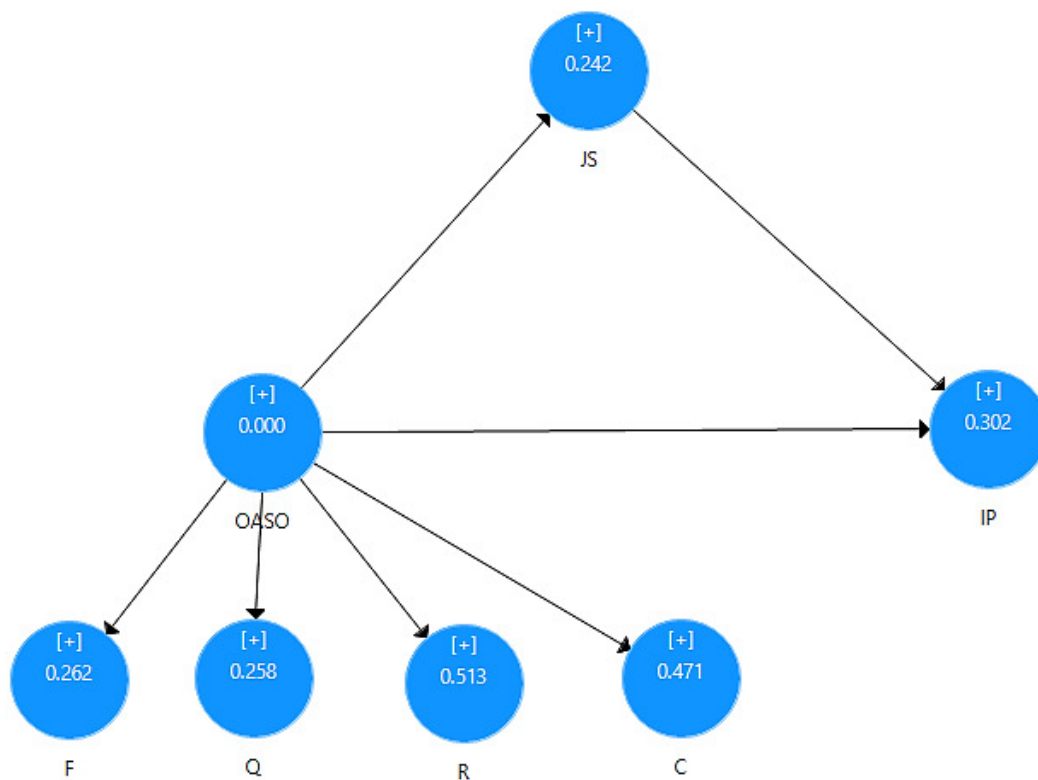


Figure 3. Structure Model.

Source: own elaboration.

4. Discussion and Conclusion

Managers can increase firms' performance by satisfying their employee and nurses (Everhart et al., 2013). Customers, patients, and guests are increasingly worried about the quality of their healthcare. To fulfil this need, the healthcare organizations should work to enhance their current product or service by incorporating innovation into their processes, organizational agility being the solution for this.

Healthcare organizations have been a major issue all over the world since a healthy community influences national growth, especially since Covid-19 pandemic. The lack of qualified personnel in healthcare, especially nurses, is a problem facing the entire world, and with the onset of the health crisis induced by coronavirus, this concern has increased. For this, nursing managers play a vital role, significantly influencing job satisfaction achievement and decreased concern (Tang, Hudson, 2019). Organizational agility is vital in enhancing procedures in relation to infrastructure and management needs in response to the complex demands of the healthcare industry within the global business environment (Akkaya, Mert, 2022). In addition, the healthcare sector is facing increasing competition, technological innovation, changing market environment and customer requirements (Tseng, Lin, 2011), organizational agility is becoming more important, supporting coordination and collaboration, so that the result reflects an improvement regarding the patients' experience (Vaishnavi et al., 2019).

The results of the current study are significant, being consolidated by previous studies in the literature in the field. The findings of the study indicate that organizational agility has an impact on innovation process in healthcare organizations. Data plays a vital part in enhancing organizational agility, by improving the flexibility and enhancing detail in healthcare systems, aiding in developing algorithms, facilitating the creation of self-organizing work units, establishing appropriate communication links, strengthening decision-making systems and instilling confidence in employees (Vaishnavi et al., 2019). Jones and Smith conducted a study investigating the impact of organizational agility on the innovation process within healthcare organizations (Jones, Smith, 2017). Research indicates that organizational agility is a crucial factor in enhancing innovation within the healthcare sector. Similar results were found by Alhassani and Al-Somali (2022), and Melián-Alzola et al. (2020). To achieve service innovation one of the required competencies is represented by organizational agility and is implemented in healthcare in order to provide both service innovation (Melián-Alzola et al., 2020), leading to hospitals performance (Akenroye, Kuenne, 2015).

We reported a positive relationship between organizational agility and job satisfaction of nursing managers. Melián-Alzola et al. (2020) have studied how hospital managers affect employee outcomes, the results highlighting that the hospital agility and performance significantly influence the personnel satisfaction (Melián-Alzola et al. (2020). In order to assure

improvement on patients' status, the healthcare service must be prompt (Drupsteen et al., 2016), being associated to organizational agility. The agility can be associated with lean, improving the services quality, and satisfaction (Gardner et al., 2023; Drupsteen et al., 2016; Rahimnia, Moghadasian, 2010).

The positive relationship between job satisfaction of nurse managers and innovation process was confirmed by the current study. Brimhall and Mor Barak (2018) highlighted also a positive relationship between innovation and job satisfaction (Brimhall, Mor Barak, 2018). Innovation in healthcare is vital to improve quality of care (Demircioglu, 2021), developing organizational field of healthcare (Page, 2014), digital era and technology give opportunity to healthcare organizations to be more dynamic and adaptive (Üstgörül, Akkaya, 2023), increasing employee job satisfaction (Brimhall, Mor Barak, 2018).

Job satisfaction of nursing managers mediates the relationship between organizational agility and innovation process in healthcare institutions and the results confirmed it.

This enables a more profound comprehension of the leaders' role and influence in the healthcare sector. Therefore, the nursing managers' job satisfaction significantly influences work dynamics throughout healthcare organizations. Nursing managers hold a crucial position in healthcare institutions, being accountable for managing and coordinating business processes as well as directing innovative practices. The correlation between job satisfaction and the innovation process can have an impact on the satisfaction and motivation of nurses, reinforcing the culture of innovation in healthcare establishments. Nursing managers' job satisfaction can additionally influence the organization's agility, encompassing the capacity to promptly and effectively adapt to changing conditions. Job satisfaction among managers can enhance agility in organizations, enabling smoother adaptation to innovative processes (Dekoulou, Trivellas, 2015). To our knowledge, there are no studies in extant literature, that confirm or rebut this relationship, the novelty of our paper being based on this. Thus, this current research is critically important for future researches. However, taking into account the confirmation of the relationships reflected by hypotheses above, we are predisposed to consider that the results are relevant. We restricted our focus to defining organizational agility in terms of the capacity of health care organizations to respond customers, patients and guests' expectations when they need to. This is closely related to management process and decision making (Teece et al., 2016; Zhen et al., 2021; Üstgörül, Popescu, 2023). Therefore, we collected data from nursing managers who are critically important for health care organizations to adapt environment and changes. The empirical results of current study strongly support the research model and the findings provide specific actionable guidance for health care managers on how to increase their innovation process through organization agility.

Further research is required to show what specifically nursing managers in Turkey need, where are prominent at management level and what positions are critical for decision making in the innovation process. Concrete and empirical findings are necessary in decision making to

devise appropriate strategies for successful management to ensure nurses are full participants during Covid-19 pandemic.

This research was limited to the nursing managers in healthcare in Turkey. Although the number of responses is high ($n = 470$), all participants were either living in west of Turkey. Moreover, the limitation of a certain geographical region's sample may impede generalisations. The presence of predominantly local participants could be inadequate in depicting the distinct dynamics and cultural distinctions within healthcare institutions in other parts of Turkey. Secondly, the data was solely collected from nurses. This could lead to a shortfall in conveying the views and insights of other healthcare professionals and managers. Specifically, there may be variations in organisational flexibility and the innovation procedure across diverse professional sectors. Additionally, the employment of surveys as the study's data collection method might limit a comprehensive representation of participants' actual emotional states. While surveys can measure emotional and experiential components, they may overlook nuanced details and result in incomplete representation of participants' genuine emotional experiences. Additionally, it should be noted that this research was constrained by time limitations, as the study was conducted over a specific timeframe and may therefore not fully reflect the fluctuations within the variables and dynamics of the health sector over time. The use of quantitative research design method limits the interpretation of our findings. Thus, future research would be a mixed method study — combination of qualitative and quantitative methods — to study the perception of innovation and its effects on nurses in health care organizations. These limitations should be considered when interpreting the findings of the investigation and drawing broader conclusions.

The results are of high importance for healthcare managers because it raises awareness to the importance of agility in hospitals. This study presents an innovative research approach by exploring a perspective that has yet to be investigated in the healthcare sector. By undertaking this analysis, this study aims to address a significant research gap in the field. It aims to examine the correlation between job satisfaction among nurses working in health institutions and the agility and innovation process in organisations. The paucity of studies in the health sector literature examining these variables, taken with each other, demonstrates that this research fills a crucial gap in the field and makes a one-of-a-kind contribution. Furthermore, the study aimed to investigate a dimension of the mediating relationship between nurses' job contentment, organizational agility, and innovation process that preceding researches have failed to address. This article will furnish managers and decision makers in the healthcare sector with important insights for effective organisational strategy. Additionally, the study utilises an innovative methodology to comprehend this intricate relationship, enhancing the literature on methodological innovation. Thus, by implementing organizational agility, the entire healthcare systems can benefit from higher quality of services and increase value for the population.

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STATE OF THE REVIEW ON INTEGRATED EMERGENCY RESPONSE AND TELEHEALTH SYSTEMS FOR ENHANCED CRISIS MANAGEMENT

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Purpose: This study examines the purpose, methodology, findings, and originality value of implementing telemedicine in tertiary hospitals across different regions of China. The primary purpose is to address the significant imbalance in medical resources between urban and rural areas by leveraging telehealth systems, particularly focusing on the development and application of telemedicine.

Methodology: The research employs a mixed-methods approach, incorporating a literature review, surveys, and statistical analysis. Questionnaires, designed by telemedicine experts, were distributed to 185 tertiary hospitals, with a focus on telemedicine implementation, application, and key contributing factors. The survey design is optimized to represent the diversity of China's healthcare landscape.

Findings: The findings reveal a stark contrast in healthcare resources between the eastern, central, and western regions of China. Telemedicine platforms have been established in 22 provinces, covering 13,000 medical institutions. Tertiary hospitals, especially in the eastern region, play a pivotal role in providing telemedicine services. The study outlines the challenges, financial aspects, and factors influencing the success of telemedicine implementation in China.

Originality Value: This research provides original insights into the development of telemedicine in China, focusing on the telehealth system's impact on healthcare accessibility. It explores the educational background of telemedicine staff, funding sources, and the role of government support. The study also identifies key challenges and implications for practical telemedicine applications in addressing healthcare disparities, emphasizing the transformative potential of telemedicine in China's healthcare landscape.

Keywords: crisis management, emergencies, telehealth system.

Category of the paper: Review article.

1. Introduction

Today's world is a complex and rapidly evolving world. There are significant challenges faced by public safety due to crises and emergencies in which swift and coordinated responses in all sectors are important. Certain innovative approaches are integrated into the health sector to revolutionize crisis management. The integration of the emergency response system and innovation of these approaches within the transport sector along with the utilization of telehealth tools are important to manage the crisis in various sectors. This study shows the combination of integrating the emergency response system and the telehealth system along with the exploration; of how their convergence can lead to more effective and efficient responses to emergencies (Sutherland, Chakraborty, 2023, pp. 100256-100256). There is a interaction between emergency response systems operating within the transportation networks and the utilization of telehealth technologies in healthcare and this study aims to investigate the interaction between them. Integrating the emergency response system and the telehealth system are the two domains discussed in this study.

2. Emergency, Telehealth, transportation, medical transportation, cross-sectional (Medical & Telehealth)

Drones may be a very helpful means of transportation to help supply necessities, and they can be a vital tool to help vulnerable towns and populations get quick aid. Generally, the patient's arrival at the hospital was not delayed by the helicopters near landing and landing site position. In the future, helicopters could be able to view outdoors even in limited visibility thanks to technology. UAV helicopters can effectively carry water and emergency supplies to impacted locations, in place of road transportation or if there is no linked transportation network (Sutherland, Chakraborty, 2023, pp. 100256-100256).

Examining the intersection of these domains aimed at developing novel solutions fostering the improvement in coordination among emergency services and transportation networks along with the healthcare providers. The goal of this review is the enhancement of the outcomes and well-being of the individuals who require urgent medical attention during a crisis. A comprehensive review and analysis of the integration of emergency response systems and telehealth tools are being done in this article to highlight the potential for the transformation of crisis management practices. The interconnectedness between the integration of emergency response systems and telehealth systems is being explored and this exploration it's helpful for the pavement of the way for innovative strategies that are helpful for the optimization of resource allocation, and response time along the delivery of critical medical care during

emergencies and crises (Langabeer, Gonzalez, Alqusairi, Champagne-Langabeer, Jackson, Mikhail, Persse, 2016, pp. 713-720). The technique of cross-sectoral lens is adopted and the framework is cohesive for the alignment of emergency response protocols with transportation networks and telehealth capabilities in the healthcare sectors. Due to this integration, there is a paradigm shift in crisis management that ensures a more agile, responsive, and coordinated approach to addressing emergencies and crises in various sectors. There was an extreme burden on the health system of every country due to the introduction of the COVID-19 pandemic in which all the countries highlighted the need to strengthen their technology infrastructure. The below image shows the telehealth and transportation response in the emergency.

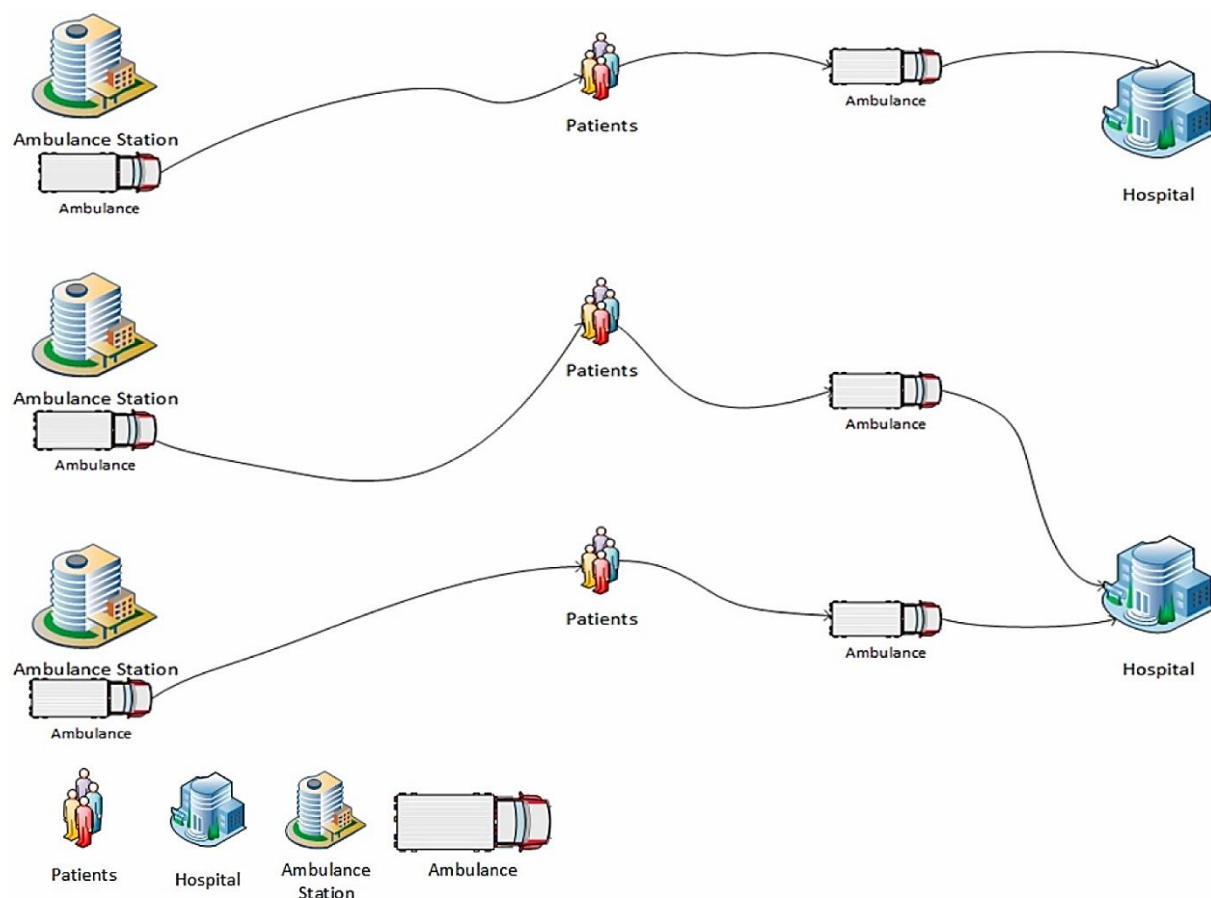


Figure 1. The suggested system for ambulance dispatch and Telehealth role in emergency response management.

Source: Sutherland, Chakraborty, 2023.

Figure 1 explains the quick response in an emergency by implementing telehealth to support the transportation system. The telehealth installed in the ambulance helps the doctors to connect with the patients and help to get the first emergency report of the patient and can do the treatment on time by decreasing the response time delay. Figure 1 depicts a model consisting of ambulance stations and hospitals, respectively. The maximum time an ambulance can take is marked by. This then creates the static nodes. The model will use the road network represented by the Open Street Map. This is an open-source mapping organization that allows you to create probable routes that will be used to build the model's routing data. To verify that it is the most

efficient way, a quality assurance process will be implemented. Telehealth was the system that was introduced for the virtual health and care of patients outside of traditional clinical settings. The healthcare delivery was efficiently and effectively improved due to the integration of a telehealth system that includes the patient's triage, consultation, treatment, and clinical care along with the education of healthcare workers and patients. To successfully represent ambulance travels across a local region, time on scene and hospital wait times must be factored into the model. The fairness of each patient will also be considered to guarantee that all patients in the region are served by an ambulance enroute, on the scene, or transported to the hospital, and these time limits are represented in the ambulance routing paper. Figure 1 depicts the suggested patient routing model, in which the patient group represents the number of patients at a place, ambulances are routed between patient groups and the hospital, and ambulances are redeployed from the hospital to a new patient. To reduce the spear impacts of COVID-19 in developing countries and low and middle-class countries with limited resources and constrained economic situations, there was the introduction of a telehealth system and integration of a response system. The rural population of China was reported 38.57% of the total population of China. China made a lot of huge investments in healthcare and several major healthcare reforms in China. Despite this huge investment, the health outcomes continue to widen the rural-urban divide in the healthcare resources of China (Cui, He, Liu, Zheng, Wei, Yang, Zhou, 2021, pp. 103-115). During the COVID-19 pandemic, there was a disparity that posed an even larger threat because timely and high-quality healthcare services were important for vulnerable populations in rural areas. The telehealth system was based on technological infrastructure along with sufficient economic support.

Along with the economics board, there were well-trained workforces and target use populations with higher digital literacy. However, the countries having limited resources and no established infrastructures were unable to apply these implications. Thus, it becomes important to understand and share sustainable strategies for the implementation and adaptation of telehealth systems in developing countries. This search aims to understand and summarize the characteristics, challenges, and successful experiences in the implementation of telehealth services in various sectors. There is an in-depth exploration of the implementation of these strategies along with insights into the characteristics of telehealth implementation. In addition, there is the application of this implementation size to synthesize the findings and offerings of practical strategies in developing countries. Specific recommendations are provided to build telehealth systems that include guidance on infrastructure and mechanisms valuable for developing countries that are looking to develop their telehealth capabilities (Cui, He, Liu, Zheng, Wei, Yang, Zhou, 2021, pp. 103-115).

3. Benefits of telehealth system

Team-based care and interrelated care objectives are being supported with the help of a telehealth system (Hasselfeld, 2020). The benefits of the telehealth system are organized into four categories.

- Improved provider experience.
- Improved client experience.
- Improved population health.
- Decrease costs.

4. Improved provider experience

Telehealth methods are applied by the providers to improve the quality of care they provide to the patients. With the help of the telehealth system, there is increased flexibility in appointment scheduling (Greenway Health, n.d.). There are a lot of civilians including 40 to 60 percent who are treated in primary care offices rather than especially clear settings. The underserved and rural areas and the people belonging to these areas benefit from this telehealth system because it can access the client's home environment with the help of screen sharing, then formation regarding therapeutic intervention or diagnosis can be provided easily allowing doctors to see the videos and slideshows of the client. The patients and clients can call emergency on the response system with the instruction given by the telehealth system in case of emergencies that provide emergency dispatchers with the location of the client. There are a lot of factors that are burned out by the patient in the pervasive issue including the time pressures, fast-based environments, and family responsibilities used with the help of deadly health systems because they provide greater flexibility introduction in commute time to the clients (Gajarawala, Pelkowski, 2021, pp. 218-221).

5. Improved client experience

In the telehealth system, clients are experiencing many benefits from it regarding their mental health and other problems. It made it easy for the clients to reach the providers and the doctors that are distant away from their locations. The transportation and travel costs were reduced due to the telehealth system and its providence to the clients which increased the livelihood of the clients and they were able to attend the regular and scheduled appointments

with the providers. The geography and technological barriers were reduced with the help of the telehealth system and provide the opportunity to individuals in remote locations to access what they need and the clients who were experiencing panic disorders were able to receive care treatment in a very safe environment of their location (Maxson, 2023). In addition, individuals who have physical visual or hearing problems and some clients are isolated due to mental disorders can easily assess with the telehealth providers stop the clients do not have to take significant leave for their checkups. The burden of finding childcare is also reduced with the help of a telehealth system that provides home-based care to clients. The care and treatment provided to the clients are team-based services and group-based interventions by which multiple providers can connect remotely at the same time with the client along with the promotion of provider collaboration and the exchange of health information among them.

6. Improved population health

Telehealth systems and treatment are based on telehealth systems as a result of the improvement in health outcomes along with the improvement in quality of life and access to healthcare (Collins, Johnson, Tyson, 2023). There are a lot of people who are facing serious mental issues without having any treatment due to limited resources. With the death of the telehealth system people have the opportunity to bring improvement in their quality of life and their mental health as well due to the reduction in depressive symptoms and more confidence in managing depression because of the increase in satisfaction with mental health and coping skills stop in addition there were a lot of people who were taking the alcohol index but with the help of the treatment based on telehealth system, there was a lot of reduction in alcohol consumption by those clients along with the degrees in tobacco cessation.

7. Research questions

How can transportation infrastructure be optimized to facilitate faster and more efficient emergency medical responses by using Telehealth?

Implementing advanced traffic management systems that leverage real-time data can help emergency vehicles navigate through traffic more efficiently. Smart traffic lights, dynamic lane control, and adaptive traffic signal timings can be employed to create green corridors for emergency vehicles (Jordan, 2023). Designating exclusive lanes for emergency vehicles can significantly reduce response times. These lanes can be strategically placed on major routes and highways, allowing ambulances and other emergency vehicles to bypass regular traffic.

During critical situations all over the world, emergency medical responses play a very pivotal role in saving the lives of thousands of people globally. But the emergency medical responses are only effective when the responses are provided on time and there is timely access to the health care facilities and resources for all people. To get swift and efficient medical assistance, there is a crucial component that plays its role which is transportation infrastructure. As we know telehealth technologies are being integrated into the healthcare system all over the world emerges a potential way to optimize the transportation infrastructure for the enhancement of speed and efficiency of emergency medical responses in various sectors (Kobeissi, Hickey, 2023).

Equip emergency vehicles with advanced communication and navigation systems. Integration with traffic management systems can provide real-time updates on optimal routes, traffic conditions, and potential obstacles, allowing emergency responders to make informed decisions. Enhancing public awareness about yielding to emergency vehicles and educating drivers on proper behavior when an emergency vehicle is approaching can further improve response times (www.linkedin.com). Public campaigns and educational programs can contribute to creating a more responsive and cooperative traffic environment.

Using telecommunication technologies is the basic characteristic of a telehealth system that helps provide healthcare remotely. The traditional landscape of medical services is transformed with the help of telehealth systems and telecommunication technologies all over the world. The efficiency and timeliness of interventions are augmented with the help of this integration into emergency medical responses (Williams, Tremblay, 2019). By seeking the help of platforms related to telehealth systems it has become very easy and accessible for professionals and doctors to assess and diagnose patients and clients by providing them with immediate guidance in emergencies (Feng, Pan, 2021, pp. 1-10).

Pre-positioning ambulances and emergency medical resources in strategic locations, such as high-incident areas or near major events, can expedite response times. This involves predictive analysis and coordination between emergency services to anticipate potential demand (Utilities One, n.d., The Impact...). Implement and enforce legislation that supports the prioritization of emergency vehicles on the road. This may involve legal measures to penalize non-compliance with rules related to yielding the right of way to emergency vehicles.

Now patients can seek the healthcare facility and their treatment can be initiated even in their comfort zone without reaching the healthcare system. A lot of time was required at an early age to make critical medical decisions but now the telehealth system has made this process easy potentially saving precious moments that are crucial for patients in critical conditions (Sullivan, Hadi, Allen, 2016; Mohammadzadeh, Saeidnia, Lotfata, Hassanzadeh, Ghiasi, 2023). It has become very imperative to optimize transportation infrastructure to leverage the potential of telehealth in emergency medical responses. Several strategies can be employed to achieve the optimization of transportation infrastructure in the healthcare system. With the help of

telehealth systems, it has become very easy to enable real-time data sharing between emergency responders and healthcare professionals.

The integration of a telehealth system in the healthcare system makes sure that the responders have the accessibility to crucial patient information and medical guidance during transit. They also helped the patients with swift decision-making and appropriate pre-hospital care. The optimization can also be achieved with the help of the implementation of an advanced routing and navigation system that considers real-time traffic data and medical facility proximity. The integration of this system healthcare system can be optimized through the identification of the most efficient routes for emergency vehicles that are further helpful in the reduction of transit times to healthcare facilities.

Ensuring robust telecommunication networks and connectivity can also be helpful in the optimization of telehealth systems along transportation routes for the facilitation of uninterrupted communication between emergency responders and healthcare providers. For seamless telehealth operation during transit, high-speed Internet and reliable communication infrastructure can also optimize the telehealth system. According to Mathews et al., another important strategy that would be helpful in the optimization of the telehealth system is the emergency vehicle design and infrastructure because due to the design emergency vehicles that are equipped with telehealth technology are helpful in interfacing and medical equipment for supporting immediate interventions. In addition, if we established designated lanes and priority access on roads for emergency vehicles then it would be significantly helpful in the expedition of their transit (Amjad, Kordel, Fernandes, 2023, p. 6655).

Comprehensive training can also be provided for the optimization to achieve the best telehealth system for emergency responders for the utilization of telehealth technologies effectively if we familiarize them with the operation of medical equipment and telecommunication systems that are integrated into weaknesses then it would be a very effective strategy. There are multifaceted benefits to optimizing transportation infrastructure for telehealth integration and emergency medical responses (Little, 2021). The response time is reduced and the patient outcomes are enhanced with it along with the optimization of resource utilization although several challenges need to be addressed including the infrastructure costs, data security concerns, and the need for standardized protocols and regulations governing telehealth-enabled emergency responses.

What role can telehealth technologies play in providing initial medical support during transportation-related emergencies?

There are a lot of significant challenges that are posed by transportation-related emergencies. As we know immediate medical transport and support are necessary to post certain challenges faced by patients in which transportation-related emergencies are significant. To deliver initial medical aid during critical situations of the patient's telehealth technologies have emerged as an indispensable tool (Haleem, Javaid, Singh, Suman, 2021).

There are multifaceted roles of telehealth technology to provide crucial medical support during transportation-related emergencies. With the help of telehealth technologies, there is a complete facilitation of real-time communication between the patient and the healthcare professionals.

Video conferencing and teleconsultations have been adopted in this system with the help of which paramedical and first responders can quickly connect with the medical experts. It enables them to seek timely guidance and decision-making regarding patient care. The quality of initial medical support is enhanced with the help of this instantaneous access to specialized advice matters even in remote or inaccessible locations (Managed Healthcare Executive, n.d.). It was difficult in earlier times for the professionals to reach the take care facilities of the patient before they were in the same location but now with the help of telehealth applications telehealth professionals have access to the patients remotely about their condition in emergencies. In addition, accurate decision-making is very important and prompt during transportation-related emergencies.

With the help of telehealth technologies healthcare professionals have access to medical protocols, diagnostic support, and specialized guidance with the help of which they can make critical decisions without reaching the exact location. Due to this support, it becomes easy for healthcare professionals to suggest appropriate medical interventions to the patients by advising them on stabilization techniques. They can also optimize the chances of positive patient outcomes during transit to healthcare facilities. There is another benefit of the telehealth technology which is the continuity of care and follow-up because they can contribute to maintaining continuity of care beyond the immediate emergency response. They can also monitor and follow up on the patient's ongoing monitoring and follow-up consultation with the help of post-equalization during transportation and telemedicine facilities provided to them. Due to this reason, they ensure a seamless transition and continued medical guidance until the patient reaches the medical facility (Bokolo, 2021).

For sure the patient has to reach the healthier center but some of the patients go into very critical condition if they are not consulted with the doctor at the right time. Due to this reason, telehealth systems and telemedicine are necessary for them to make them stable enough until they reach the medical facility. It is very helpful for the providers and the patients to reduce the risk of deterioration during the transit and is also helpful in the enhancement of the overall patient experience as well (Stoltzfus, Kaur, Chawla, Gupta, Anamika, Jain, 2023). If we talk about the rural areas then it becomes very difficult for the people living in the rural areas to have access to immediate medical care. When availing the opportunities of the telehealth technologies it has become easy for the people residing in rural areas to bridge the gap between the healthcare professional and the patient as the geographical gap is bridged between them.

Telehealth technologies the remote locations are connected with healthcare expertise and with the help of this connection they have facilitated timely interventions and mitigated the impact of transportation-related emergencies in the underserved areas. This aspect of the telehealth system is crucial because they are playing a role in improving healthcare equity and

access, especially in areas where medical infrastructure is limited. In short, the literature concludes that telehealth system and their technologies are playing an invaluable role in the augmentation of initial medical support during transportation-related emergencies. They have provided the ability to provide real-time communication and are also playing their role in the remote assessment and decision-making assistance along with the continuity of care and overcoming geographical barriers. With the help of this system, there is enhancement and efficiency along with effectiveness in the medical services of emergencies because they save the lives of people during transportation-related emergencies (Hayden, Davis, Clark, Joshi, Krupinski, Naik, Ward, Zachrison, Olsen, Chang, Burner, Yadav, Greenwald, Chandra, 2021).

How can data sharing in real-time communication between emergency responders and healthcare professionals be improved to enhance patient care?

It is evident from the research that patient care can be enhanced and improved by seeking the help of data sharing in real-time communication between emergency responders and healthcare professionals. One of the most important key strategies that can significantly enhance collaboration is the interoperable system and standardization. By implementing this system, it will become easy for the emergency response and healthcare platforms to communicate seamlessly. Different data formats can be standardized with the help of this system along with the terminologies that can all also be standardized (Quinn, Forman, Harrod, Winter, Fowler, Krein, Gupta, Saint, Singh, Chopra, 2019, pp. 241-248).

With the help of this standardization of data formats, technologies, and protocols, there would be an efficient exchange of information without loss of critical details between emergency response and healthcare platforms. The development of different integrated communication platforms is necessary for real-time communication between emergency responders and healthcare professionals (Li, Wang, Wang, Zhang, 2023, p. 127017). Due to these integrated communication platforms, it becomes easy to share real-time data about the patient including the vital signs, medical history, allergies, and ongoing treatment plans of the patient with responders. This platform would be helpful for both healthcare professionals and patients because both benefit from this system. Secure messaging, video conferencing, and file-sharing functionalities are supported securely with the help of an integrated communication platform of a telehealth system.

Another important key strategy is mobile health technologies including wearable devices and mobile applications (Webisoft, 2023). Utilizing these technologies would be helpful in the facilitation of the continuous monitoring of patient's health status. With the help of these mobile health technologies, it has become easy for emergency responders and health care professionals to get access to the real-time data of the patient and use them timely in decision making and interventions as well. It is very important to use communication technologies for sharing data between healthcare professionals and emergency responders because they are responsible for providing comprehensive training to these responders. If we make sure that all personnel are

adept at using these tools then the process of data sharing and communication during emergencies can be streamlined. Due to this reason training and education of emergency responders in healthcare professionals are necessary to utilize the communication technologies in the telehealth system.

Certain patients have sensitive information about their disease so it is very important to implement robust privacy and security measures to safeguard the sensitive information of the patient when you are sharing data with emergency responders and healthcare professionals. The development of a clear and concise protocol along with the guidelines is also necessary for sharing information and communicating between emergency responders and the healthcare professionals who are playing their role in the establishment of a standardized framework for collaboration between them. The roles, responsibilities, and procedures for effective coordination and collaboration between healthcare professionals and emergency responders should be outlined in the guidelines that are provided to them. The creation of a feedback mechanism is necessary to gather input from both emergency responders and healthcare professionals for the essential and continuous improvement that needs to be made in the telehealth system.

If the evaluation is made for the effectiveness and efficiency of communication strategies and data-sharing protocols between the emergency responders and healthcare professionals then it will allow for adjustments and enhancements to be made based on real-world experiences and challenges (Jordan, 2023). The development of advanced communication systems can be done if we encourage public-private partnerships and investment in innovative technologies of telehealth systems because they play a crucial role in tailoring specifically for emergency response and healthcare settings. In conclusion, we can say that the enhancement of data sharing and real-time communication between emergency responders and healthcare professionals needs a multifaceted approach and method. These multifaceted approaches and methods include technological advancements, standardized protocols, training, security measures, and continuous refinement when we implement these strategies in the telehealth system then there would be a consequence of collaboration between these two critical sectors and the relationship between them can be strengthened ultimately leading to improved patient care during emergencies (Utilities One, n.d., Communicating...).

8. Methodology

Case study of China

Telehealth system and telemedicine were one of the most crucial methods used by the government of China to address the inequality of medical resources between urban areas and rural areas. One of the most important issues that is relevant to the national economy and the livelihood of people in China is medical care. Patients and people living in rural and remote areas do have not easy access to high-quality medical services in China (Cui, Ma, He, Zhai, Zhao, Chen, Sun, Shi, Cao, Wang, 2020). According to the survey made in 2018 in the 11 provinces in the east of China, there were 1047 tertiary hospitals and 1216 tertiary hospitals in 21 provinces of the central and western regions of China. There were high-quality medical resources in the developed eastern regions of China and a serious lack of health resources in the central and western regions of China.

Shreds of evidence were taken from the health report of 2018 according to which 10.91 healthcare technicians per thousand people in China's urban areas and there were only 4.63 healthcare technicians per thousand people in the rural areas of China so there is a huge difference between the urban and rural areas of China that were getting the imbalance medical resources. The efficiency of treatment is reduced in rural areas and there is difficulty in accessing resources and medical treatment in the rural areas as compared to the urban areas in China. A solution was made for the assets of medical treatment for the people living in the rural areas that include the tediagnosis of patients by the healthcare professionals and providing them telemedicine that is helpful to shorten the spatial distance between the doctors and patients and it also enables the patient to be treated locally by off-site medical experts. The system of telemedicine was begun in the 1980s in China (Zhang, Lu, Shi, 2022).

According to research in 2019, 22 provinces in China established that telemedicine platform and cover 13,000 medical institutions in that coverage by providing them with teleconsultations tele diagnosis, and telemedicine along with remote medical education as well. In China, there is the application of telemedicine and the treatment of different diseases such as diabetes and burns with the help of a telehealth system (Ye, He, Beestrum, 2023, pp. 1-14). The hospitals of China have been divided into 3 levels including the tertiary hospitals, secondary hospitals, and the primary hospitals of China. Telemedicine services are mainly provided by tertiary hospitals. We can understand the development of telemedicine in China with the help of the implementation and application of telemedicine in the territory hospitals of this country.

A patient simulation is used to generate a synthetic load in order to comprehend how the suggested model will function. This simulation model simulates the process of making an ambulance call and the operator's triage decision. The ambulance would then be dispatched by the dispatcher to the specified location, where it would arrive and take the patient to the hospital. The ambulances will have a certain amount of time to get all patients to the hospital.

The real-time deployment of ambulances within the designated area is another goal of this simulation model. It takes a long time for the ambulance to arrive at the site, treat the patient in preparation for transport, and then drive the patient to the hospital (www.oecd-ilibrary.org). The door-to-doctor meter is the second most significant measure for assessing overall hospital performance within the hospital. One crucial metric is LOS. Reduced door-to-doctor time and maybe lower LOS can be achieved by shortening the ambulance's arrival time at the hospital. A patient's boarding time on a ward may grow if they require repeated consultations with specialists from different specialty departments, contingent on their severity. Because the ED is a complex environment, reducing any part of the procedure can help lower the LOS measurement (Gupta, Dogar, Zhai, Singla, Shahid, Yildirim, Singh, 2019).

The state of the road the ambulance travels on has an impact on how long it takes to get to the hospital and to the site. The ambulance would have to take a different route, which could delay the response time. This can have an impact on short-term transportation while the road is being fixed, in addition to prolonging the urgent patient transfer. From this point on, the model would need to account for a repair period as well as temporary detours. In order to compute arrival times accurately, the model must also take into account the driving speed and satisfy the ambulance's average speed. The average speed increase when driving under lights and sirens can exceed the posted speed limit by up to 20%. The Polish ambulance speed case study also noted a similar issue, and both of these studies noted an elevated average speed that should be considered. The ambulance services in Australia vary by state; they all offer the same service but function separately (Hornyak, 2020). Every triage code in the wonderful state of Victoria has a maximum response time that must be fulfilled. The average response times will be recorded and compared within the model; this will then add to the scene's time (which will be standardized for simulation reasons), after which the patient has to be transported to the closest hospital. The best route and the condition of the roads are the only factors that affect patient transportation.

LGA stands for Local Government Area. The table shows the Average Arrival Time (in minutes) and the percentage of responses that occurred within 15 minutes for different quarters (20Q3, 20Q4, 21Q1, 21Q2) in the specified areas (Wodonga, Indigo, Wangaratta). The model's top priority in achieving the project's objectives is figuring out and implementing the most effective path for an ambulance to go to the emergency room. This will be modeled after how ambulances behave in Victoria's LGAs using call-out information for codes 1 through 5. Nevertheless, by restricting the routing simulation to just three Victorian LGAs—Wodonga, Wangaratta, and Indigo—the model's applicability is limited. The node graph sampled in Fig. The Australian Institute of Health and Welfare's annual reporting of hospital admissions from all Australian states and territory provides the data that the model is built on.

Table 1.*Average Arrival Time in at least 15 minutes*

LGA	Average arrival time (min)				%Responses≤15 min (%)			
	20Q3	20Q4	21Q1	21Q2	20Q3	20Q4	21Q1	21Q2
Empty Cell								
Wodonga	11:49	11:33	11:45	12:01	83.6	83.5	84.1	82.7
Indigo	21:28	23:12	22:39	21:51	28.3	21.5	27.6	26.3
Wangaratta	13:42	13:46	14:48	14:55	73.2	73.6	72.2	70.71

Last, but not least, think about the route selection to make sure the average time is satisfied. Because an ambulance should come within minutes after a Code 1 call, this is of the utmost importance. Because the exact location of demand is unknown, routing is a difficult option to make. The simulation used in this project is comparable to previous work in the field; for example, it relied solely on road transport, had a set number of stations, hospitals, and ambulances, assumed that all scene locations could accommodate patients, and followed predetermined paths.

After the investigation, it was found that the total number of tertiary hospitals in China was 185 according to the research. Almost 24 questionnaires were incomplete due to the missing data provided by 24 hospitals out of 185 hospitals. The number of valid questionnaires out of 185 was 161 and the effective rate of this validation was 87.0%. 59 hospitals were located in the eastern region, 54 hospitals were located in the central region and 48 hospitals were located in the western region. The accounting for these three hospitals was 36.7%, 33.5%, and 29.8% respectively. According to the research published, 161 hospitals were involved in the telemedicine and telehealth system. 137 treasury hospitals in these regions where their daughters were providing telemedicine services to the patients and 111 hospitals were seeking telemedicine services from the other hospitals to provide aid to the patients in emergencies. The results of some items were invalid and missing due to the incomplete information provided by multiple hospitals.

The answers that were unqualified in the analysis of corresponding content were considered as missing values or missing data that the hospitals did not provide accurately in the questionnaire. Mean values were used for describing the quantitative data in the questionnaire and the qualitative values were described with the help of count and percentages. The implementation and application of telemedicine were represented on the questionnaire with the help of Excel software and column charts, bar charts, pie charts, and radar charts so stop methods of cheesecake test, two-sided test, variance analysis, and non-parametric tests were used to apply the study methods. The development of telemedicine in different regions was compared by using these techniques in the questionnaires. The dependence of telemedicine services effect on the other factors in the multivariate analysis was calculated and adopted with the help of the model of dependence the software SPSS 23.0 was used to get the significance of the test level.

75.8% of the tertiary hospitals in China ranged from one to six in the following figure. There were 6.8% of the average number of telemedicine staff in each hospital in China. 7.4% of the telemedicine staff were in the tertiary hospitals of the eastern region, 6.7% of the telemedicine staff were in the central region of the tertiary hospitals of China and 6.2% of the telemedicine staff were present in the tertiary hospitals of the western region of China respectively. The telemedicine staff was mainly composed of those staff who have master's and bachelor's degrees. 49.58% of the telemedicine staff have a bachelor's degree and 38.85% of the staff have a master's degree along with 11.56% percentage of the telemedicine staff having decreased below the master's and bachelor's degrees. The majority of the telemedicine staff were connected with the fields of medicine, computer science, and communication along with the management field as well.

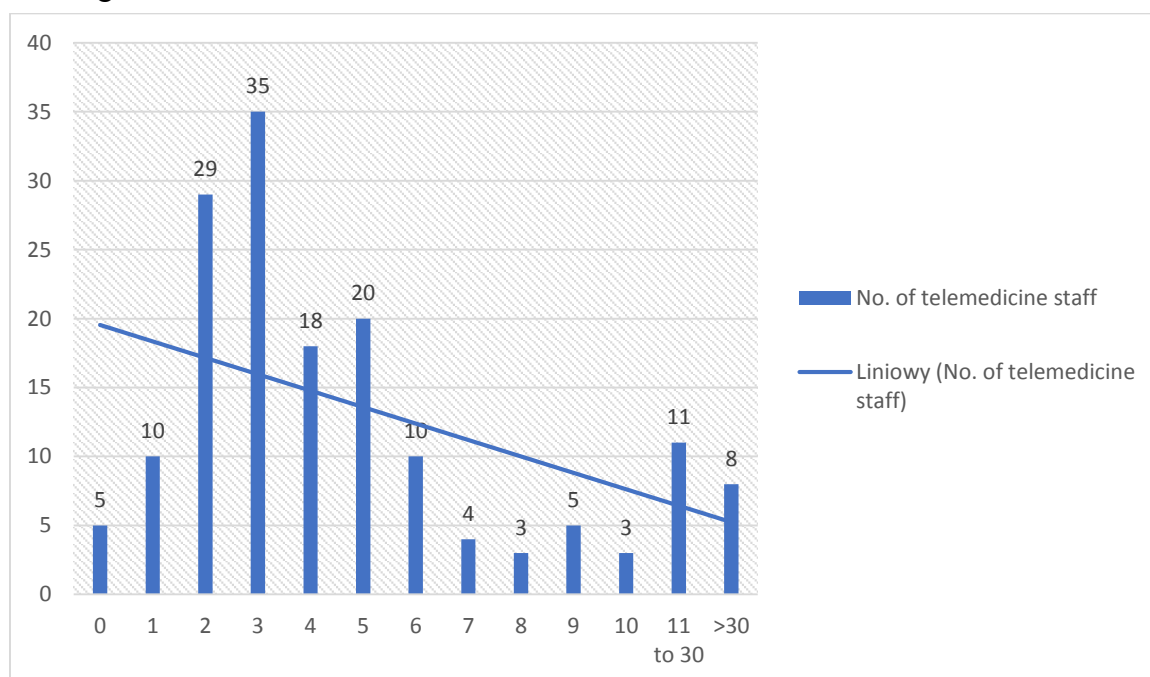


Figure 2. Distribution of the telemedicine staff and telehealth technology to improve the emergency response time collaborating with the transportation system in China.

Data source: Journal from National Library of Medicine.

Figure 2 shows that emergency response time can be decreased by using the well-trained staff and telehealth system in the transports for the emergency management. Telehealth is an advanced technology-based solution that is also helpful for the doctors to see more patients at a time. Figure 2 shows the results of the survey that was taken in the journal. As per the survey findings, telemedicine was introduced by 83.2% (134/161) of the tertiary hospitals through self-fundraising. In contrast, just 8.1% (13/161) of the hospitals were able to secure financing for their research. When it came to capital investment, 64.6% (104/161) of tertiary hospitals had made an investment of less than 500,000 RMB, or roughly US \$71,218. About 19.3% (31/161) of the hospitals made an investment in telemedicine deployment of more than 1 million RMB (about \$142,500 USD).

Government financial support, versatile fundraising, research funding, and corporate sponsorship are the main sources that are funding for telemedicine implementation in the tertiary hospitals of China. 83.2% of the implementation of telemedicine in tertiary hospitals in China is done with the help of self-fundraising. 8.1% of the financial support was received by the research funding for the implementation of study medicine in China (News-Medical, 2020; www.linkedin.com, n.d., U.S. to China...; Wang, Gu, 2009, pp. 23-27).

Table 1.

Educational background of the telemedicine staff in the tertiary hospitals of different regions in China (person per hospital)

Educational background	Total (n)	Eastern Region	Central Region	Western Region
Computer science and communication	1.8	1.4	1.6	2.5
Medicine	2.7	4.1	1.9	1.7
Management	1.3	1.3	0.9	1.6

Table 2 shows data analysis on the telehealth used in the emergency response system by the transportation/ambulances in China. Teleconsultation is the core service of telemedicine in the telehealth system. We need to explore teleconsultations in depth. The teleconsultants in the tertiary hospitals of China are considered as the deputy chief physicians of the hospital. According to a deep and thorough analysis of teleconsultations in tertiary hospitals in China, 72.1% of the tertiary hospitals apply the teleconsultation process through the platform of telemedicine. The telemedicine platform is the most important way of application of teleconsultations in telehealth systems. 74.5% of the hospitals in China provide consultation services within 24-hour intervals. They provide teleconsultations in different hospitals during the time interval of 10 to 40 minutes. 20 to 30-minute time intervals is the highest duration of time interval in 43.8% hospitals of in China. 51.4% of the effect of teleconsultations was considered good and 31.5% is considered an excellent effect of teleconsultation in the hospitals of China whereas 17.1% of the hospitals provided poor consultation services to the patients. Another core business of telemedicine in the telehealth system is remote education. However, the overall participation in the frequency of remote education in the tertiary hospitals of China is relatively low compared to other countries (Zhou, Huang, Llp, 2022).

9. Research limitations and implications

Certain key factors are affecting the development of telemedicine in tertiary hospitals in China. These key factors include process optimization, patient cognition, funds, medical staff cognition, market demand, construction plan, laws and regulations, degree of emphasis on telemedicine, unified standards, advanced software, advanced hardware, and many other factors

as well (He, Cui, Lyu, Sun, Zhang, Shi, Zhang, Jiang, Zhao, 2024, pp. e45020-e45020). The most crucial factor which is prominent as 68.3% of the treasury hospitals is the standard formulation. The promotion of telemedicine in international hospitals in China is mainly hindered by the lack of uniform standards. It explores the key factors that are affecting telemedicine in China by considering the court telemedicine services in China. By applying these examples of unordinary logistic regression for the analysis of the relationship between the effect of telemedicine and the aforementioned factors above. The effect and impact of teleconsultation study is to know how useful tele-consultation purpose in the treatment and health of patients. The effect of teleconsultations is divided into 3 categories poor good and excellent (Bangert, 2004).

10.Limitations

As we took out findings having a deeper insight into the development of telemedicine and telehealth systems in China several limitations are hindering the way of research as well (Ma, Sun, Tan, Li, He, Zhai, Wang, Cui, Li, Gao, Wang, Zhao, 2022, p. 104856). This research sample covers most of the area after tertiary hospitals in China but the sample size is still insufficient as some areas having tertiary hospitals do not provide complete information about the hospital because their questionnaires have blank spaces and were incomplete due to incomplete data.

11.Practical implications

Certain practical implications pose the impact of telemedicine and telehealth systems in China. As we know the significant disparity in the medical resources between urban and rural areas in China has been highlighted in this review. With the help of telemedicine and telehealth systems, the gap between remote access to high-quality medical services can be bridged. This underscores the significance of such technological intervention in addressing healthcare disparities worldwide. With the help of initiatives taken by telemedicine and telehealth systems, patients in rural and remote areas can receive timely medical consultation and treatment from healthcare professionals who are located away from their location.

By seeking the help of teleconsultations all over the world the patient has access to specialists and medical care professionals without traveling. Sometimes the patients are in critical condition but they are away from the location of the specialists and healthcare professionals. But now they can leverage the help of teleconsultations and healthcare

professional with the help of telemedicine and telehealth systems at their location without traveling long distances. It is also helpful in the improvement of healthcare sensibility and reduction of burden on the physical infrastructure as well. This research is also based on the economic and societal implications of the implementation of telemedicine and telehealthcare systems. Telemedicine and telehealthcare systems have reduced the necessity for physical travel to urban centers for medical care and treatment as the patients can seek consultancy at their homes with healthcare professionals through video conferencing and many other ways integrated into the telehealth system (Yang, Hu, Jiang, Li, 2023). The healthcare costs of patients are also lowered with the help of telehealth systems because they have improved the overall efficacy and efficiency of healthcare delivery, especially in remote areas and rural areas.

Certain challenges are affecting the successful implementation of telemedicine and telehealth systems in China that are revealed in this research. These challenges and issues are related to the funding sources because fundraising was less. In addition, another issue that was promoted and highlighted in the research is the standardization, technological infrastructure, and staff qualifications as well. It is very important and crucial to address these challenges for sustainable growth and the widespread adoption of telemedicine practices in China. Telemedicine plays a very crucial and pivotal role in providing telemedicine services to patients. Tertiary hospitals also serve as a hub for teleconsultations and remote medical education.

The comprehension of this hierarchical structure within the healthcare system serves as an aid in the development of targeted strategies for the optimization of the implementation of telehealth services. The research was conducted based on research methodologies and questionnaire-based surveys were included and statistical analysis was taken that provide a valuable and deep insight into the current state of telemedicine implementation in the tertiary hospitals of China. Certain limitations exist in the questionnaire-based surveys and statistical analysis including incomplete data and missing information provided by certain hospitals that impact the comprehensiveness of the findings. This research also underscores the importance of standardized protocols and regulations in the telemedicine and telehealth system to make sure that there is uniformity, equality, quality, and interoperability in all different healthcare institutions in China.

Clear-cut guidelines and instructions were established that were helpful to overcome the obstacles that are relevant to varying standards and enhancement of the effectiveness of telemedicine services in the telehealth sectors. Adequate training and education in telemedicine practices for healthcare professionals is also necessary and the importance of this study is highlighted in this research because the main focus is on education and skill development in telehealth technologies among the medical staff. This development and further training of the medical staff are helpful in the enhancement of the quality and reach of telemedicine services in the telehealth sectors of China. The telemedicine implementation cannot be overstated without the help of government sectors and government support because they were the only ones to provide support funding and research grants and facilitate telemedicine implementation in China (Anthony, 2020, pp. 1-9).

The role of government support was prominent in the encouragement of more extensive financial backing and policy support for the acceleration of adaptation and evolution of the telehealth system. The findings and research suggest future research and improvements made in the tertiary hospitals of China emphasize the need for comprehensive studies that delve deeper into the impact, efficacy, and longer-term outcomes of telemedicine implementation in China's healthcare landscape. In short, we can say that this research highlights and signifies the importance of the transformative potential of telemedicine imitating healthcare disparities in China.

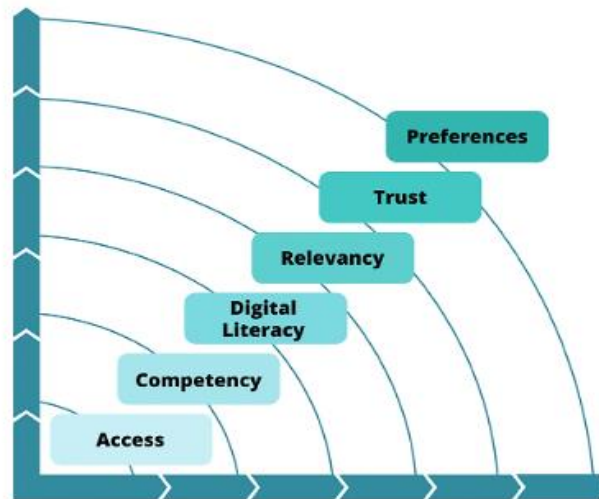


Figure 3. Telehealth engagement drivers and emergency response management system integrating with transportation crisis management.

Source: Sakumoto, Krug, 2023.

Figure 3 indicates (Sakumoto, Krug, 2023) access is to ensure widespread availability of telehealth services, considering factors like internet access and device availability. Competence refers to the healthcare professionals' proficiency in using digital tools for remote patient care, requiring continuous training and education. Both providers and patients need to be adept at using digital devices and online platforms for effective telehealth engagement leads to digital literacy. Customizing telehealth to align with cultural, linguistic, and individual preferences for improved effectiveness and acceptance. Trust and Preferences are for building confidence in the security of telehealth services and acknowledging diverse preferences, crucial for widespread adoption.

12.Social implications

The implementation and growth of telemedicine and telehealth systems in China pose significant social implications on society because various aspects of society, public attitudes, corporate social responsibility, environmental issues or policymaking, and the overall quality of life are influenced by it.

13.Impact on society

Telemedicine and telehealth system in China has a great influence and impact on society as it bridges the gap in healthcare access between the urban areas and rural areas of China. It was difficult for the people residing in rural areas to reach the healthcare systems immediately when they were in emergency and critical situations but having the help of the telemedicine telehealth system it became very easy for them to assess the healthcare professionals and providers in a short time (Hong, Li, N., Li, D., Li, J., Li, B., Xiong, Li, W.-M. Zhou, 2020). Now the telemedicine and telehealth system has facilitated the system by providing easy access to medical expertise for individuals who are residing in remote regions and do not have easy access to healthcare centers for the improvement of healthcare equity across the country. Medical services are enhanced with the help of telemedicine and telehealth systems because this system provides teleconsultations and remote health care to individuals who are residing in rural areas. As a result, individuals in underserved areas receive improved medical services timely by having timely consultations without the need for extensive travel (Huang, Xu, Sian Hsiang-Te Tsuei, Fu, Yip, 2023). The efficiency of medical services is also enhanced with the help of the integration of telemedicine technologies in the telehealth system. It also enables remote diagnosis and treatments with the reduction of the burden on healthcare facilities and the increasing of effectiveness as well.

14.Influence on public attitudes

Public attitudes are positively influenced after the successful implementation of telemedicine in the telehealth system. It also fostered trust and reliance on technology-enabled healthcare solutions the integration of telemedicine and the telehealth system is helpful in the encouragement of people to seek medical assistance more promptly and easily (Getzzg, 2023). The expectations are also Increased after the public awareness of telemedicine in the telehealth system. People are expecting more and more from the system because they can get treatment and guidance residing in rural and remote areas. It has become easy for them to assess the healthcare professionals and providers dealing with their emergency and critical situations. This public awareness is leading towards the increment in the expectation for accessible healthcare services which is in turn helpful in the promotion of demands for similar advancement in the healthcare systems (Haimi, 2023, p. 95).

15. Influence on corporate social responsibility and environmental issues

One of the main influences on corporate social responsibility is the strengthening of their profiles. The corporations that are supporting telemedicine and taking the initiatives of telemedicine in the telehealth industry are strengthening their CSR profiles due to their contribution to healthcare assessment they are also contributing to aligning their goals and societal well-being (www.china-briefing.com). The environmental effect due to the telemedicine integration in the telehealth system is the reduction of pollution. As we know with the integration of telemedicine people are not forced to move and cover the travel distances from their location to the Healthcare Center for treatment, which introduces pollution in the way that it minimizes the carbon emission from the vehicles on which they are going to travel to reach the healthcare centers (Telemedicine Development...). In this way, the integration of telemedicine in the telehealth sector helps contribute to positive environmental sustainability by lowering the carbon footprint associated with frequent patient travel for medical consultations.

16. Influence on policy development

Policy development is also influenced by the help of telemedicine and telehealth systems because the research findings could inform policymakers about the critical factors affecting the development of telemedicine and telehealthcare systems. With the help of this system, there is an encouragement in the formulation of policies that promote standardized practices, and funding these policies is also helpful in the promotion of infrastructure development for supporting telehealth services across different regions. The regulatory bodies are prompted with the help of insights into the limitations and implications for the establishment of unified standards and regulations for telemedicine practices in different regions of China that also make sure that the quality and ethical delivery of services are provided to the patients.

17. Impact on quality of life

The quality of life is also impacted and influenced by the integration of telemedicine in the telehealth center (European Commission, 2018). The enhanced accessibility to telemedicine is positively impacting the quality of life by providing timely medical intervention there is also a reduction in the severity of the illness with the help of the improved healthcare system of

telemedicine in the health system. With the help of telemedicine, healthcare professionals are potentially saving lives in remote areas and rural areas of different countries. The need for extensive travel is also minimized with the help of telemedicine in the telehealth system for medical consultations (Omboni, McManus, Bosworth, Chappell, Green, Kario, Logan, Magid, Mckinstry, Margolis, Parati, Wakefield, 2020, pp. 1368-1383). With the help of telemedicine, the financial burden on the patients is reduced and lowered because they are seeking health care at their location which is positively influencing their quality of life as well.

18.Originality and value

The comprehensive examination of the implementation and impact of telemedicine and telehealth systems in Chinese tertiary hospitals Highlights the originality and value of this research (CGTN). There are certainly significant issues between health care inequality in rural areas and urban areas in China. These issues and challenges are addressed in this research along with the scarcity of high-quality medical resources in rural regions compared to the well-resourced urban areas. In this research, we came to know about the unequal distribution of medical resources between the eastern regions that are developed in China and the under-resourced regions of China including the central and western regions of China (Earley, Newman, 2021, pp. 109-127). This research highlights the disparity in the number of healthcare technicians per thousand people. This disparity is significantly higher in the urban areas of China and much lower in the rural and remote areas of China which are affecting the efficiency and accessibility of healthcare services for the people who are residing in the rural and remote areas of China. They were completely unable to get access to the healthcare providers and professionals in their emergency and critical situations but with the help of telemedicine in the telehealth system it becomes easy and efficient for them to assess the healthcare professionals in time of emergency (Chen, Wu, Zhang, Jing, Cheng, Tian, Jin, 2023).

The research based on the treasury hospitals of China further delves into the development and application of the telemedicine and telehealth system as a solution to fill the gap between the urban areas and rural areas of China by providing them the healthcare services very easily. Moreover, we get further insight and thorough comprehension of the establishment of tally medicine platforms across multiple provinces of China. This surge covered thousands of medical institutions in China and the aim of this research is the facilitation of teleconsultations, Tele diagnosis, and remote medical education to the people who are living in the rural and remote regions of China.

Certain factors are affecting the implementation of telemedicine in the hospitals of China. These factors include the financial sports sources, staff qualification, and standard formulation (Allen, 2022). It further emphasizes the importance and necessity for uniform standards in China that are helpful in the exploration of various factors that are hindering telemedicine's full potential.

19. Conclusion

In conclusion, it is a pivotal opportunity for the revolutionizing of crisis management across various sectors through the help of the integration of emergency response systems and telehealth technologies in the healthcare system. This research is the investigation, and innovation of the strategies that are leveraging this system and the aim of this research is for the enhancement of crisis management globally. After a complete and thorough examination of the intersection of emergency response and telehealth systems, this research has identified the practical frameworks, tools, and protocols that foster seamless coordination, collaboration, and healthcare delivery during crises and emergencies. The convergence of these systems underscores the optimization of resources and refinement of response time. With the help of multiple case studies along with simulations and prototypes, this result is the evaluation of technological advancements along with the regulatory challenges and logistical considerations that offer valuable insight to integrate telehealth into emergency response frameworks across a diverse range of sectors including public safety, healthcare, disaster management, and community services as well. The critical leads of collaboration and communication among the stakeholders including government agencies, healthcare providers, technology developers, and emergency responders are critically addressed and studied in this research (Huawei; External).

Different approaches are being tailored to various crisis scenarios in this research to emphasize the adaptable strategies and guidelines through the cross-sectoral partnerships and interdisciplinary cooperation between them. The government frameworks regarding telemedicine and telehealth systems were modified and accounts tweeted after the COVID-19 pandemic because, after the COVID-19 pandemic, there was an adoption of telemedicine telehealth systems along with the integration of emergency response systems for the promotion of telehealth services worldwide. There were certain challenges and concerns faced by telemedicine and telehealth systems during this time.

These challenges and concerns include healthcare infrastructure, high-speed Internet access, and healthcare information systems. In short, we can say that telemedicine and telehealth system was a key strategy during the COVID-19 pandemic, especially in the areas that were rural and remote, and it was hard to reach the improvement of sensibility and healthcare delivery

to people living in these areas. To emphasize the necessity and importance of our robust telehealth infrastructure and adequate resources in developing countries some disparities persisted in this way. This research also integrates the benefits of the telehealth system and telemedicine to improve the system of management for telehealth in rural and remote areas. The certain benefits of telehealth systems are the categorization of improved provider and client experience, enhancement of population health, and reduced cost as well. Certain facilities were promoted with the help of telehealth including remote care, improved accessibility, and a positive impact on mental health and chronic condition management.

Addressing the research questions of this research, this article is the exploration of optimization of transportation infrastructure, employing telehealth technologies for initial medical support during emergencies, and enhancement of real-time data sharing between the emergency responders and healthcare professionals. With the help of strategies used in this research, there is encompassment in the interoperability integration of communication platforms, mobile health technologies, comprehensive training, robust privacy measures, critical and clear protocols along with the feedback mechanism. Public-private partnerships are very important and crucial for the improvement of patient care during emergencies through their collaboration and investment in innovative telehealth technologies.

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CONSTRUCTION OF A MODEL FOR DATA PROCESSING IN THE SETTLEMENT OF THE COSTS OF PUBLIC TRANSPORT OPERATING IN THE MUNICIPALITIES OF THE UPPER SILESIAN METROPOLITAN UNION – PART TWO

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Purpose: Development of a model for processing and sharing of data which were prepared and developed according to the assumptions described in the article titled „Model of data of the settlement of costs of public transport operating on the territory of the Upper Silesian Metropolitan Union”. The developed model should have the possibility of practical use in local government units operating in the Upper Silesian and Zagłębie Metropolitan Area (GZM) (<https://metropoliagzm.pl>), support public transport managers in the analysis of public transport costs, and present to municipalities the components of the costs they incur in the framework of the joint venture implementing public transport in the GZM. The solution presented is intended to ensure that the analysis can be performed in terms of the various cross-sections to which the analysed data can be subjected.

Design/methodology/approach: due to the fact that one of the constraints during the implementation of the task was the need to use only those tools that have been used so far and for which the GZM has appropriate licenses, the study was limited to the functionality provided by the Office 365 suite.

Findings: In the course of the work, it was found:

- dispersion of data between different cost-controlling units,
- lack of uniform data structures between units,
- inconsistency of dictionaries over time.

Practical implications: The data model developed during the work was used to build the analytical platform used within the GZM.

Social implications: The developed model was used for presentation to the mayors of the municipalities that make up the GZM. It is an analytical tool used by the management of the GZM to present and optimize the scope of communication in the designated area.

Originality/value: Authorial model for processing data from heterogeneous sources into a coherent and unified data structure has been developed.

Keywords: Public transportation, public transport, data modeling, visualization.

Category of the paper: Practical implementation of data processing system and data model construction.

1. Genesis

In November 2017, the Metropolitan Transport Authority (ZTM) was established by the Assembly of the Upper Silesian and Zagłębie Metropolis (GZM), which took over the responsibilities of the three previous public transport organizers by combining the public transport system operating in Silesia and Zagłębie and serving the territory of 56 cities and municipalities (<https://metropoliagzm.pl/droga-do-metropolii>).

Resolution No. 7/2020 of January 15, 2020, of the Board of Directors of the Upper Silesia-Zagłębiowska Metropolis (<https://bip.metropoliagzm.pl/uchwala/125860/uchwala-nr-07-2020>) adopted a document on "principles of proceeding in calculating the variable part of the Annual Contribution for municipalities of the Upper Silesia-Zagłębiowska Metropolis and subsidies for municipalities not belonging to the GZM" On December 23, 2021, amendments were made to the above-mentioned resolution, which were announced by Resolution 325/2021 of the GZM Board (<https://bip.metropoliagzm.pl/uchwala/128104/uchwala-nr-325-2021>).

These documents set out the rules of procedure for calculating the variable portion of fees to be paid by individual GZM municipalities and subsidies to non-GZM municipalities for public transportation provided on their territory.

The company responsible for organizing public transportation is the Metropolitan Transport Authority (ZTM) (<https://www.metropoliaztm.pl/pl>). It should be noted here that ZTM performs its tasks mainly on the territory of the GZM, however a partial scope of its activities is also implemented on the territory of municipalities not belonging to the GZM.

Based on the aforementioned resolutions, employees of ZTM's controlling department have prepared planning and settlement sheets determining remuneration for individual operators providing public transportation, as well as sheets calculating the variable premium (<https://metropoliagzm.pl/tag/skladka-zmienna>) which is charged to individual municipalities.

The amount of the variable premium is determined by two main factors:

- the portion resulting from the amount of transportation provided, and,
- the part resulting from the surcharge covering the organization's operating costs.

Implemented plans and settlements are carried out in annual cycles, their rules are gradually modified and therefore variable in subsequent years.

In 2021, there was a need to develop a data model that would allow the heads of individual municipalities (mayors, aldermen, mayors) to present the components of the surcharge that burden each municipality in a relatively simple way. This paper presents the issues and stages of building such a model.

2. Data analysis and sharing model

2.1. Input data

The input data for the model were binders of data provided by two departments that deal with the settlement of transportation costs. One of them deals with the determination of the so-called variable contribution, i.e. the fee that individual municipalities pay to the joint budget.

The process of collecting the transformation of cleansing and unifying the data was presented within the framework of the article entitled "Model of data of the settlement of costs of public transport operating on the territory of the Upper Silesian Metropolitan Union".

All post-processing data was aggregated into a single standardized dataset. The dataset was organized in such a way that the data could be processed and grouped using the standard mechanism offered by spreadsheet pivot tables.

2.2. Tabular summary

The first columns of the dataset contain data allowing the grouping of objects in the following sections:

1) Affiliation:

- a) GZM municipalities - municipalities belonging to the GZM (<http://gzmetropolia.pl/metropolia>),
- b) Foreign municipalities - municipalities not belonging to the GZM,
- c) GZM - a virtual group collecting three virtual "municipalities" that are directly financed by GZM funds:
 - COMMUTING - a "municipality" that shows funding for tram access between the tram depot and the end stops,
 - GZM - "municipality" which shows funding for metropolitan lines (marked M), some bus and tram lines funded directly by GZM,
 - EVENTS - "municipality" which shows funding for additional tram lines created to serve events held in the GZM,
- d) OTHER - a virtual group collecting two virtual "municipalities" that have additional funding:
 - Hypermarkets - lines created for the purpose of access to hypermarkets,
 - Detours - additional routes resulting from the need to create detours,
- e) Airport - a group of lines serving access to Pyrzowice airport (marked AP).

2) Operator Type:

- a) PKM - the operators are Public Transport Companies:
 - PKM Gliwice,
 - PKM Katowice,

- PKM Sosnowiec,
- PKM Świerklaniec,
- PKM Tychy,
- b) PRYW - operators are private carriers and Motor Transport Companies (PKS),
- c) TRAM - operator is the company TRAMWAJE ŚLĄSKIE S.A.,
- d) TROLLEYBUS – operator is the company TLT Sp. z o.o.
- 3) Type of Line:
 - a) A – buses,
 - b) T – trams,
 - c) TB – trolleybuses,
- 4) Operator – all operators taking part in organizing the transport,
- 5) Line number – number of particular lines,
- 6) Municipality – all municipalities including virtual "municipalities" participating in the organization of transportation,
- 7) Year – years from 2020 to 2024,
- 8) Data type – presents the plan and execution data, respectively.

The appearance of the cross- section selection panel is shown in Figure 1.

Przynależność	(Wszystko)	▼	◀ Dokonaj wyboru (Pola Niebieskie)
Typ_Operatora	(Wszystko)	▼	
Opreator	(Wszystko)	▼	
Typ_Linii	(Wszystko)	▼	
Nr_linii	(Wszystko)	▼	
Gmina	(Wszystko)	▼	

Figure 1. Cross-sectional data analysis panel.

Source: own study.

The tabular part of the cost analysis is divided into six sections.

The first section of the data model shows net transportation costs, where the following types of costs are distinguished:

- 1) M net cost – Costs of bus transport operated by M-type vehicles,
- 2) A net cost – Costs of bus transport operated by A-type vehicles,
- 3) B net cost – Costs of bus transport operated by B-type vehicles,
- 4) C net cost – Costs of bus transport operated by C-type vehicles,
- 5) TB net cost – trolleybus transport costs,
- 6) T net cost – tram transport costs by group:
 - a) A - capacities < 150seats (length < 20m), high-floor,
 - b) AN - capacities < 150 seats (length < 20m), low-floor,
 - c) B - capacities > 150 seats (length 20-30m), high-floor,
 - d) BN - capacities > 150 seats (length 20-30m), low-floor,
 - e) CN - capacities > 150 seats (length > 30m), low-floor.

The classification of each type of tram carriage is shown in Table 1 (Tundys, 2008; Lubka, Stiasny, 2011, pp. 20-21).

Table 1.
Tram rolling stock - groups

Wagon type	Group
105N/E1	A
2x105N	B
116th	BN
PT-8	B
PTM	BN
2012N	CN
2017N	BN
2020N	CN
MF10AC	AN
MF/AC	BN
105NK	A
2*105NK	B
105HF	A
2*105HF	B

Note. Division of tram rolling stock into groups.

The appearance of the first section is shown in Figure 2

Wartości	2022	2022	2022-2022 Różnica Wykonanie-Plan	2022-2022 Odchylenie % Wykonanie-Plan	2022-2022	
	Plan	Wykonanie			Efekt wzkm (PLN)	Wykonanie-Plan Efekt stawki (PLN)
M koszt netto	18 237 880	21 409 468	3 171 589	17,4%	-320 846	3 492 434
A koszt netto	25 196 638	26 766 548	1 569 910	6,2%	-1 116 020	2 685 930
B koszt netto	419 601 661	448 100 021	28 498 361	6,8%	-31 504 798	60 008 159
C koszt netto	254 812 186	280 706 644	25 894 458	10,2%	-9 470 299	35 364 757
TB koszt netto	14 156 758	14 262 718	105 960	0,7%	105 960	0
T koszt netto	175 326 942	142 147 550	-33 179 392	-18,9%	-32 173 144	-1 006 248
T "A" koszt	51 720 216	21 310 802	-30 409 413	-58,8%	-31 720 659	1 311 246
T "AN" koszt	8 931 089	8 718 949	-212 141	-2,4%	-224 952	12 811
T "B" koszt	17 889 353	34 269 347	16 379 994	91,6%	16 932 898	-552 904
T "BN" koszt	60 861 792	49 234 302	-11 627 490	-19,1%	-8 894 478	-2 733 013
T "CN" koszt	35 924 492	28 614 151	-7 310 342	-20,3%	-4 039 007	-3 271 334

Figure 2. Section I.

Source: own study.

Section two of the data model includes additional costs charged to the bus and trolleybus fleet among which costs are distinguished:

- 1) AIR CONDITIONING – costs of air conditioning,
- 2) MONITORING – costs of monitoring installed in the fleet,
- 3) WIFI – costs of wireless access to the Internet available in the fleet,
- 4) SDIP – costs of operating the Dynamic Passenger Information System (SDIP). SDIP is an integrated information system that provides information on the performance of transportation tasks performed by public transportation to passengers and makes it available to supervisory services (<https://sprint.pl/pl/uslugi/sdip-system-dynamicznej-informacji-pasazerskiej>),
- 5) PPK – the cost of operating the Employee Capital Programs (ECP) program,
- 6) Wage_min – costs of handling the equalization of wages to the statutory minimum wage level,
- 7) OTHERS – other costs unclassified before.

The appearance of the second section is shown in Figure 3.

Wartości	2022	2022	2022-2022	2022-2022
	Plan	Wykonanie	Różnica Wykonanie-Plan	Odchylenie % Wykonanie-Plan
A i TB koszty dodatkowe	48 412	522 206	473 795	978,7%
KLIMA koszt netto	0	0	0	
MONITORING koszt netto	0	0	0	
WIFI koszt netto	0	0	0	
SDIP koszt netto	0	0	0	
PPK koszt netto	48 412	97 626	49 215	101,7%
Placa_min koszt netto	0	370 234	370 234	
INNE koszt netto	0	54 346	54 346	

Figure 3. Section II.

Source: own study.

The third section of the data model determines the size of the contribution that individual municipalities must make to the joint budget that finances public transportation on the territory of GZM.

The following elements are additionally included in the settlement:

- 1) Ticket revenue;
- 2) Costs of the organization;
- 3) Lost revenue (free rides for children and youth);
- 4) Lost income (railroads);
- 5) Lost income (other);
- 6) Sheds (W);
- 7) Other settlements (I).

The appearance of the third section is shown in Figure 4.

Wartości	Plan	Wykonanie	Różnica Wykonanie-Plan	Odchylenie % Wykonanie-Plan
Koszty Przew. finansowane przez Gminy	915 634 120	944 062 900	28 428 780	3,1%
Dochody z biletów	260 751 747	189 113 356	-71 638 391	-27,5%
Koszty organizacji	19 655 853	13 886 148	-5 769 705	-29,4%
Utracone dochody (bezpłatne przejazdy dzieci i młodzież)	16 416 400	18 192 550	1 776 150	10,8%
Utracone dochody (kolej)	1 125 306	3 084 893	1 959 586	174,1%
Utracone dochody (inne)	0	2 639 902	2 639 902	

Figure 4. Section III.

Source: own study.

Another, fourth section of the data model includes the incremental costs charged to the tram fleet. These costs have been accounted for differently between partners over the years. Thus, until 2021, these costs were fully funded by individual municipalities. Starting in 2022, part of the costs were separated and their financing was taken over directly by the GZM. The additional costs of the trolley fleet include such elements as:

- 1) Air conditioning – costs of air conditioning in trams,
- 2) Cost of commuting trips – the cost of commuting of tram fleet between the depot and the end stops,
- 3) Stop fees – fees related to maintenance of stops,
- 4) Property tax,
- 5) Perpetual use of land,
- 6) Depreciation of other assets,
- 7) Maintenance of tracks, networks, substations,

- 8) Depreciation of infrastructure,
- 9) Depreciation of fleet,
- 10) Redemption of bonds,
- 11) Financial costs.

The value of the designated contribution in this section is the amount that is charged to the budgets of each municipality. The values from the previous sections allow you to understand the individual components that burden the municipal budget. The appearance of the fourth section is shown in Figure 5.

Wartości	Plan	Wykonanie	Różnica Wykonanie-Plan	Odchylenie % Wykonanie-Plan
<i>Podatek od nieruchomości</i>	22 753 208	20 421 970	-2 331 238	-10,2%
<i>Użytkowanie wieczyste gruntów</i>	390 118	402 694	12 576	3,2%
<i>Amortyzacja pozostałego majątku</i>	11 391 440	12 654 324	1 262 884	11,1%
<i>Utrzymanie torów, sieci, podstacji</i>	33 593 489	36 159 231	2 565 742	7,6%
Dodatkowe wynagrodzenie Tramwajów Część inwestycyjna (TrIn)	48 515 813	49 373 622	857 809	1,8%
<i>Amortyzacja infrastruktura</i>	15 499 859	12 727 109	-2 772 750	-17,9%
<i>Amortyzacja tabor</i>	11 419 048	10 923 411	-495 637	-4,3%
<i>Wykup obligacji</i>	6 216 256	0	-6 216 256	-100,0%
<i>Koszty finansowe</i>	15 380 650	25 723 102	10 342 452	67,2%
Rozliczenie wiat (R1)	2 297 773	2 955 116	657 343	28,6%
Rozliczenie audytu rekompensaty PKM Świerklaniec (R2)	0	5 520	5 520	
Rozliczenie audytu rekompensaty PKM Tychy (R3)	0	-994 366	-994 366	
Rozliczenie audytu rekompensaty Tyskie Linie Trolejbusowe (R4)	0	927 160	927 160	
Dopłata do linii 69 w gminie Żory (R5)	0	40 724	40 724	
Zmienna część składki rocznej dla gmin z uwzględnieniem dodatkowych rozliczeń (ZczS+TrBi+TrIn+R1+R2+R3+R4+R5)	776 438 361	867 270 856	90 832 495	11,7%

Figure 5. Section IV.

Source: own study.

The fifth section contains quantitative data showing the amount of kilometers traveled by each type of the fleet. The appearance of the fourth section is shown in Figure 6.

Wartości	Plan	Wykonanie	Różnica Wykonanie-Plan	Odchylenie % Wykonanie-Plan
J. W. bez części inwestycyjnej TS SA	727 922 548	817 897 234	89 974 686	12,4%
M wzkm	4 140 760	4 074 327	-66 433	-1,6%
A wzkm	4 675 328	4 478 939	-196 390	-4,2%
B wzkm	64 370 130	59 870 432	-4 499 698	-7,0%
C wzkm	32 423 771	31 298 202	-1 125 568	-3,5%
TB wzkm	1 437 234	1 447 992	10 757	0,7%
T pkm	14 496 559	11 827 952	-2 668 607	-18,4%

Figure 6. Section V

Source: own study.

The sixth section shows the cost per kilometer of each transport unit. The appearance of the fourth section is shown in Figure 7.

In addition, in the columnar layout there are two areas that allow you to select any combination of comparisons of data type (Plan-Execution) and time (Years 2020-2024). This means that you can compare, for example, the assumed plans between years or compile a comparison of the plan and execution for a set period (year). After determining the dimensions of the data, you get basic information such as the difference in value and percentage between the selected dimensions.

In addition, for the data of the first section, two values are determined for each type of rolling stock, which break down the value difference into parts showing the changes in costs due to the difference in fare rates in the compared dimensions (price effect) and the difference in the number of kilometers traveled between the set dimensions (distance effect), respectively.

3. Graphical overview

In addition to the analytical tabular presentation which can be difficult for some audiences to perceive, a graphical presentation of the changes of individual component factors on the change in the variable premium was prepared. The graphical presentation shows the individual components that affect the change in costs between the two selected points chosen in the tabular section. The first point is the parameters determined in the first column of the selection and, respectively, the second point in the second column. Each point is determined by a selection from a pair of parameters:

- Years (2020-2024),
- Plan – Execution.

With this approach, the types can be compared:

- Plan – Plan,
- Execution – Execution,
- Plan – Execution.

Compiled within the framework of different years.

The starting point is the amount of the variable contribution determined for point one, then the cost factors that affect the change in costs are shown until reaching the amount of the contribution selected in point two. Components marked in green indicate an element that reduces costs, and components marked in red indicate elements that increase costs. An example of a cost analysis summary is shown in Figure 9.

Analogous to the cost visualization, a summary is presented showing the distance settlement in thousands of kilometers for each type of rolling stock used in the public transport organization. An example of a summary of the settlement of kilometers is shown in Figure 10.

The next graphic shows the structure of costs at both boundary points. An example is shown in Figure 11.

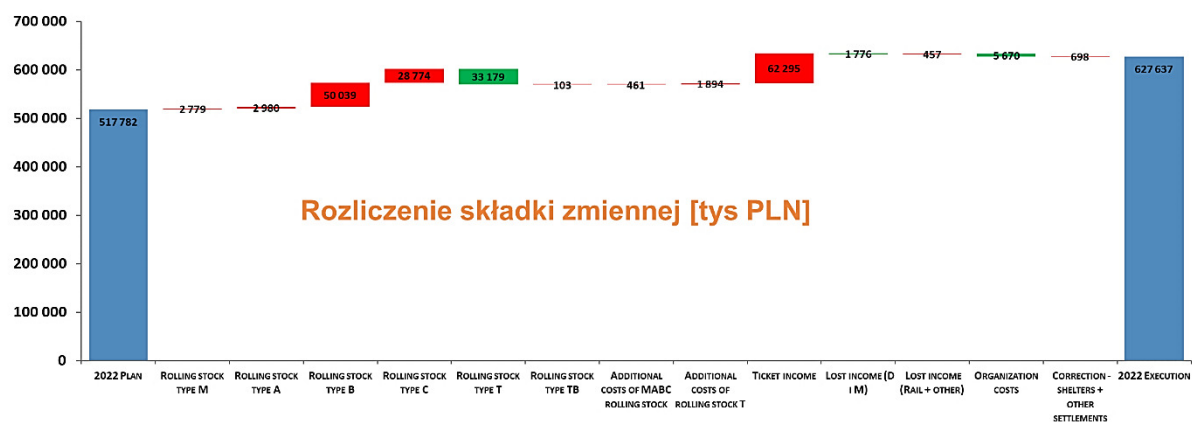


Figure 9. Costs settlement.

Source: own study.

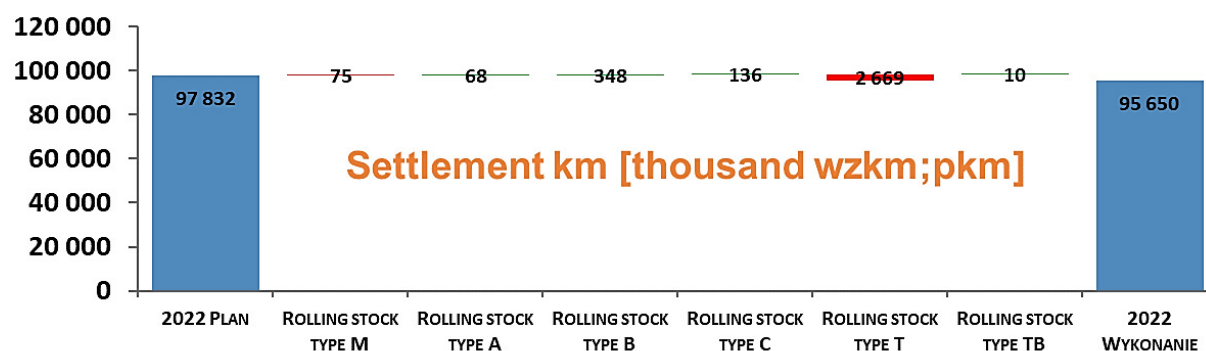


Figure 10. Kilometers settlement.

Source: own study.

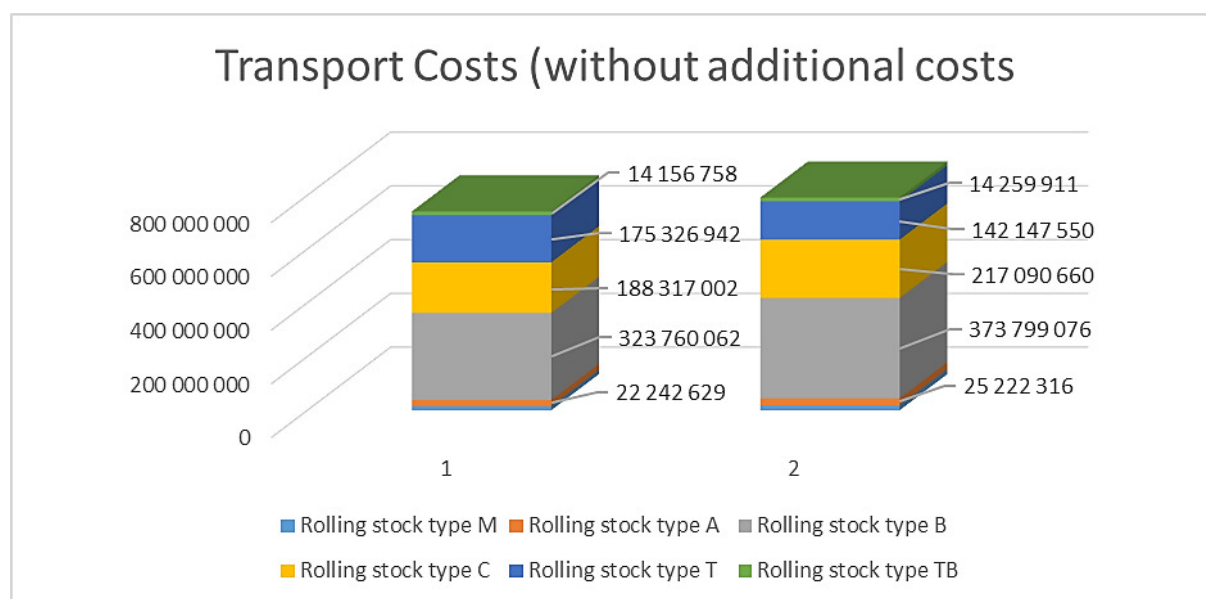


Figure 11. Cost structure.

Source: own study.

4. Final conclusions

The scope of this study is limited to the second stage of work which included the scope of construction of the data processing model and the tool for its analysis. Preparation of the tool in a clear and precise manner allows the end user to analyze the causes of deviations between the compared points. Explain the components that go into the variable premium allowing municipal administrators to better understand the reasons that determine the amount of fees that must be paid by the municipal budget to the GZM.

The expediency and correctness of the application of the presented solution is evidenced by the fact that to date three cycles of settlements, carried out at annual intervals, have already been implemented using the presented tool.

Data analysis using the developed tool will be presented by the author as part of the next article in this series.

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METAMODEL OF CUSTOMER DISSATISFACTION

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Purpose: The principal aim of this paper is to present a conceptual metamodel of customer dissatisfaction, based on a review of the relevant literature. The metamodel includes a number of different factors, the influence of which on customer dissatisfaction may be either direct or indirect, and may be causal or merely correlative in nature.

Design/methodology/approach: Metamodel synthesizes previously validated models to propose new models and hypotheses for dissatisfaction. The metamodel explores the relationships between anger, dissatisfaction, and customer responses, providing insights into cognitive, affective, and behavioural reactions.

Findings: The paper proposes a metamodel for the construct of dissatisfaction. It aims to inspire the development of smaller, more focused models for research across various market sectors.

Research limitations/implications: The paper addresses the lack of research on customer dissatisfaction and its modelling, offering insights for researchers interested in exploring this underrepresented area. Further research can explore the impact of dissatisfaction and anger on customers' cognitive, affective, and behavioural responses.

Originality/value: The paper is based on own studies and reviews, presents own-developed metamodel which may serve as inspiration for future research in various market sectors.

Keywords: dissatisfaction, regret, dissatisfaction models, customer, satisfaction.

Category of the paper: General review, conceptual paper.

1. Introduction

Understanding customer satisfaction and dissatisfaction is crucial for any organisation. Both customer satisfaction and dissatisfaction can have significant impacts on the functioning of an enterprise, resulting in positive and negative effects.

However, achieving complete customer satisfaction is often difficult, if not impossible. There will always be groups of customers with varying levels of satisfaction, ranging from very satisfied to moderately satisfied and dissatisfied.

According to Garcia and Curras-Perez (2020), customer dissatisfaction does not always lead to resignation from services, and satisfaction does not always result in loyalty.

A significant amount of literature is dedicated to customer satisfaction, including models, influencing factors, and resulting effects. However, there is a lack of research and literature on the topic of customer dissatisfaction and its modelling. This area has not been thoroughly and systematically described in the literature. The available knowledge is scattered and unsystematised.

Researchers often neglect the study of customer dissatisfaction or regret. This may be due to various reasons, including the negativity associated with dissatisfaction, the difficulty of measuring subjective emotions like regret, and the emphasis on positive aspects such as satisfaction and loyalty. A search in the most popular scientific databases for the keywords ‘customer satisfaction’, ‘customer dissatisfaction’, ‘customer regret’ shows how great the disparity is in the amount of research and publications covering these issues (Table 1).

Table 1.

Number of results found for customer satisfaction, dissatisfaction and regret in popular science databases (years 2020-2024)

Number of results found	Customer satisfaction	Customer dissatisfaction	Customer regret
Google Scholar	77 900	11 600	82
Scopus	10 749	308	6
Web of Science (tittle search)	927	6	1
Wiley (tittle search)	35	1	0
Springer (all fields search)	18,697	1231	15

Source: own elaboration.

The aim of our paper is to use the concept of a metamodel and, based on a literature review, to propose its form for the construct of dissatisfaction. The metamodel is a synthesis of previously validated models that can be used to propose new models and hypotheses based on previous studies. This model can serve as inspiration for the development of smaller, more focused models (non-expanded models) and their validation in research across various market sectors and research areas.

2. Customer dissatisfaction and its consequences

Every consumer have their own experiences with satisfaction and dissatisfaction. Among them there are those that are remembered for a long time and those that are not remembered. All these experiences (including positive ones) influence purchasing decisions, customer expectations, satisfaction or dissatisfaction.

The concept of customer dissatisfaction, like customer satisfaction, is related to emotions and is difficult to describe unambiguously. Table 1 presents various approaches to the concept of dissatisfaction proposed by different authors.

Table 1.
Example explanations of the concept of dissatisfaction

Autors	Explanation of the concept of dissatisfaction
Bougie et al. (2003) citing Storm, Storm (1987)	Negative term, related to anger, hatred, and disgust.
Isac, Rusu (2017).	Will happen if the perceived performance falls beneath expectations, or if the perceived performance goes beyond the expectations.
Johnston (1995)	Dissatisfaction is usually elicited by tangibility or integrity problems.
Isac, Rusu (2017)	Dissatisfaction could never appear unless the evaluation process began with the customers' negative expectations.
Oliver, DeSarbo (1988)	Negative disconfirmation which may cose to a feeling of disappointment. The delight of a positive disconfirmation enhances a satisfaction judgment, while the disappointment of a negative disconfirmation decreases it.
Taylor, Burns (1999)	The function of the consumer's expectation about the product performance, and some form of comparison between the pre-purchase expectation and the post-purchase performance.
Giese, Cote (2000)	Dissatisfaction can be defined using the three components of the definitional framework: affective response, focus, and timing.
Fornell, Wernerfelt (1987)	A state of cognitive/affective discomfort caused by an insufficient return relative to the resources spent by the consumer at any stage of the purchase/consumption process.

Source: own elaboration.

As Giese and Cote (2000, cited in: Souca, 2014) points out the dissatisfaction has three key components:

- an affective response,
- it has a clear focus point,
- it happens at a determined point in time.

Shweta and Agarwal (2022) state that the main reasons for consumer dissatisfaction are knowledge, perceived importance, and unfulfilled promises, including advertising promises.

Negative customer feelings, such as dissatisfaction, can elicit various reactions, including regret and disappointment (Jang, Kim, 2011). These emotions can also lead to frustration, anger, and even aggressive behaviour.

Customer dissatisfaction is not only a function of disappointment (negative disconfirmation), but also of regret (the performance of forgone alternatives) (Mahapatra, 2014). The point of reference of regret is the nonchosen option while the point of reference of disappointment is the expected but unrealized outcome within the same chosen option. Luckily people tend to avoid choices that could generate regret (Matarazzo et al., 2021).

Many authors associate dissatisfaction with emotions. As noted Laros and Steenkamp (2003) emotions are often conceptualized as general dimensions, like positive and negative affect (satisfaction and dissatisfaction). Nevertheless in the literature some researchers use a comprehensive set of specific emotions i.e. surprise, regret, sympathy and empathy,

embarrassment and anger. According to Isac and Rusu (2014) the satisfaction/dissatisfaction is not an emotion, but the evaluation of an emotion.

Generally, there are two ways to respond to dissatisfaction, namely active response (upset-action) and passive response (upset-no action) (Mahapatra, 2014; Farrell, 1983). In some branches (e.g. services), the negative impact of customer dissatisfaction may even be greater than the positive impact of satisfaction (Kim et al., 2017).

Consumers respond to dissatisfaction in various ways, including exit, voice, and loyalty behaviours (Farrell, 1983; Cho, Song, 2012):

- Exit behaviour: (leave, withdrawal or escape) involves leaving the relationship by not making any further purchases.
- Voice behaviour: problem solving, suggesting improvements, communicating complaints to management and suggesting improvements.
- Loyalty behaviour: accepting the situation, faithfulness, trust and exhibiting latent passive behaviour.

It is important to note that some these behaviours (e.g. exit and voice behaviours) are not mutually exclusive and can coexist.

There is difference between these types of response i.e.: voice is active and constructive, exit is active and destructive, loyalty is passive responses to dissatisfaction (Farrell, 1983).

Fig. 1 shows selected examples of antecedents and consequences of customer satisfaction and dissatisfaction. The consequences of satisfaction and loyalty may differ from those of dissatisfaction and disloyalty (Bloemer, Kasper, 1995). Additionally, the service attributes' components are not identical and may have different impacts on satisfaction or dissatisfaction (Vargo et al., 2007; Edvardsson et al., 2005; Bloemer et al., 2002; Bianchi et al., 2012).

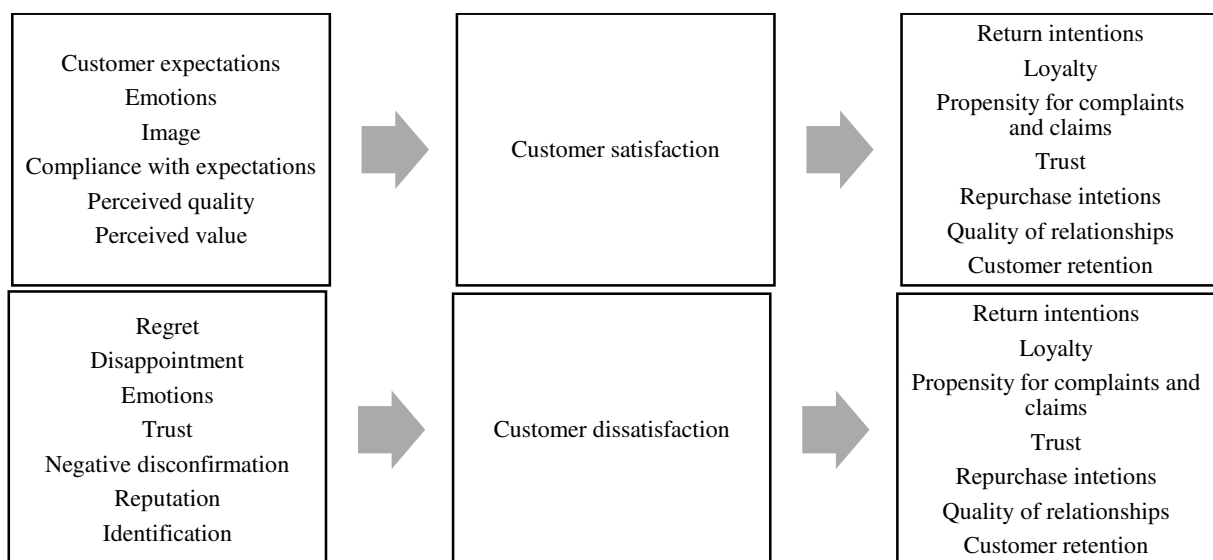


Figure 1. Selected examples of antecedents and consequences of customer satisfaction and dissatisfaction – comparison.

Source: own based on: Biesok, Wyród-Wróbel (2016), Cho, Song (2012), Boadi et al. (2017), Bui et al. (2011), Kim et al. (2017), Pascual-Nebreda et al. (2021), Zeelenberg, Pieters (1999).

Dissatisfaction is directly related to regret, and regret is more associated with switching behaviour and affect on decision-making (Zeelenberg, Pieters, 1999, Inman et al., 1997, Bui et al., 2009). Whereas dissatisfaction may not necessarily induce complaining and some satisfied customers may still complain (Nimako, 2012).

As notice Oliver (1999), dissatisfaction is loyalty's Achilles tendon, because of its important role in ending the customer-company relationship.

3. Metamodel of customer dissatisfaction

The modelling of satisfaction or dissatisfaction aims to uncover and validate the relationships between elements that have or can impact satisfaction, as well as its effects. These relational structures can be explored through various modelling methods, such as structural equation modelling.

Models illustrate the relational connections, typically causal, between the constructs being studied. This relationship assumes the existence of influential factors, also known as explanatory, independent, or causal variables, that affect the behaviour of dependent or effectual factors, also known as explanatory or effectual variables. It is also possible for these factors to influence each other (Biesok, Wyród-Wróbel, 2016).

The multiplicity of research results forces researchers to structure the state of knowledge on an ongoing basis. One way of doing this is to create metamodels. A metamodel is a synthesis of previously validated models from which one can propose one's own models and influential hypotheses, and suggest how they have been supported in previous studies. In its form, it is a diagram of relationships showing the relationships between different factors and satisfaction that have been explored and confirmed by subsequent authors. The metamodel illustrates a cross section of hypotheses that have been positively validated in previous studies, provides an understanding of the place of the construct being analysed in a broader context than would be apparent from individual models, and inspires one to propose one's own hypotheses and related model forms (cf. Biesok, Wyród-Wróbel 2018).

In order to better understand its context and the links of negative satisfaction, the authors, built a dissatisfaction metamodel based on detailed models presented in the literature. To this end, more than 80 publications covering dissatisfaction and consumer regret were collected and reviewed. This is a considerable number, given that relatively few researchers (cf. Table 1) address these issues in their studies.

In the metamodel, the authors synthesised 10 studies on customer dissatisfaction. The authors focused on those studies that proposed and/or validated dissatisfaction models.

These models could be categorised as:

- Simple models – involving a small number of constructs and relationships between them (Bougie et al. (2003), Lee, Kim (2020), Nam et al. (2020), Putri et al. (2020)),
- Complex models – showing more elaborate relationships (Boadi et al. (2017), Cho, Song (2012), Kim et al. (2017), Lee et al. (2015), Lu et al. (2012), Pascual-Nebreda et al. (2021)).

The studies included in the metamodel were selected to ensure the maximum variety of models used, which should ensure the cross-sectional shape of the metamodel created from them.

The model proposed by Bougie et al. (2003) is based on two studies of the experience and consequences of anger and dissatisfaction in response to unsuccessful service encounters. The aim of Study 1 was to assess the specific feelings, thoughts, tendencies, actions and emotional goals that differentiate the experience of anger and dissatisfaction. In contrast, Study 2 examined the impact of service dissatisfaction and anger on customers' cognitive, affective and behavioural responses.

The results show that dissatisfaction is a significant predictor of switching, even when anger is taken into account. Conversely, anger is a significant predictor of supplier switching, complaint behaviour, negative WOM and third party complaints. As the authors of the paper suggest, while most dissatisfied customers do not complain, angry customers exhibit a range of different responses aimed at discouraging the supplier from continuing to do what is causing their anger or correcting the service failure.

Another example is a model that examines the effect of dissatisfaction on WOM and distrust (Nam et al., 2020). Dissatisfaction leads to negative eWOM and distrust of pre-existing electronic WOM, and ultimately distrust of the review site itself.

The model proposed by Lu et al. (2012) shows that dissatisfaction has a significant direct and indirect effect on repurchase intention, and exerts a strong influence on the negative emotions that lead customers to leave their suppliers.

Another example of a dissatisfaction model is the model proposed by Kim et al. (2017), called the “dissatisfaction-attitude-negative behavioural intention model”. The findings indicate that an individual's attitude towards the service provider plays a significant mediating role in the relationship between dissatisfaction and its negative consequences. Furthermore, the results show that dissatisfied customers form negative attitudes towards the hotel, which resulted in an overall unsatisfactory experience.

A metamodel synthesising these research findings is presented in Figure 2. The metamodel presents the hypotheses verified by the cited researchers of the relationship between dissatisfaction and its antecedents and consequents. The arrows show the direction of influence or outcome between the factors. The metamodel reveals a network of links between dissatisfaction and other constructs, enabling the construction of one's own models for their confirmation.

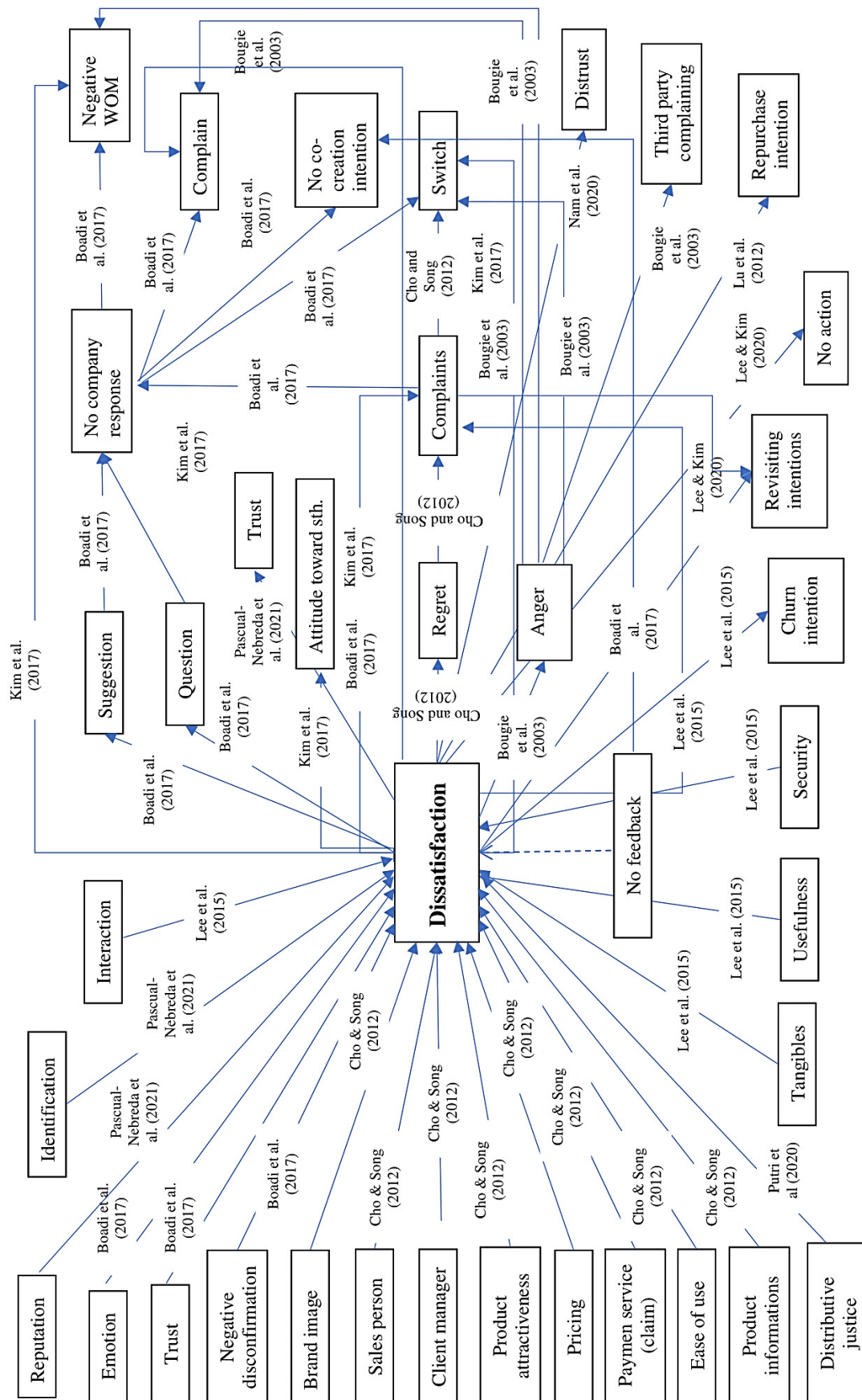


Figure 2. Proposed metamodel of customer dissatisfaction.

Source: own based on referenced studies.

4. Conclusion

The topic of dissatisfaction and consumer regret remains relatively under-researched within academic circles, often overshadowed by the extensive focus on customer satisfaction. Despite their profound impact on consumer behaviour and business performance, they do not receive proportionate attention in academic research. This may be caused by the fact that customer satisfaction is a positive emotional state and has positive association with customer loyalty and profitability.

Dissatisfaction has its own types, causes and consequences (Table 2). Each of these is an interesting research area. Exploring them enables overlooking critical insights into product or service shortcomings, customer dissatisfaction drivers, and opportunities for improvement.

Table 2.

Exemplary areas, causes and consequences of dissatisfaction that can be the subject of academic research

Areas of dissatisfaction	Causes of dissatisfaction	Consequences of dissatisfaction
Dissatisfaction with product quality	Unmet expectations	Negative word of mouth
Dissatisfaction with usability	Product defects	Switching intentions
Dissatisfaction with performance	Poor service	Complaints
Dissatisfaction because of expectations	Competency	Inertia
Dissatisfaction with customer service	Poor communications	Regret
Dissatisfaction with institution	Lack of training and information	No co-creation intentions
	Lack of customer focus	No consumer engagement
	Attitude problem	

Source: own elaboration based on: Biu et al. (2009), Boadi et al. (2017), Lahey (2023).

Failure to consider dissatisfaction and consumer grievances risks overlooking critical insights into product or service shortcomings, customer dissatisfaction drivers, and opportunities for improvement.

Dissatisfaction often arises from unmet expectations, so studying it can help businesses align their offerings with what customers expect and it is a significant predictor of supplier switching, even when anger is taken into account. Except it, dissatisfied customers may exhibit various responses aimed at discouraging the provider from continuing the service failure. Dissatisfaction leads to negative electronic Word-of-Mouth (eWOM) and distrust of pre-existing eWOM, ultimately leading to distrust of the review website itself.

Studying customer dissatisfaction is essential for several reasons. It provides insight into areas for improvement: Dissatisfaction can provide valuable insights into areas of a product or service that require improvement. It helps businesses understand what is not working and how they can enhance their offerings.

By understanding the causes of dissatisfaction, businesses can take proactive measures to address these issues, thereby preventing customer churn and improving customer retention. This is particularly important for reputation management. In the era of social media, dissatisfied

customers can easily share their negative experiences, which can potentially damage a company's reputation. By studying dissatisfaction, businesses can better manage these situations and protect their brand image.

In order to gain insight into the phenomenon of dissatisfaction and the factors that create it, it is necessary to propose and confirm original models of dissatisfaction, regret and consumer anger. Further research can explore the impact of dissatisfaction and anger on customers' cognitive, affective, and behavioural responses. The proposed metamodel can support researches in these activities.

In conclusion, studying customer dissatisfaction is a challenging yet essential aspect of business research that can provide valuable insights for improvement and growth. This field deserves more attention from researchers. There is a compelling need for researchers to dedicate more attention to understanding and addressing these aspects of the consumer experience in order to foster more comprehensive and effective strategies for enhancing customer satisfaction and loyalty.

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PROJECT MANAGEMENT MATURITY ASSESSMENT OF THE SME SECTOR ENTERPRISES – RESULTS OF OWN RESEARCH

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Purpose: The purpose of this study was to assess the project management level of small and midsize enterprises cooperating with the Częstochowa University of Technology, considering the key factors determining the level of maturity.

Design/methodology/approach: A quantitative method was applied using a survey questionnaire on the interankiety.pl platform. Project maturity was assessed using the following models: the level of maturity of the organization in project management proposed by S. Spalek and the H Kerzner's Project Management Maturity Model.

Findings: The research showed that the percentages of enterprises with the lowest and highest project maturity are at similar levels. The most important factor for project maturity level is systemic project management. The enterprises must meet the basic conditions in the area of project management methods and tools. Overall, a higher level of maturity was noted in the field of human resources and the lowest in the area of project knowledge management.

Originality/value: The study fills the research gap on project management maturity assessment in the sector of small and medium-sized enterprises commercializing scientific research results. It also identifies key project management maturity factors. Project maturity will play an increasingly important role in the field of project management. Thus, the need will arise to distinguish oneself from competitors, to compare oneself with others in terms of project implementation capacities. The research indicated that the model proposed by S. Spalek is characterized by simplicity and flexibility of application.

Keywords: project, project management, project maturity, maturity model.

Category of the paper: research paper.

1. Introduction

Project management is a method of management focused on the effective achievement of the project objective, within the specified time and budget, while neutralizing the impact of existing constraints and minimizing risks. It is also deals with fostering the motivation of the project team and proper communication between project participants (PMI, 2012).

The scope of application of project management in Polish enterprises is steadily growing. It can be concluded that the more mature the project management process, the more it is appreciated by the enterprises (Spalek, 2013). There are many benefits of implementing the project management method into enterprise practice. Among the primary ones is the positive impact of this method on the technical and organizational progress of the enterprise. They result, *inter alia*, from the possibility of combining project management with other management systems, such as concurrent design, comprehensive quality management, risk management or change management. Combining project management with other systems provides many opportunities (Pritchard, 2002), including shortening time for development of new products, extended average product life cycle, increased sales, increased revenue, increased customer base, fewer changes to technical documentation, reduced time to market for new product, higher customer satisfaction rate, better procedures for identifying risk factors, more effective response processes, increased ability to respond quickly to customer requests for change (Wójcik, 2015, p. 530). Moreover, the enterprise can take more of its own actions to increase the value offered to customers by which it will establish a good relationship with customers, which in turn will result in customer satisfaction.

Thus the increase in the number of projects carried out in enterprises is quite understandable (Fricke, Shenhar, 2000, pp. 258-268). The resulting multi-project environments began to cause new, previously unknown problems (Canonico, Soderlund, 2010, pp 796-806). The need for sharing resources, *inter alia*, has intensified (Chen, Lee, 2007, pp 202-217) as well as the issue of projects prioritization (Fricke, Shenhar, 2000, pp 258-268; Spalek, Bodych, 2011). The ability to manage knowledge has become an extremely important issue (Friesl et al., 2011, pp. 71-86; Kowalczyk, Nogalski, 2007; Liebowitz et al., 2007, pp. 1123-1153; Paliszkiewicz, 2007, pp. 825-836) – particularly concerning its effective use in subsequent projects (Holzmann, 2013, pp. 2-13; Mueller, 2012, pp. 435-447; Phusavat et al., 2008, pp 513-528; Wyrozębski, 2011). In an effort aimed at systematising knowledge in this area, Gasik (2011, pp. 23-44) presented an integrated project knowledge management model which could be effectively used in organizations. There also appeared first research works on the use of project knowledge management in practice (Cho, Hastak, 2013, p. 90, 101; Hsu et al., 2007, pp. 30-51; Li, Bai, 2011; Lindner, Wald, 2011, pp 877-888; Wyrozębski et al., 2012).

The aforementioned considerations allow us to formulate a general conclusion that modern project management should revolve around four main areas (Spalek, 2013):

- methods and tools applied in project management,
- human resources in project management,
- project knowledge management.

The growing popularity of project management in business practice and in the evaluation of this management method justify the assessment of the maturity of enterprises in this area. Project management maturity assessment is not just a “picture of the skills” an organization has in the area in question. According to Nowosielski (2012) this assessment method should be

used to improve the company's operations. The purpose of the presented study was to evaluate the level of project maturity of small and midsize enterprises cooperating with Częstochowa University of Technology, considering the key factors influencing their management maturity level.

2. Project management maturity of enterprises

Project management maturity is the ability of an organization to effectively select a portfolio of projects so that the implementation of these undertakings supports the organization's goals and strategy, and its ability to apply professional project management techniques and tools to achieve high quality project products, enabling repeatable successes and to avoid mistakes in subsequent projects (Juchniewicz, 2009a).

Thus, the logic of project management maturity is as follows: as project management maturity increases, i.e., as successive levels of maturity are reached, the organization's effectiveness in implementing projects increases, resources are used more efficiently, project experiences from previous projects, both successes and failures, are used in subsequent projects.

The project management maturity of an organization should be considered from two perspectives. Firstly, project management maturity models are diagnostic tools. They enable a comprehensive analysis of the state (level of organizational skill) of project management capacity of an organization. Secondly, project management maturity testing is not a one-off activity. The logic of project management maturity suggests implementing a philosophy of continuous improvement of project management in the organization, i.e. striving to achieve ever higher levels of maturity (Juchniewicz, 2009b).

Measurement of the organization's project management maturity is conducted using special tools, the so-called Project Management Maturity Models. They make it possible to determine in a precise way which project management processes are carried out in the organization and at what skill level they are implemented, and on this basis assign the organization to a given (strictly defined) level of project management maturity.

Project management maturity models appeared in management theory and practice in the early 1990s. For the most part, their design is based on the so-called Quality Management Maturity Grid - the first-ever model for assessing an organization's maturity (in this case, in quality management), proposed by Phillip Crosby, an American quality management specialist. The management maturity grid defines five levels of skill in an organization concerning quality management. Achieving each level requires conducting a certain well-defined processes or activities (Crosby, 1980).

The first model to measure project management maturity of an organization was developed by the Software Engineering Institute (SEI). In 1991, a document called the Capability Maturity Model (CMM) was published. This tool, initially applicable to the IT industry, was quickly recognized and appreciated by organizations in other sectors (Saemu, Prompoon, 2004, pp. 158-165).

Another tool is the Capability Maturity Model Integration (CMMI), which differentiates 22 process areas, clearly defined and named (Juchniewicz, 2009a). This model proposes two approaches to assessing an organization's maturity - continuous and graded. The continuous approach assumes that each process area is evaluated separately. On the basis of specific procedures, it is determined how a process area is implemented, and then one of six maturity levels is assigned to it (from 0 – incomplete to 5 – optimizing). In a graded approach, the entire organization is assessed. In this case, CMMI defines five levels of maturity (from 1 – initial to 5 – optimizing) (Saemu, Prompoon, 2004, pp. 158-165).

One of the most important model from the point of view of applicability is the one proposed by H. Kerzner (2001) – The Kerzner Project Management Maturity Model (PMMM). Its significant advantage is the simplicity of its design and related to it ease of the maturity assessment process. Moreover, the tool is freely available and free of charge, making it suitable for use by any organization, regardless of its size, revenue or nature of operations. The model consists of five maturity levels. At level 1, an organization may have some knowledge of project management and may be able to differentiate projects from the ongoing operations, or it may have no such knowledge at all. At level 2, the organization recognizes the processes involved in project management. In addition, these processes are common to all projects in the organization, which makes it possible to replicate the success of one project in another. At level 3, the organization recognizes the benefits from the synergy of process and their control, and develops a unified methodology, replacing individual tools and techniques. At level 4, the organization uses a uniform methodology, while being aware of opportunities to improve it based on the experiences of the best organizations around. At level 5, the organization effectively uses the knowledge gained from benchmarking and is itself a role model.

One of the more popular and at the same time more important project maturity models is the Organizational Project Management Maturity Model (OPM3) which has been developed by the Project Management Institute (PMI), the world's largest organization of project managers. The model was constructed on the basis of so-called Best Practices (BPs). It distinguishes 586 BPs. Each practice is assigned to dimensions which are based on four phases of process management (standardization, measurement, control, continuous enhancement) and three areas of project management (projects, programs, portfolios). Project maturity assessment with OPM3 is carried out using a special computer program (Juchniewicz, 2009a).

Based on the literature studies, it can be concluded that project management maturity is most often assessed in the areas of methods and tools, human resources and organizational context (project environment). S. Spalek (2013) proposes a model that includes the aforementioned areas and supplements them with knowledge management processes within each area. This model differentiates five levels of maturity in project management (Table 1).

Table 1.
Organization maturity in project management model

Maturity level	Main characteristics of the project management approach
L5. Self-improvement	<ul style="list-style-type: none"> Implementing improvements in relation to PM methods and tools implementing ameliorations and improving project team management systematic improvement of management processes supporting PM implementing improvements in systemic project knowledge management
L4. System Management	<ul style="list-style-type: none"> application of standard PM methods and tools in all projects application of project team management standards in all projects comprehensive support of PM by the management/organizational system application of project knowledge management standards in all projects
L3. Application	<ul style="list-style-type: none"> application of standard PM methods and tools in most projects application of project team management standards in most projects management/organizational system significantly supports PM application of project knowledge management standards in most projects
L2. Standardization	<ul style="list-style-type: none"> lack of defined PM methods and tools selective application of defined project team management standards management/organizational system partially supports PM selective application of project knowledge management standards
L1. Initial	<ul style="list-style-type: none"> lack of defined standard methods and tools for project management lack of defined standards for project team management lack of a management/organizational system to support project management lack of defined standards for project knowledge management

Source: Spalek, 2013.

According to the author this is a perfectly valid approach since in recent years the importance of knowledge management in enterprises has increased significantly (Cho et al., 2003, pp. 504-510; Friesl et al., 2011; Paliszkievicz, 2011, pp. 435-450) and also in projects (Gasik, 2011, pp. 23-44; Shida et al., 2007, pp. 279-288; Wang, 2005).

3. Research method

A systematic analysis of the literature showed that many researchers have tackled the subject matter of project management. A search through databases (including Scopus, Web of Science, Elsevier) found more than 800 publications on this topic. An analysis of these publications in terms of research area and timeliness of the data presented indicated that only 68 are related to the SME sector and most of them focus on one selected industry: mainly IT, logistics or industry. However, no publications were found discussing the assessment of project

management maturity in the sector of small and midsize enterprises commercializing results of scientific research.

The purpose of the study is to assess the organizational project management maturity in enterprises of the SME sector, representing various industries. Maturity is understood as the state of achieving full development, or the state of readiness of the enterprise to undertake certain specified activities. Consequently, the following research questions were formulated:

Q1. Are there differences in the level of maturity in project management between micro, small and midsize enterprises?

Q2. What factors have a key impact on a company's maturity level in project management?

The study used the concept of maturity levels of H. Kerzner's (Kerzner, 2001) and S. Spalek's (Spalek, 2013) models. The presented here empirical research was carried out between December 2023 and March 2024. A quantitative method was used with a survey questionnaire consisting of closed questions with a 5-point Likert type scale for assessing individual phenomena, as well as explanations of key concepts and a metric. The survey was conducted via the interankiety.pl platform.

To assess the level of project management maturity in enterprises, measures were made for four areas of modern project management (according to S. Spalek), namely: methods and tools in project management, human resources in project management, project environment and project knowledge management (Table 2).

Table 2.

Measures for assessing the maturity of enterprises in project management

Area	Measure
The area of methods and tools in project management	Project planning tools
	Project implementation tools
	Common defined language to describe project activities
	Mathematical models for planning purposes
	Collection system of project related information
	Baseline schedule
	Management of projects stakeholders
	Projects related risk management system
	Established project management policies
The area of human resources in project management	The company ensures competent workers for projects
	Managers are competent in effective project management
	Managers are competent in project planning, completion and implementation
	Project management training is provided to individuals playing specific roles in the project
	Project team members follow a code of ethics
	Project managers are trained in leadership
	Individuals assigned to projects have appropriate competences to play the assigned roles
Project environment area	The company has procedures in place to coordinate interactions that occur between projects
	The company has a defined vision for project management
	Use of benchmarking to increase project management effectiveness
	Employees understand the benefits of project management
	Company uses tools to standardize, measure, control and improve project management processes

Cont. table 2.

The area of project knowledge management	A system that measures the level of competence of people involved in projects
	Cyclic training on methods, tools and techniques in project management
	Use of benchmarking to evaluate project management with generally accepted standards
	Procedures to ensure that project managers and project team members have adequate knowledge and competences
	Implemented experience gathering process
	Procedures for using information and experience to improve project management

Source: prepared on the basis of Spalek (2013).

Small and midsize enterprises were invited to participate in the study; the main variable in selecting entities for the research sample was location by region, i.e. the northern sub-region of the Silesian Voivodeship, and cooperation with the Czestochowa University of Technology for the commercialization of knowledge in the region. The latter condition made it possible to include companies that implement projects.

4. Presentation of research results

Seventy-three respondents took part in the study, the leading sectors were banking services, finances and logistics (Table 3). Companies with more than 49 employees predominated. The vast majority, more than 81%, have been implementing projects for more than a year but less than 5 years.

Table 3.
Characteristics of the study group

Size	Micro 12%		Small 30%		Midsize 58%
Industry	IT 13%	Banking/Finances 46%	Automotive 7%		Logistics 34%
Size of the project team	1-2 persons 5%		3-9 persons 79%		More than 9 people 16%
How long has the company been implementing	Less than a year 3%		1-5 years 81%		For more than 5 years 16%

Source: own research.

The highest percentage (30%) of surveyed companies represent maturity level 3, the application level. This means that the following attributes are developed and applied in most projects: standard project management methods and tools, project team management standards and the enterprise organizational system supports project management. At this level of maturity, there is also a process for managing accumulated project knowledge. The highest level of project management maturity was reached by 13% of the surveyed companies, which declare to have been implementing improvements in the surveyed project maturity areas and are improving project management.

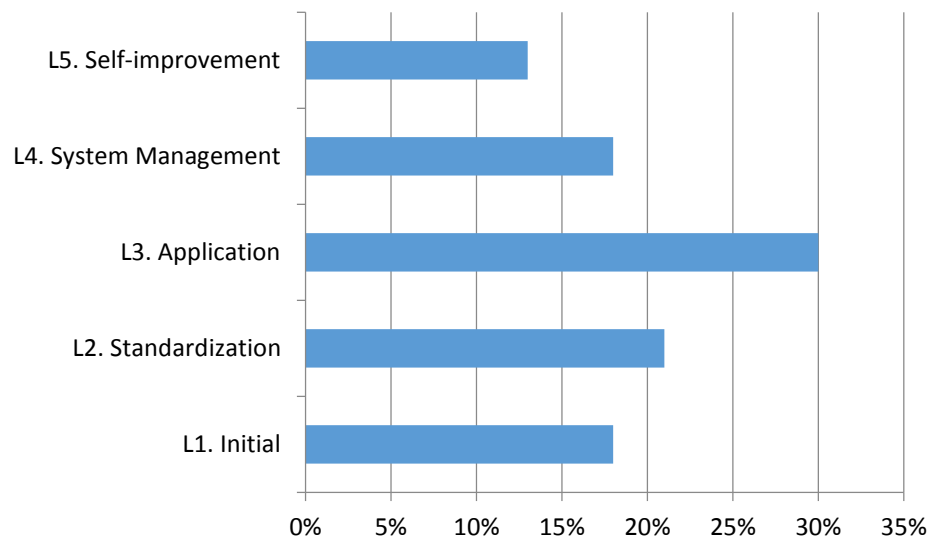
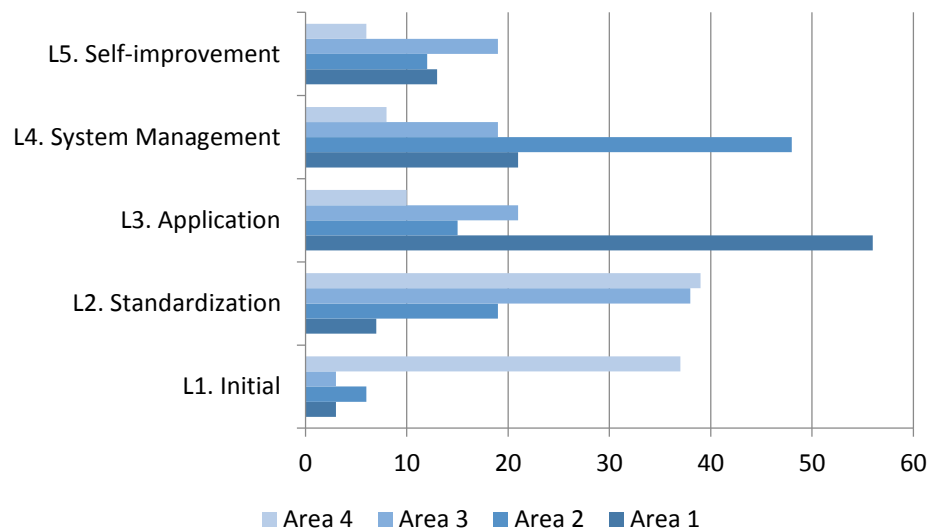


Figure 1. Levels of project management maturity of surveyed enterprises.

Source: own research.

No interrelation was found between enterprise size and project management maturity. In the groups of micro, small and mid-sized enterprises, the smallest percentage represented enterprises with maturity level 5 (4%, 8% and 7% respectively) and the largest percentage represented levels 3 and 2. In the group of micro enterprises, the total was 75%, small - 43% and mid-sized - 57%

The most dispersed results were obtained for the methods and tools area, where the highest number of indications, 56%, was for level 3, followed by 21% for level 4 and 13% for level 5. On the other hand, 3% of companies were classified at maturity level 1 and almost 7% at level 2. An analysis of the results combining levels 4 and 5 of project management maturity, shows that the surveyed companies perform best in the area of human resources with 60% of companies (48% at level 4 and 12% at level 5, respectively) caring about the skills and qualifications of employees involved in projects. The selection of project team members is not random and ethics in conduct and decision-making is an important aspect of project management. Companies show the least maturity in the area of project knowledge management. In this case, only 14% of surveyed companies show level 4 or 5 (8% and 6%, respectively) and as many as 76% show level 1 and 2 (37% and 39%, respectively). Most of the surveyed companies in this area do not have developed standards for gathering knowledge and procedures for using experience to improve project management. On the other hand, there is an emphasis on periodic training in project management methods, tools and techniques, as well as procedures to ensure the proper selection of project team members in terms of competence. This explains the high level of maturity of companies in the area of human resources.



Area 1 – methods and tool in project management,
 Area 2 – human resources in project management,
 Area 3 – project environment,
 Area 4 – project knowledge management.

Figure 2. Levels of project maturity in different areas of project management (%).

Source: own research.

The assessment of an enterprise maturity in project management is influenced primarily by the awareness of the enterprise management of the importance of systemic project management. This is the starting point for considerations about enterprise maturity, as it is only on this basis that the need to improve project management processes arises. Therefore, key project maturity factors include: standard techniques and tools used in the planning, organizing and execution phases of the project, risk management methods, and project stakeholder management methods (Table 4).

Table 4.

Key factors affecting the project management maturity of an enterprise

	Measure	Average rating
Area of methods and tools in project management	Tools for planning and organizing a project	4,9
	Tools for project implementation	4,9
	Project stakeholders management	4,6
	Risk management system for projects	4,8
Area of human resources in project management	Project management training is provided to individuals playing specific roles in the project	4,3
	Projects managers are trained in leadership	4,5
	Individuals assigned to projects have appropriate competences	4,3
Area of project environment	The company has a defined vision concerning project management	4,0
	Use of benchmarking to increase project management effectiveness	3,6
	The company uses tools to standardize, measure, control and improve project management processes	4,1
Area of project knowledge management	A system measuring the level of competence of people involved in projects	4,2
	Mechanisms to ensure the reliability of the information gathering process	4,4
	Implemented experience gathering process	3,9

Source: own research.

The research also emphasised the importance of planning and estimating project costs as well as defining measures of success. Setting up rules for assigning people to a project according to their competences is another key factor. A project management mature organisation takes care of periodic training dedicated to project team members. In addition, it makes sure that project managers have appropriate knowledge and leadership skills. Another group of key factors concerning enterprises maturity in project management is related to the system of collecting information and experience. Important here are: a system that measures the level of competence of people involved in projects, mechanisms to ensure the reliability of the information gathering process, and an implemented experience gathering process. An enterprise will represent a high level of maturity if it defines a project management vision and implements tools to standardize, measure, control and improve project management processes.

Summary

The undertaken subject matter is in line with current considerations about the direction of development of models for assessing the level of enterprises maturity in project management. The research indicated that the model proposed by S. Spalek is characterized by simplicity and flexibility of application. In the group of respondents, the lowest project maturity, at level one and two, is characterized by 39% of enterprises. A slightly smaller percentage, 31%, are enterprises with the highest level of maturity. No correlation was noted between the size of the company and its maturity level.

The conducted assessment of the maturity of enterprises in project management included an attempt to identify the key factors affecting the level of maturity. It turned out that the most important factor is systemic project management. In enterprises, the basic conditions in area of project management methods and tools must be met. Overall, a higher level of maturity was identified in the area of human resources and the lowest in the area of project knowledge management. This indicates a low awareness of the importance of knowledge, which is the cause of, among other things, a lack of standards on gathering information and experience. Such an approach to project knowledge management may result in a lack of need for enterprise development in project management. Moreover, it may constitute an obstacle to the effective implementation of projects (Kusyk, 2010). According to Wittek (2011, pp. 282-290), this can be prevented by including project management in the company's strategy. However, since the lowest level of maturity is represented by 18% of companies, the second level by 21% and the third level by 30%, a positive conclusion can be made: by reaching higher levels of project management maturity, companies are moving from the unconscious to the conscious zone of project management. This transition is very important, especially at the second level, because

it represents a turning point in the development of project management. Here we are dealing with standardisation, which constitutes the basis for the application of the adopted solutions.

According to the author the project management maturity model according to S. Spalek emphasises the importance of knowledge, which naturally encourages self-improvement. They take a similar approach Paliszkiewicz (2011, pp. 435-450) oraz Gasik (2011, pp. 23-44). Project maturity will play an increasingly important role in the field of project management. Thus, the need will arise to differentiate from competitors, to compare with them in terms of project implementation skills. We can, therefore, expect similar trends to those in quality management, where the high level of knowledge in an organisation has necessitated the development of tools to distinguish one's activities from competitors. The project management maturity survey is also an excellent tool for organisations which do not have even a rudimentary awareness of the existence of projects in their operations, as well as for those which want to carry out projects more effectively but are unable to improve their project management skills.

Concerning the key factors of project management maturity, the research ought to be continued. The question of the importance of individual factors as the level of maturity changes has not been tackled. When analysing the results, such question, for example, arises: are the key factors at lower levels replaced by others as higher levels are reached? This is an interesting aspect of the subject matter under study, requiring further development. It is also legitimate to consider which approach to project management, classic or traditional, is more effective in achieving project management maturity.

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STORAGE TECHNOLOGIES AND ORDER PICKING METHODS ON THE EXAMPLE OF AN ENTERPRISE

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Purpose: The aim of the article was to analyze why customers are less willing to use the services of the described company, at what stages of warehouse processes the company wastes the most time, what to do to save time and what solutions to introduce to improve all activities.

Design/methodology/approach: An SMED analysis was performed, which allowed the entire warehouse process to be presented step by step, how much time each stage takes and which of them takes the most time. Then, it was determined what solutions should be made to improve the process. Again, using SMED analysis, the times were verified and at what stage the savings were noticed.

Findings: The conducted research allowed us to determine how important information technology is in current logistics and how the investments introduced allow for a sudden change in the services provided by the company.

Research limitations/implications: The practical part is intended to reflect the actual compliance of the company with the imposed rules.

Practical implications: Analysis conducted before and after introducing the permitted changes determine whether the problem has been resolved and what benefits the company has experienced. Test the time of individual processes allowed for the implementation of a new IT system, which contributed to the development of the company and allowed us to save a large amount of capital.

Social implications: The aim of the proper selection of the strategy is to increase the efficiency of the process, shorten the duration and reduce costs. The main strategies are discrete picking, group picking and zone picking. Discreet picking involves performing single orders, when an employee can assemble items from only one order in one cycle. This is the simplest strategy and is often used when orders have a large number of items relative to media units.

Originality/value: The article draws attention to the importance of a non-routine approach to the dynamics of picking capabilities in an enterprise. This is important for management as a scientific discipline, but also for the enterprise, which indicates various possible development paths.

Keywords: Picking, SMED analysis, logistics, management.

Category of the paper: Research paper.

Introduction

The logistics system is an artificial system created by humans, its purpose is to move goods and/or people. It is a technical and social system because its elements are not only machines and devices that are used to move goods and/or people, but also the goods and/or people being moved, machines and people who manage this movement (Brewer, Speh, 2000). The implemented transformation mechanism consists in moving, i.e. changing the place where a specific good or person is located (Kabus, Piersiala, Miciuła, 2020). This transformation is carried out in order to move a specific good or person to its destination, i.e. where for some reason this good should be located, and the person would like to be there (Bień, Jędrzejczyk, Kucęba, 2020). Characteristics of this logistics system, which is called the flow chain, or goods chain.

Enterprise logistics systems (micrologistics systems) include such logistics processes as: purchasing, inventory management, warehousing, packaging and transport. Integration and coordination of these processes that take place in the enterprise's logistics system can be achieved by having integrated management of all logistics processes that take place within the logistics subsystems of supply, production, sales and service.

The research method used in the article is SMED analysis, which allowed us to compare the time of the warehouse process. The main research goal was to verify the hypothesis that the introduction of modern information technologies and systems in the enterprise will speed up the entire warehousing process, and above all, picking. It was checked based on the SMED analysis, where the company loses the most time during the entire warehouse process, from notifying the driver who will come to collect the goods from the warehouse, to its release. Then, appropriate changes were introduced that will improve the process and it will be verified how much time was saved thanks to the introduced changes.

Literature review

Picking is the process of placing orders consisting of various products that will then be transported to recipients. We have two main types of picking: horizontal and vertical. Horizontal involves placing products on the warehouse floor and handling them using simple tools such as wooden or electric pallets. The priority of this method is easy access to goods, therefore they should be arranged in such a way that employees can easily reach the most frequently rotated products. Vertical storage involves arranging goods in rows; access to them is more difficult than in the case of goods stored horizontally. The use of specialized equipment is required, such as forklifts, ladders and lifts (Buda, Sawicka, 2015). We arrange products

along the entire width of pallet racks to maximize storage space. We also have single picking, where each product is placed separately, and collective picking, where the products are placed together in one package. It is important to choose the appropriate picking method that will best meet the needs of a given company and its recipients. The picking of goods in terms of the method of handling products can be divided into several types: manual picking is based on not using any specialized equipment or machines, the available goods are located on the floor, the employee who picks the goods can easily get to the goods; Semi-automatic picking involves performing some tasks using machines such as forklifts to lift or arrange products, move them to a specific place or sort them (Zajac, 2014; Brewer, Speh, 2000). People are responsible for activities such as packing products into packaging or preparing them for shipment. It is most often used where flexibility and adaptation of the process to various types of products or orders are required; In automatic picking, machines are responsible for all activities related to picking: picking goods, arranging and packing them, and shipping orders. The use of this technology, such as industrial robots or sorting machines, makes the entire process very fast and almost error-free. It is most often used in large warehouses, where efficiency and reliability come first. Unfortunately, huge investment outlays are required, but in the long run it can bring very large savings, for example by reducing employee maintenance costs.

Picking is also divided into one-stage and two-stage. One-stage picking, the so-called order picking, is the most common picking model used in warehouses. The picking path is carried out in a "stream" arrangement, which means a unidirectional and alternating arrangement of working aisles (Rostek, Knosala, 2015). During the implementation of single-stage picking, the following organizational assumptions are made: the picking zone is most often located at level "0" of the storage zone and includes goods locations accessible to warehouse employees from the floor level; assortments of individual product groups collected as part of the order are distributed evenly in the picking zone; when locating assortments in the picking zone, the results of the Pareto analysis are taken into account: according to the size of releases, i.e. division into storage technological zones (A, B, C); by editions where location within technological zones (X, Y, Z); the location of the assortments in the picking zone are most often pallet slots for group A goods (most frequently rotating), shelf space for groups B and C (least rotating - group C); picking orders are executed sequentially according to the order of entry (notification), which corresponds to the release (loading) schedule; the basis for completion are system documents corresponding in material terms to the issue document; the picking path in each aisle is unidirectional, and in subsequent aisles the directions will be arranged alternately (Wrzalik, Niedbał, 2022). Two-stage picking, the so-called assortment picking, is a less common picking model used in warehouses (Richards, 2016). The picking path is "mixed": the first level of picking: for group A assortments (zone A) consists of single cycles of picking full load units; for assortments from groups B and C (BC zone) it has a "comb" arrangement, the second level of picking - the picking path has a "stream" pattern (Battini, Calzavara, Persona, Sgarbossa, 2015). During the implementation of two-stage picking, the following basic organizational assumptions are made: goods locations

available to warehouse employees from the floor level; assortments of individual product groups collected as part of the order are distributed evenly in the picking zone; when locating assortments in the picking zone, the results of the Pareto analysis are taken into account, as in the case of single-stage picking; A storage area for the stock intended for replenishing the picking zone is most often located above the picking zone; the location of assortments in the picking zone is most often: pallet slots for group A goods, shelf space for group B and C; picking (first stage of picking) takes place in parallel in two zones: location of assortments of group A and groups B and C. The basis for completion is the system document "Collective Pick-Up List", which corresponds to the material scope of the batch of "Issuance Orders". The picking strategy is the way in which employees will perform the picking process, including decisions regarding the number of orders to be completed in one cycle, the area in which the employee will perform activities, the method of completing picking lists, etc. The aim of the proper selection of the strategy is to increase the efficiency of the process, shorten the time duration and cost reduction. The main strategies are discrete picking, group picking and zone picking (Dzideczek, 2018). Discreet picking involves performing single orders, when an employee can assemble items from only one order in one cycle. This is the simplest strategy and often used in situations where when orders have a large number of items relative to media units. It does not require large time and organizational investments. Order batching is a technique of grouping picking orders that are to be processed simultaneously. The goal is to increase the efficiency and productivity of the picking process by reducing the time it takes for workers to move around and pick items. This process is called group picking or group picking (Szymonik, 2010). However, properly combining and grouping orders can be a difficult task, known as the order batching problem. In some situations, an increase in congestion in the picking zone may result from the use of this strategy. There are many publications in the literature on the problem of improving order picking processes. Some of them recommend using the branch-and-price algorithm for less complicated problems, while others propose the descent approximation algorithm for more complex cases. In one of the articles, De Koster compared two heuristic algorithms: seed algorithms and savings algorithms, to solve the problem of grouping orders. Two ways of moving employees in the picking zone were analyzed: each aisle (S-shape) and the largest gap (Largest gap). Algorithms were compared in terms of the length of picking time, the number of order groups and the ease of their use. After conducting research, the author concluded that each of the analyzed order grouping methods significantly improves order picking processes compared to the FCFS (first-come first-serve) method (Szada-Borzyszkowska, Szada-Borzyszkowski, 2017). Seed algorithms are more efficient when combined with S-shape routing and the use of larger capacity media. In turn, savings algorithms are better used in conjunction with Large gap routing and using small capacity media. Zone picking is a logistics strategy in which the picking zone is divided into several subzones. Each of them is assigned to one or several employees who will only collect products found in this zone. This method of picking shortens the travel time of employees and enables faster finding of products, which contributes to reducing congestion problems. However, it is necessary to perform additional activities, such as

consolidating orders from individual subzones, before they are sent to the customer. A variation of zone picking is a strategy called bucket brigades. In this strategy, the size of the zones is variable and depends on the current performance of the employees. Each of them moves along the shelves, picking up products and following the principle of "pick until the next employee takes over your list, then come back for another one and start filling it out". Generating picking routes determines the sequence of offer locations that a worker will visit to fulfill customer orders and the route between them. A properly selected method can reduce picking time and distance and improve process efficiency (Kudelska, Pawłowski, 2019). There are different methods for generating routes, such as heuristic and optimization methods. The authors developed an algorithm based on graph theory and dynamic programming that allows to find the optimal picking route for a specific picking zone layout. Unfortunately, the implementation of this and other optimization algorithms can be difficult due to the variety of picking zone layouts in warehouses. In addition, routes calculated using optimization methods can be illogical for employees and be ignored. Another problem is the inclusion of congestion in picking aisles, which increases picking time and efficiency. Therefore, heuristic methods are used as an alternative to optimal picking routing methods (Jacyna, Kłodawski, 2019). The most well-known heuristic methods of routing in a warehouse include, m.in, the S-shape method, the return method, the mid-point method, the largest gap method, the combined method and the optimal method.

SMED analysis and implementation of changes

The customer regularly makes notifications at the company where he calls out certain parts of his goods, which he then delivers to his customer. During the first analysis, the client made e-mail notifications, where the forwarder then prepared all the data on a printed packing list, thus confirming the details of the driver who appeared at the office, then placed himself at the ramp and only then was he loaded by the warehouseman. Based on this process, I made an SMED analysis, which presented from start to finish how long specific parts of the warehouse process will last, which will allow drawing conclusions and introducing appropriate changes in subsequent stages. This analysis presents specific stages of the warehouse process during the picking of 33 pallets.

Table 1.*Analysis of the warehouse process*

Name of the work item	Starting point	Ending point	Value expressed in minutes	Additional comments (non-cyclical operations)
1. Preparatory activities	6:00	6:35	35	
Receiving a notification with the details of the driver who will collect the goods and information about what goods he will collect	6:00	6:05	5	
Printing information about the picked up goods	6:05	6:10	5	
Contact the warehouseman to direct him to the office	6:10	6:15	5	
Handing over a card containing information about what goods are to be collected by the warehouseman	6:15	6:35	20	The warehouseman heads to the office within a few minutes depending on whether it is busy or not
2. Goods picking	6:35	7:25	50	
Removing pallets from the shelves to a temporary storage place	6:35	7:25	50	
3. Delivery of the goods	8:00	9:00	60	
Driver arrival (driver goes to the office)	8:00	8:05	5	
Confirmation of data by the forwarder and sending it to a specific ramp	8:05	8:10	5	
The driver enters the ramp x - in the meantime, inform the warehouseman under which ramp the driver is entering	8:10	8:20	10	
Driver loading	8:20	9:00	40	
4. Completion of the process	9:00	9:40	40	
The driver goes to the office to confirm that the goods have been loaded	9:00	9:05	5	
The forwarder checks with the warehouseman whether the goods fit	9:05	9:10	5	
The forwarder is writing an e-mail to the client with information that the goods are loaded, and asks to send documents for the driver	9:10	9:15	5	
The driver is waiting for the documents	9:15	9:30	15	
The forwarder prints the documents and gives it to the driver for signature	9:30	9:35	5	
The driver heads towards the vehicle	9:35	9:40	5	

Source: Own study based on internal company materials.

The SMED analysis in Table 1 showed that the entire process takes 185 minutes. In this whole process, the company wastes a lot of time, especially on preparatory activities, the release of goods and the completion of the process. The goods are not assembled for specific exit ramps, the driver does not insert himself under a specific ramp, he has to confirm his identity in the forwarder's office, and above all, he wastes a lot of time waiting for documents that could have already been prepared if the goods data were visible in the system and the forwarder would be aware that the goods will certainly fit on the means of transport.

Table 2.*The sum of time and the percentage of each step in the process*

Operations	Time [min]	Participation [%]
Preparatory activities	35	19
Goods picking	50	27
Delivery of the goods	60	32
Completion of the process	40	22
Total process execution time	185	100

Source: Own study based on internal company materials.

The customer regularly makes a notification at company XYZ, where he calls out certain parts of his goods, which he then delivers to his customer. During the first analysis, the customer made an e-mail notification, where the forwarder then prepared all the data on a printed packing list, thus confirming the data of the driver who appeared in the office, then inserted himself under the ramp and was only then loaded by the warehouseman. On the basis of this process, I made an SMED analysis, which presented from start to finish how many specific parts of the warehouse process will last, which in the next stages will allow to draw conclusions and introduce appropriate changes. This analysis shows the specific stages of the warehouse process during the picking of 66 pallets.

Table 3.*Warehouse process analysis*

Work item name	Start point	End point	Value in minutes	Additional notes (non-recurring operations)
1. Preparatory activities	10:00	10:35	35	
Receiving a notification with the details of the driver who will collect the goods and information about what goods he will collect	10:00	10:05	5	
Printing information about the picked up goods	10:05	10:10	5	
Contact the warehouseman to direct him to the office	10:10	10:15	5	
Handing over a card containing information about what goods are to be collected by the warehouseman	10:15	10:35	20	The warehouseman goes to the office within a few minutes, depending on whether he is busy or not
2. Picking the goods	10:35	12:00	85	
Removing pallets from the shelves to a temporary storage place	10:35	12:00	85	
3. Release of goods	12:00	13:30	90	
Driver arrival (driver goes to the office)	12:00	12:05	5	
Confirmation of data by the forwarder and sending it to a specific ramp	12:05	12:10	5	
The driver enters the ramp x - in the meantime, inform the warehouseman under which ramp the driver is entering	12:10	12:20	10	
Driver loading	12:20	13:30	70	

Cont. table 3.

4. Completion of the process	13:30	14:15	40	
The driver goes to the office to confirm that the goods have been loaded	13:30	13:35	5	
The forwarder checks with the warehouseman whether the goods fit	13:35	13:40	5	
The forwarder is writing an e-mail to the client with information that the goods are loaded and asks for documents to be sent to the driver	13:40	13:50	5	
The driver is waiting for the documents	13:50	14:05	15	
The forwarder prints the documents and gives it to the driver for signature	14:05	14:10	5	
The driver heads towards the vehicle	14:10	14:15	5	

Source: Own study based on internal company materials.

The SMED analysis in table 3 shows that the entire process takes 255 minutes. Throughout this entire process, the company loses a lot of time, especially on preparatory activities, issuing goods and completing the process. The goods are not picked at specific exit ramps, the driver does not arrive at a specific ramp, he has to confirm his identity at the forwarder's office, and above all, he wastes a lot of time waiting for documents that could have already been prepared if the goods' data were visible in the system and the forwarder would be aware that the goods would definitely fit on the means of transport.

Table 4.

The sum of time and percentage of individual process stages

Operations	Time [min]	Share [%]
Preparatory activities	35	14
Goods picking	85	34
Delivery of the goods	90	36
Completion of the process	40	16
Total process execution time	250	100

Source: Own study based on internal company materials.

In both cases, the entire process took approximately the same time, but in the second case, the completion of goods and their release were longer due to the increase in the number of pallets. Unfortunately, it currently takes a very long time due to the fact that the warehouseman does not have information under which ramp the driver will be loading, so he has to place the completed goods in the temporary storage zone, so it takes longer to transport the goods to the vehicle that takes the goods.

The analysis carried out on the company made us aware of where the greatest time losses are and what needs to be changed to make the entire warehouse process, from the moment of receiving information about the driver picking up the goods to the moment of loading the goods onto the car, more efficient. Table 5 presents the tasks whose implementation will increase the efficiency of the warehouse process.

Table 5.*Record and status of tasks*

Lp	Task description	Completion date	Person responsible	Implementation status
1.	Investment in RFID gates	Until the end of the first quarter of 2023	Management of the company	Completed
2.	Purchase of new scanners for warehouse workers	Until the end of the second quarter of 2023	Management of the company	Completed
3.	Presenting the system to customers and providing them with appropriate instructions on how to use it	By the end of the third quarter of 2023	Logistics specialist Sales specialist	Completed
4.	Introduction notification platforms	By the end of the third quarter of 2023	Branch manager Management of the company	Completed
5.	Starting use EDI by customers	Until the end of the first quarter of 2023	Customers of XYZ company	Completed

Source: Own study based on internal company materials.

Ad. 1-2. To shorten the picking time by warehouse workers, the company's management invests in RFID gates and new scanners. The whole idea of the operation is that the warehouse worker will have a picking path that he must follow and this order will automatically be placed on the scanner. The warehouseman no longer has to go to the office to obtain any papers from the forwarder to know what to collect.

Ad. 3. The contract logistics specialist prepares special instructions for the salesperson, who addresses the customers and presents the new system, provides information that it is free (on our company's side), will streamline the entire process and, above all, will help avoid mistakes during picking, the goods will not get lost, and you will always be sure that the goods will fit in the car.

Ad. 4. The company is setting up a notification platform, which allows the warehouseman to automatically verify the driver's data when he arrives at the ramp. When picking the goods at this point, the warehouseman does not pick the goods into the temporary storage zone, but starts picking them at a specific exit gate.

Ad. 5. Customers start sending notifications to us using EDI through interconnected systems. At this point, when entering the shipment into the system, the contractor provides: the number of pallets called (earlier, when the goods reach us, the goods are covered with RFID stickers), the exact dimensions of the pallets are entered into the system (so there is no need to verify whether the goods will fit on the vehicle), provides data about the driver's car and the data of the driver himself. After entering the shipment, the forwarder only verifies the correctness of all data and transfers it to the warehouseman's scanner, the one who is free at a given moment accepts the "order" and starts picking at a specific ramp (the customer adds in the comments what time the driver is notified and at which ramp he will be stood up), following the picking path determined by the scanner based on the pallets entered via RFID.

After implementing the changes, the accuracy and efficiency of the warehouse increased. The use of information technologies allowed the company to develop, reduce the number of complaints, warehouse workers have easier picking, and customers can easily change the details of the drivers who collect the goods or the number of pallets they would like to pick up. After introducing changes in the described company, the client made a notification in which he requested thirty-three pallets to be loaded onto the means of transport, an SMED analysis was made in table 6, which presented a specific time division of the entire warehouse process.

Table 6.

Analysis of the warehouse process

Name of the work item	Starting point	Ending point	Value expressed in minutes	Additional comments (operations non-cyclical)
1. Preparatory activities	6:00	6:15	15	
The customer enters the shipment with information about the driver and the goods	6:00	6:05	5	
Throwing the parcel to the warehouseman on the scanner, printing documents for the driver	6:05	6:15	5	
Acceptance of the order by the warehouseman	6:15	6:20	5	
2. Picking the goods	6:35	7:15	40	
Removing pallets from racks to the exit gate (BWY))	6:35	7:15	50	
3. Release of goods	8:00	8:30	25	
Driver arrival - data verification by the warehouseman	8:00	8:05	5	
Driver loading	8:05	8:25	20	
4. Completion of the process	8:25	8:35	10	
The driver goes to the office to collect the documents that the forwarder has already prepared	8:25	8:30	5	
The driver heads towards the vehicle	8:30	8:35	5	

Source: Own study based on internal company materials.

After analyzing the data in table 6, you can see how much the warehouse efficiency has improved. The duration of the process shrank from 185 minutes to 95 minutes, with the most time saved during preparatory activities, issuing goods and completing the process. This is due to the fact that the forwarder receives the notification together with the warehouseman for a specific product and sees the driver's details, so the driver does not have to confirm them in the office. The warehouseman picks the goods for a specific ramp, because the driver is notified in advance for a specific time and a specific ramp. Most importantly, the driver does not wait for the documents in the office, but receives them almost immediately, because the customer is obliged to enter the dimensions in the system, which helps avoid sending a vehicle that is too small for loading.

Table 7.*The sum of time and percentage of individual process stages after introducing changes*

Operations	Time [min]	Share [%]
Preparatory activities	15	17
Goods picking	40	44
Delivery of the goods	25	28
Completion of the process	10	11
Total process execution time	90	100

Source: Own study based on internal company materials.

After introducing changes in the described company, the client made a notification in which he requested 66 pallets to be loaded onto the means of transport, an SMED analysis was made in table 8, which presented a specific time division of the entire warehouse process.

Table 8.*Analysis of the warehouse process*

Name of the work item	Starting point	Ending point	Alue expressed in minutes	Additional comments (operations non-cyclical)
1. Preparatory activities	10:00	10:15	15	
Entering the shipment by the customer with information about the driver and cargo	10:00	10:05	5	
Throwing the parcel to the warehouseman on the scanner, printing documents for the driver	10:05	10:10	5	
Acceptance of the order by the warehouseman	10:10	10:15	5	
2. Picking the goods	10:15	11:15	60	
Removing pallets from racks to the exit gate (BWY)	10:15	11:15	60	
3. Release of goods	11:15	12:00	45	
Driver arrival - data verification by the warehouseman	11:15	11:20	5	
Driver loading	11:20	12:00	40	
4. Completion of the process	12:00	12:10	10	
The driver goes to the office to collect the documents that the forwarder has already prepared	12:00	12:05	5	
The driver heads towards the vehicle	12:05	12:10	5	

Source: Own study based on internal company materials.

After the analysis in table 8, you can see how much the warehouse efficiency has improved. The duration of the process shrank from 255 minutes to 130 minutes, the most time was saved during preparatory activities, issuing goods and completing the process. This is due to the fact that the forwarder receives the notification together with the warehouseman for a specific product and sees the driver's details, so the driver does not have to confirm them in the office. The warehouseman picks the goods for a specific ramp, because the driver is notified in advance for a specific time and a specific ramp. Most importantly, the driver does not wait for the documents in the office, but receives them almost immediately, because the customer is obliged to enter the dimensions in the system, which helps avoid sending a vehicle that is too small for loading.

Table 9.*The sum of time and percentage of individual process stages after introducing changes*

Operations	Time [min]	Share [%]
Preparatory activities	15	11
Goods picking	60	46
Delivery of the goods	45	35
Completion of the process	10	8
Total process execution time	130	100

Source: Own study based on internal company materials.

Thanks to this method, we managed to notice where the problems are in the company, why it is losing customers and what should be improved by the company to retain customers and even encourage new customers to use the services. The SMED analysis in the tables above in the first part of the analysis allowed us to notice exactly at which stages of the warehouse process the organization loses the most time. Then, the management itself or with the help of specialists from specific departments planned the introduction of investments, changes and certain solutions to make the entire process even more effective. Thanks to this, in the next part it was verified how these investments influenced the effectiveness. This allowed the entire company to shorten the entire warehouse process by as much as 50%. In the example of the warehouse process, where the customer retrieved 33 pallets, from the moment of notification to the moment of the driver's final departure, it took 185 minutes before the changes were introduced, and after introducing them, it took 90 minutes. The same applies to the process where 66 pallets were developed, the entire process from 250 minutes shrank to 130 minutes.

Conclusions from the SMED analysis and the changes introduced

The introduction of appropriate changes to the company allowed for increasing the efficiency of the organization's warehouse processes. Before the changes introduced, the company wasted a lot of time on completely unnecessary things. Simple solutions, investments and focusing on the warehouse process itself allowed us to show how much time can be saved and customer satisfaction. The first SMED analysis showed us that the preparatory activities themselves and the completion of the process take more time in percentage terms than the release of goods or picking, which is completely unacceptable, they took 19% and 22% respectively, taking a total of 41% of the picking time; where issuing goods took 32% and picking 27%, in the case of issuing 33 pallets for a customer. On the example of another notification, which was sent to the company, this time for 66 pallets, it was noticed that, although preparatory activities and completion of the process (14%; 18%) do not take as much time as picking the goods or issuing the goods (33%; 35%), but the sum of these parts of the process is still very high and a solution had to be found that would allow the organization to save as much of this time as possible. Therefore, the Management Board decided to introduce

several investments and innovative solutions that will shorten the entire warehouse process and increase customer satisfaction with the services that are provided to these customers. RFID gateways were introduced, new scanners were purchased, a connection between the senders' systems and the company was introduced, and a platform for driver notification was introduced.

Thanks to this, the whole process has become much more effective and as a result, it was possible to save over 50% of the time that was previously required for such a process: in the case of 33 pallets we needed 185 minutes, now we need 90 minutes, which gives 95 minutes of time savings – about 51%, if we were talking about a notification, as a result of which 66 pallets are called, The whole process has been shortened from 250 minutes to 130 minutes, which also gives 48% savings. The most important parts of the process on which we wanted to save time were: preparatory activities and the end of the process. With the changes made to 33 pallets, the preparation work previously took 35 minutes and accounted for 19%, now it takes only 20 minutes (17%) – the goal has been achieved. Then, talking about the end of the process, it used to take 40 minutes and it was 22% of the whole process, after making changes it takes 10 minutes and it is only 11% of the process, we were able to save time here – the goal was achieved again. Speaking of the other two parts of the process, i.e. picking the goods and the release of the goods, a great success was also achieved here, these parts took respectively: 50 minutes (27%) and 60 minutes (32%), after the introduction of changes they take: 40 minutes (44%) and 25 minutes (28%) – the percentage result is higher, but the picking itself no longer takes place in place of temporary storage, but directly under the unloading ramp, which significantly reduces the driver's loading time.

After introducing the changes, in the case of processing 66 pallets, the preparatory activities previously took 35 minutes and accounted for 19% of the entire process, now they last only 15 minutes, representing 11% of the entire process - the goal was achieved. Then, talking about the completion of the process, it previously took 40 minutes and constituted 16% of the entire process, after introducing changes it takes 10 minutes and constitutes only 8% of the process, we managed to save here - the goal was achieved again. Talking about the other two parts of the process, i.e. picking the goods and issuing the goods, a great success was also achieved here, these parts took respectively: 85 minutes (34%) and 90 minutes (36%), after introducing changes they took: 60 minutes (46%) and 45 minutes (35%). The percentage result in this case is not that impressive, in reality the time has been saved, the percentage is higher, but it should be noted that, as in the case of picking 33 pallets, the picking is also for a specific exit ramp, and therefore the entire loading time is much shorter, and the percentage itself is a larger percentage, but much smaller of the total process time.

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UNDERSTANDING THE CORRELATION BETWEEN SOCIAL PSYCHOLOGY OF RISK, LEADERSHIP AND A NEWTON'S CRADLE

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Purpose: In today's world many companies feel the need to move especially their leaders from traditional leadership into a more person centered approach, which is clearly defined by Social Psychology of Risk. The pioneering methodology was invented to support personhood, care for ethics and promote an appropriate culture of an organization. The following article explains the fundamentals of Social Psychology of Risk, as well as underlines its definitions about leadership. Material shows original aspects of understanding some of the most important roles humans might take upon themselves not only as leaders, but also as employees in any organization or field of work.

Design/methodology/approach: The paper uses the desk research method of analysis.

Findings: Today's leadership.

Social implications: Many aspire to be great leaders; however, not many are on the pathway of receiving value adding answers regarding the matter.

Originality/value: The article is an original approach to understand some of the most efficient ways to create a great leadership, mostly submerged in the fundamentals of Social Psychology of Risk and that all being explained while using a Newton's cradle and a "jar of time".

Keywords: leadership, leader, Social Psychology of Risk, SpoR, Workspace, Groupspace, Headspace, "jar of time".

Category of the paper: persuasive paper.

1. Introduction

As per Harvard Business Review, "Leadership is the accomplishment of a goal through the direction of human assistants. The person who successfully marshals his (or her) human collaborators to achieve particular ends is a leader. A great leader is one who can do so day after day, and year after year, in a wide variety of circumstances" (Prentice, 2022). However, how to accomplish all the goals and do it consistently seem to be quite frapping ideas since a simple Amazon bookstore search shows 57,136 positions "with the word 'leadership' in the title. Why are there so many leadership books?

- Many people feel free to offer opinions on leadership.
- Readers have many different tastes in leadership books.
- Anyone can publish a leadership book.
- The practice of leadership is constantly evolving.
- There is no limit to the way leadership can be described” (Iarocci, 2020).

Many people are a pure personification of all mentioned above aspects. As vivid readers, writers, published creators of material regarding leadership and experienced leaders many do not want to only manage, or as it was mentioned in the first paragraph of portrayed work “achieve goals,” but build a lasting impression of bettering at least something, if not someone. How to do that? The group head of safety and health at Mondi Group (which is one of the biggest multinational paper and packaging companies) Brian Darlington, created a phrase: “Leadership is time and a simple cup of coffee” (Darlington, 2022). Of course, the coffee does not have to be constant in this equation, as it can be a glass of water or juice; however, something that is non-negotiable is time. While keeping in mind the irreplaceability of mentioned above, more leaders should also understand the pricelessness of relationships. As even though, especially the front-runners do not have to be reminded how precious time can be, sometimes it should be recapped that even the pricelessness of time means nothing, if there are no people to appreciate it enough to be the eternal recipients of proposed leadership. So, what happens when leaders in order to reach a particular goal, give the time for a cup of coffee? One of the simplest answers is: relationships would be built, which is exactly what is at the core of influential leadership, the kind of guidance that really matters and makes the biggest impact.

2. Social Psychology of Risk (SPoR)

That “impact” is what makes up for a base of Social Psychology of Risk (SPoR), which “approaches the realities of fallibility, randomness, entropy and evolution from a foundation of social reality and dialectic. It is through an honesty with social reality that we can best tackle risk” (Long, 2021). Dr Robert Long, the founder of SPoR also defines it as “how decisions are influenced by the presence or perceived presence of others” (Darlington, Long, 2021). An “environment” could be also added to the definition, as people act differently next to their supervisor, when they only think that he or she might be present, or among a group of coworkers who might (and usually have) a valid influence on the individual. When it comes to the evolution of Social Psychology of Risk as an academic discipline, it is graphically illustrated below (Figure 1).

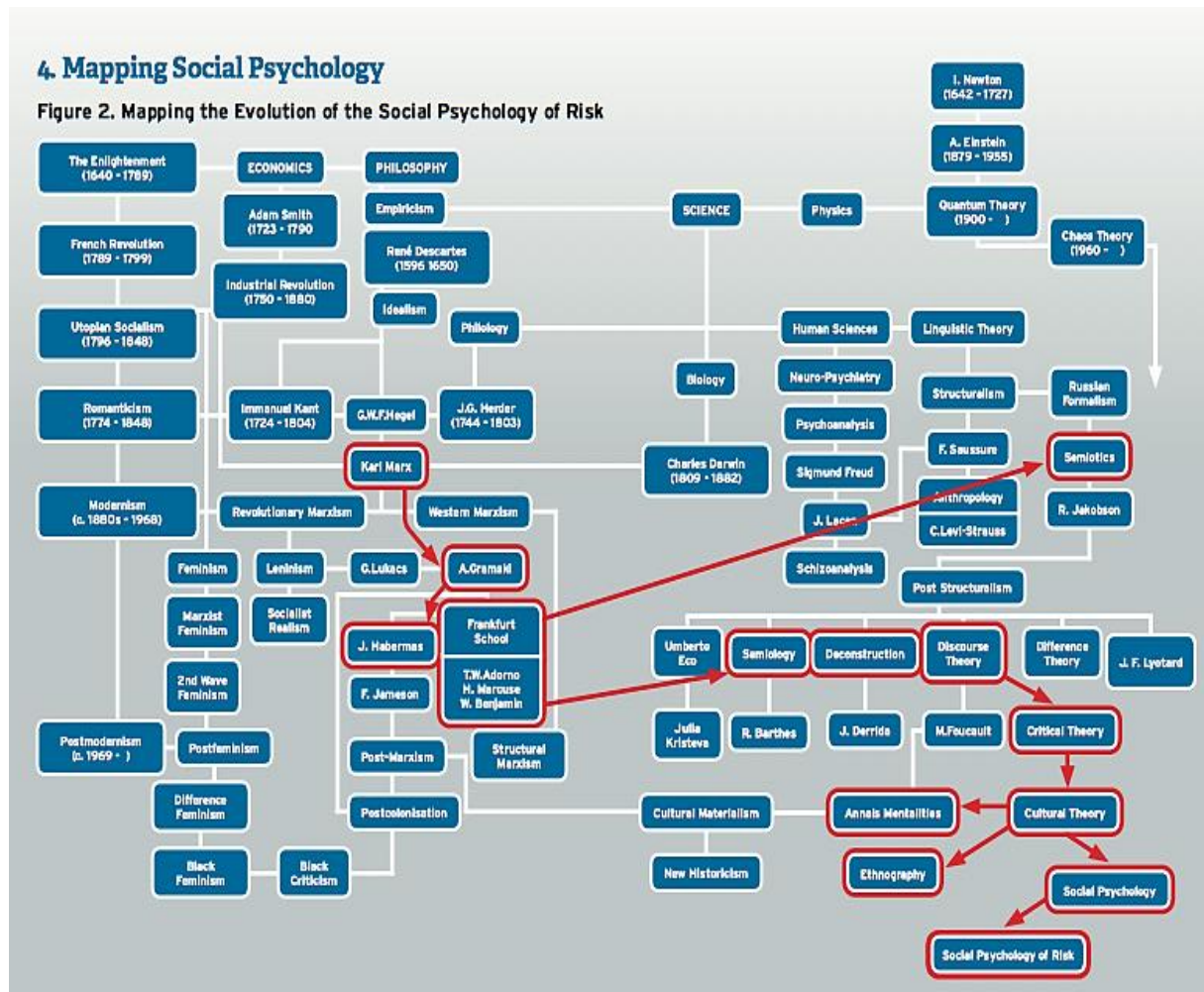


Figure 1. The Evolution of Social Psychology of Risk.

Source: Long, Thorne, 2023.

Proposed above, “graphic maps the territory concerning the development of the Social Psychology of Risk from its roots in The Frankfurt School and the birth of cultural theory. The representative map provides links showing an evolution from post-Marxist thinking through to Semiotics, Critical Theory, Cultural Theory, Ethnography and Social Psychology. In this way the tradition and discipline of Social Psychology can be explained in relation to its roots and in contradistinction to associated human sciences and positivist science. This semiotic map also shows related disciplines and theorists that SPoR anchors to, such as: Soren Kierkegaard, Erich Fromm, Jacques Ellul and Carl Jung who are not named on the map but have roots through existentialist thinking, theology, critical theory, cultural theory, sociology and psychology” (Long, Thorne, 2023).

According to many layers of Social Psychology of Risk a true leadership happens only when people suspend their agenda, bias and authority. Which all happens when they understand that there is a lot that they still do not know and can learn one from another. As follows it all comes down also to understanding the fundamental elements of SPoR, verifying what can and cannot be controlled, being able to understand the various layers of psychological sphere of a human being and being able to notice a culture of a particular group.

3. Critical differences between Social Psychology of Risk approach and any other methodology of leadership

What differs SPoR from other approaches to leadership? There are three critical changes which seem to be incredibly significant, these are: personhood and ethics, socialite and semiotics.

- **Personhood and Ethics:** The starting point for all conversations and methods in tackling any (especially a difficult situation) is, the centrality of persons and making Ethics central to practice. As a matter of fact, it is pointless to say one cares for the safety of others then brutalise them in the process of tackling difficulties. As follows, it is meaningless to say one seeks understanding and then not enact care through helping, but adopting an approach of telling, dominating and oppressing others. This is why the semiotics and language of numbers should be the anathema to humanising leadership. Intolerance is not the social context for listening, helping and learning the right approach towards leadership. The fixation on only numeric and metrics rather than persons is the foundation for dehumanising the workplace. The only idea to humanise the way we tackle the right version of leadership in work is through centralising personhood and ethics, and at least trying to suspend one's agenda and bias.
- **Socialite:** As explained by Dr Thomas Fuchs, in his article titled "Intercorporeality and Interaffectivity" from 2017, "since the rise of cognitive psychology in the early 1970s, 'social cognition' has become the dominant concept in social psychology and cognitive neuroscience to denote the processes of social understanding and empathy. It is commonly based on a representationalist point of view: Internal cognitive mechanisms such as a 'theory of mind' enable observer to 'mentalise' or 'mind-read,' i.e. to infer others' hidden states of mind" (Fuchs, 2017). Later on, in the same article, he mentioned "to begin with, we should abandon the idea that emotions are only 'mental' phenomena, and the world is bare of any affective qualities. The introjection of feelings into an inner 'psyche' is a heritage of Platonic and, later on, Cartesian dualism. In fact, we do not live in a merely physical world; the experienced space around us is always charged with affective qualities. (...) In a sense, emotions are ways of perceiving, namely attending to salient features of a situation, giving them a significance and weight they would not have without emotion" (Fuchs, 2017). How does it all align with SPoR? The central question to SPoR is - how do social arrangements affect human judgment and decision making? SPoR acknowledges the importance of subjectivity in tackling leadership and that most of the leadership is conditioned by context. There is no neutrality or objectivity in how humans as persons understand leadership. SPoR does not understand leadership through systems or humans as factors in systems, but rather takes an ecological view of persons acting in a social manner at work. The idea that one can arrange leadership by making endless lists and checklists of hazards is meaningless. SPoR is focused on subjects, not objects.

- **Semiotics:** Semiotics and Semiosis (the making of meaning and purpose) are foundational to the practice of SPoR. This means that signs, symbols, gestures, rituals, images, graphics, icons, myths (which are symbols), metaphor and any visual language is put into consideration in SPoR. If one wants to understand unconscious decision-making processes, then the study of semiotics is essential. If one wants to communicate to the human unconscious and collective unconscious then, understanding the semiosphere (the symbolic world) is absolutely essential.

4. Finding the Balance

To find the balance with traditionally understood leadership as well as the SPoR, three elements must be explained: Workspace, Headspace and Groupspace (Figure2).

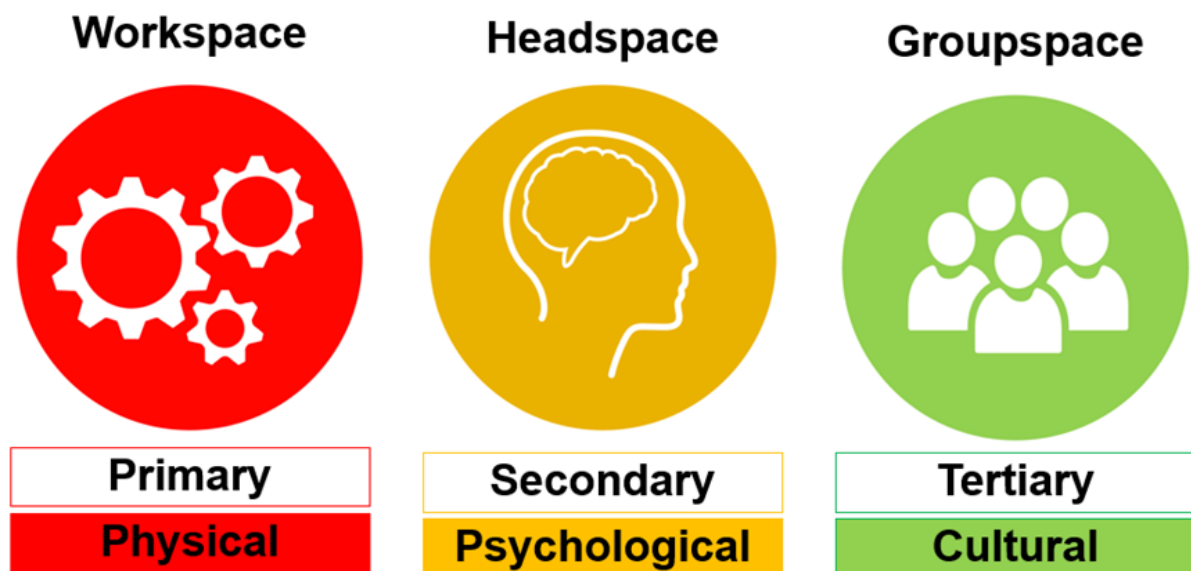


Figure 2. The three fundamentals of Social Psychology of Risk.

Source: Darlington, Long, 2021.

- **Workspace** - elements are the physical controls of the working environment, so much of what happens in leadership management takes its focus on Workspace. It is called the physical or “primary” dimension of leadership. This is easy to administer and regulate, because what is required is visible, measurable and accountable through checklists and metrics matched to regulations. For example, walking around and observing what is physically out of place is relatively easy. Unfortunately, every time people undertake observations, they seem to concentrate on the same things they found the last time. Without ownership, nothing changes and leaders need to make sure that their work does not seem like the “repetition cycle” which does not bring any sensible resolutions.

- Headspace - describes the psychological aspects of every human being regardless of the working position, considers the dynamics of the individuals conscious as well as unconscious driven behaviour. As follows, it concerns all things that happen psychologically that cannot be seen nor measured, but are critical for human well-being and wholeness. All the things like trust, learning, hope, faith, care and understanding required to tackle any kind of work-related situation make up the definition of a Headspace.
- Groupspace - is all that happens between people. All relationships, exchange, interaction, communication, social enactment and culture are lived in Groupspace. Humans are social beings and how they all impact each other consciously and unconsciously and as a collective unconscious matters and impacts the culture of all their environments. Groupspace is represented by cultural aspects of any organization or simply speaking a group of individuals. As follows, it considers the effects of the group conscious as well as unconscious decisions making process.

The last aspect of the definition of the groupspace mentions conscious and unconscious behaviours. Some might ask, why is there a need to focus on both? Simply because “there is an increasing body of evidence that only a minuscule proportion of the sensory data processed by the unconscious mind (capable of processing approximately 11 million bits per second) is referred to the conscious mind (capable of processing approximately 50 bits per second)” (Wiliam, 2006), as portrayed in the illustration below (Figure 3).



Figure 3. A visual comparison of conscious and unconscious minds processing information abilities, proposed by Dr Robert Long.

Source: Long, Thorne, 2023.

When it comes to great leadership it is submerged (but not limited to) in the unconscious, ethics, learning, paradigm, social contract, power, will, resilience and is conveyed by the language and discourse used as presented in the illustration portrayed below (Figure 4).



Figure 4. Dialectical Leadership proposed by Dr Robert Long.

Source: Long, Thorne, 2023.

5. Newton's cradle and SPoR?

When it comes to the fundamentals of Social Psychology of Risk the three elements: the workspace, groupspace and headspace need to work simultaneously and removing any of them would create a chaos. The whole process is best explained using a Newton's cradle which works in the following way, it "is usually a system of five balls attached to a structure by two strings on either side. A ball on one end is lifted, and when it is released, strikes the other four balls. This collision creates a force through the other four balls and causes the ball on the other end to be pushed upward" (Newton's..., 2020). The item is often described as a "desk toy", that "demonstrates the laws of conservation of energy and momentum" (Patel, 2023). The illustrations below, although using the laws of physics, acquired a different role in presented work, as the following page portrays the outcome of a powerful leadership, based on the fundamentals of Social Psychology of Risk.

On the picture below, the inner elements represent the three fundamentals of SPoR, for the demonstration purposes colours were used to represent different aspects of the spaces:

- workspace – red,
- headspace – yellow,
- groupspace – green.
- additionally, the first element of the cradle is purple, symbolizes the leader,
- the last element is blue and characterizes the employee.



Figure 5. Newton's cradle, with marked fundamentals of Social Psychology of Risk in the state of stasis.

The illustration below portrays that the more effort is put into the cradle by the leader, the more outcome is noticeable on the employees' side, meaning the outcome is much better, more vigorous. Of course, the Newton's cradle works the other way as well, meaning the more effort the employees put into their work the more force is felt on the leadership. Therefore, one can be lead into a conclusion that great leaders encourage great employees and the other way around.

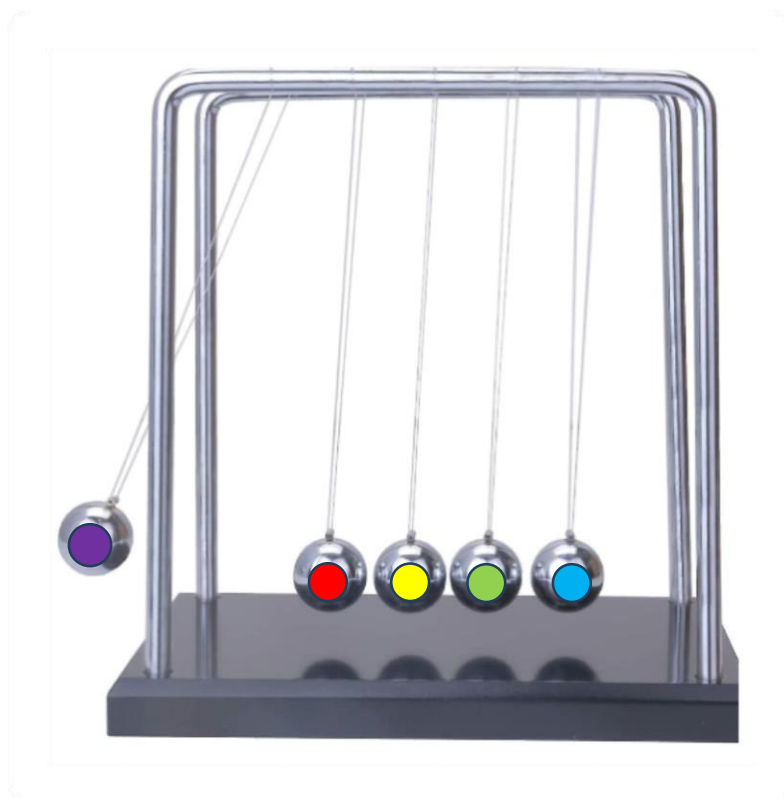


Figure 6. Newton's cradle, with marked fundamentals of Social Psychology of Risk in motion.

When it comes to Social Psychology of Risk, in its core practice is a study which emphasises keeping the balance between all three (inner parts of the cradle). With the same energy and effort all three aspects of mentioned above spheres should be included in any organization which is seriously thinking about implementing SPoR into its organizational culture. In reality (it was not presented as an illustration, as it would be incredibly difficult to capture) the portrayed model can also present what happens when one of the fundamentals is removed. During the practice test, regardless of which sphere was removed, workspace, group space or the headspace, the Newton's cradle did not work. As follows, when the employee or the leader were removed from the test, the cradle also did not work as it should. Additionally, whenever there would be a barrier such as a sticker or a small amount of paint placed between the elements of the cradle, the whole system stopped working, which can be understood as a personification of the idea, that all three elements workspace, group space and headspace must work simultaneously without any barriers between them, as that jeopardizes the whole structure.

There are various experiments available regarding the topic, but one which might deserve attention is exactly the same test as the one described above, but presented in the airtight container which portrayed very interesting results (Figure 7).



Figure 7. Illustration: A Newton's cradle tested in an airtight container (How..., 2018).

The results of the test commenced in the airtight container were exactly the same, which can lead into a conclusion that regardless of what the outside conditions might bring upon an organization, a workplace with the right balance between all elements of SPoR, impactful and receptive leaders and equally as impactful and receptive employees create an appropriate company culture. No, it is not a golden recipe, but definitely - a step in the right direction, that is given that the direction is actually the appropriate one.

6. How to find direction?

How to define the right pathway? Dr Peter Boyd from the “Center for Business and the Environment” at the Yale university lectures the idea how to make space for particular things in a busy schedule. The lecturer proposes so called “jars of time” filled with:

- important visions – rocks,
- pebbles – less important aspects of work,
- and sand – the least important tasks, which do not bring much meaning into an overall, grandiose vision of the organization, but must be completed in everyday routines.

The idea is presented in the illustrations below (Figure 8 and Figure 9).

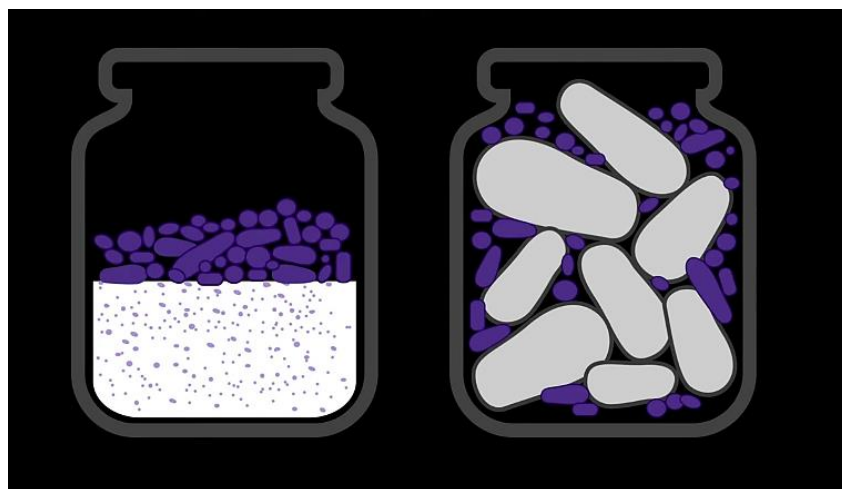


Figure 8. The “jars of time” - one filled with sand and pebbles, the other one with stones and pebbles, as proposed by Dr Peter Boyd.

Source: Ted, 2017.



Figure 9. Two jars of time – both filled with sand, pebbles and rocks, different arrangement makes the pieces fit better into the available space, as proposed by Dr Peter Boyd.

Source: Ted, 2017.

As illustrations propose, if the products are placed in the right order, all of them can be fitted, which is a great reminder to focus on the bigger aspects first. According to Dr Boyd, leaders do not “waste their time on sand” (Ted, 2017), they must have a clear vision of the rocks and work together with the employees on the pebbles, as very often there is an overwhelming amount of them. Some could agree with this illustration or division of the tasks, others could argue that leaders do not have to “waste their time” on the sand only if they have the right people taking care of those aspects of a business. A great leader should also try his or her hardest to never forget about the fact that “sand” exists and sometimes needs attention from the employees. That is why in the ideal organization, people understand their “jars of time”, the principals of their attention dividing process and accept the feedback going, just like in the Newton’s cradle, both ways. Also keeping in mind, the fact that people’s decisions are affected by the conscious and unconscious mind, meaning headspace as they all use the workspace in building a better groupspace.

7. Summary

Understanding semiotics, the power of language used, respecting ethics, at least trying to suspend one’s bias and agenda leads to creation of better leaders. The kind of supervisors who understand others and even if they do not care much about the “sand” in their “jars of time”, they respect the fact that even the meaningless tasks can be someone’s meaningful responsibility; therefore, they should not be taken for granted. The Newton’s cradle is a great explanation of the hierarchy of “impact” of one on to another with the use of the fundamentals of Social Psychology of Risk. As with the quote by Mahatma Gandhi: “You must be the change you want to see in the world” (Soschner, 2024), great leaders should aspire to put so much emphasise to finding the balance between workspace, groupspace and headspace that the Social Psychology of Risk would become a core curriculum for well-organized culture in any organization.

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REALITIES OF EMPLOYEE TRAINING IN SMALL AND LARGE BUSINESSES – SELECTED ASPECTS

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Purpose: The purpose of this discussion is to present selected theoretical and practical solutions for organising the training process. The theoretical considerations focus on a brief review of the literature on the subject. The empirical inquiries, on the other hand, are based on the results of our own research, presenting the training policy practices implemented in both small and large companies, together with an evaluation of this activity from the employee's perspective.

Design/methodology/approach: The study uses a descriptive-empirical approach and the research methods used are induction, deduction, literature studies, as well as a survey and data analysis.

Findings: empirical research indicates that the substantive sophistication of employee training and the involvement of employers in the organisation of this training differs between small and large companies. Furthermore, training policies, from the perspective of the employees of these companies, are not sufficiently developed.

Research limitations/implications: Due to the size of the research sample and the scope of the analyses carried out, the results obtained cannot be conclusive. Therefore, future research directions should focus on further and extended exploration of the issue. It would be worthwhile to include both small and large operators in order to gain valuable insights and help develop more comprehensive solutions

Practical implications: The results of the survey are a key element in assessing the sophistication and commitment of entrepreneurs in organising training projects. Through their analysis, possible differences in this matter depending on the size of the entity can be identified, thus giving suggestions for business practice.

Social implications: Building awareness of the nature and specificity of the training process as part of knowledge and skills support.

Originality/value: The research carried out is crucial for understanding the issues related to employee training in a small and large company, and can therefore be of cognitive value to all those who are interested in this topic in the context of their professional work.

Keywords: training, training process, small and large enterprise.

Category of the paper: research paper.

1. Introduction

The company's value objectives, strategy and structure should be integrated with all areas of human resource management. Indeed, coherence between these elements is the key to successfully managing a modern organisation to cope with changing market and technological conditions. The changes in question, such as increasing globalisation, the knowledge-driven economy and computerisation or the ageing of society, have significantly contributed to the growing importance of training in organisations (Warwas, Rogozińska-Pawelczyk, 2016, p. 67). At the same time, EU funding and the growing number of training companies have increased the availability of educational services in Poland. All these factors have influenced and seem to still influence the development and quality of training projects in different contexts. It is worth emphasising that investing in employee development is not only a benefit for the organisation itself, but also for the employees themselves. Experience and research indicate that awareness of training among employers, managers and employees themselves is increasing. Nevertheless, training projects often fail to meet their expectations. A. Różański notes that the problem lies with entrepreneurs, who do not pay adequate attention to a comprehensive study of training needs. They often limit themselves to delivering 'trendy' and 'bargain' courses. Based on his own research, he concludes that only one in five companies uses professional needs analysis tools in the process of selecting training courses for employees, and in one in ten a full evaluation of learning outcomes was conducted (Różański, 2012, p. 76). It seems that the problem is not only the awareness of the need to educate subordinates, but also the adaptation of training to the current needs of the company and its employees. Without a clarified vision and clear objectives, even the most elaborate training can prove ineffective. A vision provides the foundation on which effective development programmes can be built, while matching training activities to the current needs of the employees and the company is crucial, and understanding the objectives and specific expectations allows the content and methodology of training to be adapted, resulting in better results and efficiency. Therefore, those responsible for training policy in a company should start by identifying, considering what path will be good for both the employee and the company as a whole, before embarking on any improvement activities for their employees. Discrepancies between an employee's development goals and those of the company are a common occurrence. It is important to manage these differences in a constructive manner. It is obvious that on the road to improvement, employers or managers will encounter obstacles, mistakes and shortcomings, but it is important to learn lessons and make better decisions. M. Sasin aptly observes that mistakes are an integral part of the process of acquiring knowledge and experience. It is through making mistakes that we learn, develop our skills and gain competence (Sasin, 2018, pp. 319-321).

The attention paid to the issue of employee training has resulted in a growing interest in the subject, both in the reflections of theorists and in practical management processes, illustrating its state of permanent development and a kind of trajectory of transition to a mature phase. Hence, training issues are considered in different contexts, both in foreign literature (e.g. Pérez-Bustamante Ilander et al., 2016, pp. 234-250; Nai-Wen, Chih-Yun, Yeh-Yun Lin, 2008, pp. 1962-1975; Görlitz, 2011, pp. 691-701; Ada et al., 2023, pp. 1-14) and domestic literature (e.g. Różanski, 2012, pp. 72-76; Pauli, 2014, pp. 123-194; Gonera, 2016, pp. 12-39; Buś-Bidas 2016, pp. 37-54). The idea of training is not new, but the sophistication of the content and the involvement of entrepreneurs in the process itself is an important variable that modifies practical solutions. The literature review confirms the cognitive gap in the presented topic in relation to small and large enterprises. The motive of the author of this paper to take up the issue of employee training in a group of small and large enterprises was the desire to raise the profile of the signposted topic presented from the perspective of the employees of these enterprises. This is important in the context of constantly deepening knowledge and increasing awareness of entrepreneurs and subordinates, as well as drawing attention to the fact that, regardless of the size of the company, both the staff must be aware of their development needs, and entrepreneurs must see that personalised approach to training is now not only an option, but a necessity.

2. Basic definitions

The word 'training' has an interesting etymology. This is because it derives from the Russian word 'школить', which means 'to train'. During the Partition period, trainers used the term to refer to a training process whose main purpose was to impart knowledge to people who were to perform simple activities in factories that did not require theoretical preparation (Szkolenia..., 2024). Nowadays, training is interpreted as a complex method of improving qualifications from the borderline of management, psychology and pedagogy (Laguna, Fortuna, 2011, p. 9). In Poland, the availability of publications on strictly training is limited. Nevertheless, the literature on human resource management (HRM) is wide and varied, and many of these items also discuss the topic of training. In reviewing this literature, it is noticeable that there is a great diversity in the definition of the key term, which limits the framing of effective organisational practices. According to Wisniewski, this diversity in interpretation may be due to issues of topicalist or forward-looking attitudes, consideration of different audiences, and separation or combination of training and improvement (Wiśniewski, 2004, p. 174). The topicalist stance focuses on the current needs of the organisation and employees and therefore training is tailored to current challenges and goals. In contrast, a forward-looking approach considers the long-term goals of the organisation and the

development of employees, and training is strategic and focused on future needs. Considering different audiences, we look at the context and relevance of training in relation to the needs of different groups of employees, such as managers, professionals or new recruits. Separating training from improvement means treating training as a separate area, independent of other staff development processes. On the other hand, combining training with improvement, e.g. with mentoring, coaching, allows for a holistic approach to employee development.

However, without entering into an in-depth discussion of the ways in which the concept is defined, it is important to point out the two main definitional streams operating in both domestic and foreign literature (Table 1). Initially, training was understood as the apprenticeship of employees to perform specific tasks. This current includes the definition proposed by M. Armstrong. According to the author, training is a systematic and planned process of modifying and improving the knowledge, experience and skills of employees in order to achieve significantly better results on the job (Armstrong, 2000, p. 448). However, there has been a rapid updating of this approach, since, as researchers - including A. Pocztowski - agree, training is a series of systematic and purposeful activities of an organisation to deepen and broaden an employee's potential to meet not only current, but also future needs of the company (Pocztowski, 1996, p. 26). Additionally, M. Kostera emphasises that training supplements an employee's knowledge, skills and competencies necessary for his or her promotion (Kostera, 1999, p. 47).

Table 1.
Selected definitions of training

Author	Definition
First definitional approach - training the employee for specific tasks	Training is teaching technical workers the methods of doing things at the jobs where they do their work - vocational courses (J.A.F. Stoner, R.E. Freeman, D.R. Gilbert)
	Training is a short-term activity that is educational in nature and its purpose is to develop in a given employee the knowledge and skills necessary for the requirements of the chosen position (J.W. Rothwell)
	Training is a planned process by which knowledge is enhanced, resulting in a more effective performance of an activity or range of activities (J.P. Wilson)
A second definitional approach - developing employee potential in the context of business needs	Training is a planned process of changing the way of acting/behaviour of a specific group of employees, built on the basis of supplementing - related to the change - the competence deficit in the attitudes, knowledge and skills of people, giving identifiable business benefits in the company (P. Kopijer)
	The training of employees is aimed at both maintaining and increasing the efficiency of the work currently carried out, helping them to develop their capabilities, to adapt to new working methods, organisational solutions, but also to adapt to new work content (J. Penc)
	Training is the broadening of already acquired qualifications, knowledge (and its consolidation) and the acquisition of new skills associated, for example, with company crises. Employee development is, in other words, employee improvement, i.e. the creation of initiatives, entrepreneurship, innovation, the acquisition of values, culture, identification with the company or broadening of intellectual horizons (L. Zbiegień-Maciąg)

Source: own elaboration based on (Stoner, Freeman, Gilbert, p. 378; Rothwell, 2008, p. 172; Wilson, 2005, pp. 4-5; Kopijer, 2020, p. 15; Pec, 2006, p. 207; Zbiegień-Maciąg, 1996, pp. 87-88).

3. Organisation, methods and techniques of training

Continuous development and systematic training are crucial to the effective functioning of any organisation and the development of each employee. Employee training is not just a learning event, but also a certain process, involving a whole series of activities to increase the level of knowledge, competences and skills possessed. Many researchers and practitioners analyse different aspects of this process. A. Andrzejczak, in her research, draws attention to the training process in the context of its relationship with the organisation's flexibility towards change. In her view, some organisations respond to change in an uncontrolled and spontaneous manner. This means that only when change is inevitable do they take any action. Other organisations try to anticipate change and prepare for it in advance (a proactive approach). They strive to continuously develop the competences of employees so that they are ready for new challenges. Some companies systematically adapt to change, but do not necessarily try to anticipate it in advance. Their approach is more reactive. A. Andrzejczak also states that as organisations mature, their approach to training and employee development is changing. More and more companies are becoming proactive, investing in human resource development as a long-term strategy (Andrzejczak, 2010, p. 93).

Most of the training processes and the activities undertaken within them, as described in the literature, are similar, and the basic criterion for distinguishing them seems to be the number of stages in the process of organising them. The first group of authors, which can include P. Bramley and M. Kostera, divides the organisation of the training process into three stages. According to P. Bramley, stage 1 is the organisational stage, providing support to the participants before the course, stage 2 is the educational stage, whose task is to support the participants during the training and stage 3 is, according to the author, the diffusion stage, giving support to the trainees to make changes in the workplace (Bramley, 2007, cited in: Buś-Bidas, 2016, p. 38). On the other hand, following M. Kostera, the process of personnel training and development includes in stage 1 the identification of individual and organisational needs, in stage 2 deciding on the form, methods and level of training and in stage 3 evaluating the effectiveness of activities (Kostera, 1999, p. 110).

The second group of authors, represented by M. Armstrong and A. Pocztowski, among others, detail 4 stages in the process of organising training. According to M. Armstrong, the classical training process includes: analysis of training needs, design of a training plan, implementation of training using professional trainers and training institutions, and evaluation of the conducted training to ensure that it was effective (Armstrong, 2005, p. 499). A similar approach to the topic is also represented by A. Pocztowski. His cycle of systematic learning includes: the identification of training needs over a planned period, the development of mandatory and optional training plans, the implementation of planned training, and the evaluation of the training and its effects (Pocztowski, 1998, p. 226).

The third group includes authors who prefer more elaborate models. This group can include the 5-stage model proposed by K. Gonera (Gonera, 2016, pp. 33-34), or the model developed by A.D. Kirkpatrick, which includes as many as ten stages of the training process (Kirkpatrick, 2001, cited in: Buś-Bidas, 2016, p. 38).

In the employee training literature there are two terms: training method and training technique, and despite significant differences in terms of level of generality (method is more general and technique is more specific), application (method is applicable in different areas and technique is applicable in a specific area), or dependency (technique can be part of a larger method), these terms are often used interchangeably (Czym się różni..., 2024), and the literature provides examples in this regard. Thus, for example, A. Dolot divides training methods and techniques into 3 groups: 1 group includes those conducted at the workplace (e.g., role modeling, on-the-job instruction, or mentoring), 2 group includes those conducted outside the workplace (e.g., lectures, case studies, simulations, or workshops), and 3 group includes universal methods and techniques (e.g., coaching, action learning, or self-study) (Dolot, 2019, pp. 245-259). In turn, adopting after B. Czerniachowicz, training methods and techniques can be divided according to 4 basic criteria. The first criterion, due to the way participants learn, distinguishes passive (e.g. participation in a conference, or lectures) and active (e.g. games and simulations, or case studies) methods and techniques. The second criterion is a division according to the composition of the participants, which distinguishes between individual methods and techniques (e.g. conferences, staging or outdoor training) and group methods and techniques (e.g. conferences, training programmes or staging). A third approach due to the place of training distinguishes between those carried out on the job (e.g. apprenticeships, mentoring and coaching) and off the job (e.g. lectures, conferences and stimulations). The last criterion with regard to the mode and manner of knowledge transfer distinguishes information and training methods and techniques (Golnau, 2004, p. 353, cited in: Czerniachowicz, 2010, pp. 187-190).

4. The training process and its specifics in a large company – the employee's perspective

4.1. Description of the survey

In October 2017, one of the companies, based in the territory of the Silesian Voivodeship, approached the author of this study with a proposal to establish cooperation in the provision of research services. The purpose of this cooperation was to conduct a survey, the results of which were to serve the managers of the entity to acquire key knowledge in the field of proper management and monitoring of training activities implemented in the company with a particular focus on learning the opinions of the employees of this organisation in the context of the

diagnosis of the quality and effectiveness of personnel development activities undertaken by the company. Thanks to the initiative of the HR director, the company received a very large grant for the development and further training of its subordinates. However, during the course of the project there were numerous problems related to the reluctance of staff to participate in training. The lack of staff involvement surprised management, who wondered what could be the reason for this. Sometimes staff are not interested in participating in training, which could be due to various factors such as lack of motivation, the belief that training is not relevant to them or lack of time. Or perhaps they were not interested in training because they were overworked or it was poorly organised in terms of timing, location or availability? In order to help the company, the author decided to work with the company and her main objective was to find out the opinions of the staff in the above-mentioned area. The research used a diagnostic survey method with the survey technique, and the survey questionnaire became the basic research tool, which is a good tool for collecting opinions in a very short time. This tool also proves to be very effective, especially when the company employs many people and shows a dispersed location. The population of the survey was all employees of the company, i.e. 780 people, including 78 managers and 702 employees. The sample in this study was 100 people, including 10 managers and 90 employees. Non-random purposive sampling, which involves the purposeful selection of individuals into a sample so that they fully reflect the characteristics of a given collectivity (Garbarski, Rutkowski, Wrzosek, 2000, p. 213), was used to select the sample, and the entire process of the survey was managed by the HR director of the surveyed company, who distributed questionnaires to the surveyed respondents. Table 2 contains the full characteristics of the population of surveyed respondents.

Table 2.

Characteristics of the population of respondents surveyed

Synthetic criterion	Elementary criterion	Results % total	Results % manager	Results % employee
Gender	Woman	38%	30%	39%
	Male	62%	70%	61%
Age	18-31	15%	10%	16%
	31-41	41%	60%	39%
	41-51	41%	30%	42%
	Over 51	3%	0%	3%
Education	Basic	9%	0%	10%
	Professional	37%	0%	41%
	Medium	43%	20%	46%
	Higher	11%	80%	3%
Length of service	Up to 2 years	3%	0%	3%
	2-5	17%	0%	19%
	6-10	42%	20%	45%
	11 and over	38%	80%	33%

Source: own elaboration.

4.2. Selected results of the quantitative survey

The presented research results are divided into 3 thematic blocks, which synthetically present selected results of our own research.

Block 1 – Organisational aspects of training and respondents' attitudes towards them

- Based on the answers given by the respondents, it should be noted that training is organised in the company, but only 46% of the surveyed respondents participated in it. Comparing the answers of managers and employees, it should be noted that all managers, unlike the employee group, have participated in organised training. In the case of employees, more people did not participate than attended training (yes - 40%, no - 60%).
- When it comes to the frequency of training, according to those surveyed, training is most often provided several times a year (80%) and once every few years (53%). The survey shows that the answer once every few years was mostly given by employees, while managers considered that their training takes place several times a year. It is clear from these figures that managers are trained more often than employees.
- Valuable training programmes are crucial for the development of the organisation and the retention of employees, so it seems important to assess the respondents' evaluation of the organisation of the training process. Analysing the data collected, it was noted that the majority of employees have a negative assessment of the training process and its organisation in the company (65%). Only 24% of respondents show satisfaction. Both managers (70%) and employees (64%) are dissatisfied.
- By examining the respondents' attitudes to organised training in the company, it should be emphasised that 74% of the respondents feel a very high and high need to improve their professional qualifications, which results in their willingness to participate in organised training (98%). In the group of managers, as many as 80% of them want to improve their qualifications and all declare their willingness to participate in training projects. In the group of employees, on the other hand, 72% of them want to train and as many as 98% of them do so very willingly.

Block 2 - Preferences for subject matter, location, duration and training techniques

- 95% of all respondents want their opinion to be taken into account when selecting training courses. 100% of managers and 95% of employees agree with this statement.
- Willingness to choose training topics themselves is declared by 68% of respondents, including 80% of managers and 67% of employees.
- 53% of respondents prefer training to take place in the workplace, 41% indicated that training should be organised in dedicated institutions and 6% of respondents gave their own suggestions. It was noted that employees prefer training to take place in the

workplace (58%), which may mean that they feel safer in their everyday environment. Managers, on the other hand, felt that training should be in a dedicated institution (50%). Among their own suggestions for the location of employee training, 66% of respondents indicated that the location of the training could be outside the workplace, but in close proximity to the workplace. Such a location could, according to respondents, combine convenience with time savings. 34% of respondents noted that the choice of location depends on the type and subject matter of the training, as not all training can be conducted on site and some may require special conditions.

- Respondents have a clear preference for training during working hours (98%). All surveyed managers and 98% of employees prefer to learn during working hours.
- Survey results indicate a diversity of preferences for training methods and techniques. The results of the surveys are presented in Table 3.

Table 3.

Preferred training methods and techniques

Training methods and techniques used in the company	Manager	Employees	Total
Audiovisual methods	19%	28%	27%
Videoconference	0%	2%	2%
Simulations	16%	13%	14%
Games and case studies	16%	24%	22%
Team-building techniques	6%	9%	9%
Coaching	25%	13%	15%
Mentoring	6%	1%	1%
Learning through adventure	9%	10%	10%
Other	3%	0%	0%

Source: own elaboration.

Block 3 - Performance evaluation

- When analysing the results of the survey regarding the evaluation of the usefulness of the organised training, it was found that they are varied. 55% of the respondents believe that they actually use the knowledge acquired during the training courses in their current work. 32% of respondents showed dissatisfaction. In the group of managers, only 40% of the respondents rated the usefulness of the training positively, which may be due to the different expectations and needs of this professional group. Employees, on the other hand, show more satisfaction in this matter (58% of positive evaluations).
- In the opinion of the respondents, after the training, the employer does not verify their knowledge after the training (88%), no detailed analyses are carried out (e.g. whether the intended effects were achieved, whether the employees need further training, etc.). - the options "rather not" (49%) and "no" (22%) dominate in the responses. The same opinion is held by both managers and employees of the company.

5. The training process and its specifics in a small company - the employee's perspective

5.1. Description of the survey

The research, which aimed to provide an insight into the training policy practices implemented by small operators in Poland, was carried out in 2023 with a quantitative method, using a survey questionnaire as the measurement tool. Employees of beauty salons in Poland were surveyed, and the salons themselves were searched using the Google search engine (after entering the criterion 'beauty salon <name of city>'). The survey questionnaire was developed jointly with Roksana Habrzyk as part of her own work, and the link to the survey was sent to the mailboxes of beauty salons in Poland, as well as made available via the Internet. The survey involved 120 respondents - employees of beauty salons in Poland. The respondents were predominantly women (98.2%), aged between 30 and 44 years (54.2%), with a cosmetology degree (58%), working in micro entities with up to 5 employees (62.7%). Table 1 contains the full characteristics of the respondents' collective.

Table 4.
Characteristics of the population of respondents surveyed

Synthetic criterion	Elementary criterion	Results in percentage terms
Gender	Woman	98,2%
	Husband	1,8%
Age	18-29	30%
	30-44	54,2%
	45-59	15%
	Over 60	0,8%
	Other	0,8%
Education	Basic vocational school - beautician	1.7%
	Secondary vocational school - beauty services technician	37%
	Higher education - cosmetology	58%
	Preparation courses	2,5%
	I am self-taught	0%
	Other: secondary education and further education courses	0,8%
Employment	Less than 5 people	62.7%
	From 5 to 10 persons	31.4%
	Over 10 persons	5,9%

Source: own elaboration based on (Habrzyk, Dudzik-Lewicka, 2023, pp. 72-75).

5.2. Selected results of the quantitative survey

Block 1 - Organisational aspects of training and respondents' attitudes towards them

- The results of a survey of employees of small businesses show that employers are investing in the development of their employees through training. 81% of respondents confirmed that training is implemented in their workplace. In contrast, 11% said that no such practice exists in their workplace. The remaining 8% did not express a clear opinion on the subject.
- For the question "Does your employer care about your development?" the most common answer given by respondents was "yes" (48%). The other half of respondents split into two groups: 22% said that the employer does not care about their development and 30% had no clear opinion on the subject. It is noteworthy that such a large group of employees are not sure whether their employer invests in their development. It also appears that those with a university degree are more appreciative of their employer's efforts in terms of professional development, with as many as 35% feeling that their employer cares about their development.
- The evaluation of the level of organisation of training projects in the workplace is as follows: 43.5% of respondents rated the level of organisation of training as "neither good nor bad", 32.5% of respondents thought the level was good, 20% of people rated the implementation of training projects bad or very bad and only 4% of respondents gave a very good rating.
- In examining respondents' attitudes towards training, it was noted that 47% of respondents take part in training to fill their gaps, 28% always take part in all training organised, 20% of respondents only take part in training that is compulsory and only 5% responded that they do not take part in training at all.

Block 2 - Preferences for subject matter, location and training techniques

- For the question "Does the employer talk to employees about their training needs when planning the delivery of training?" the most common answer given by respondents was "rather yes" (38%). 30% said that the employer "rather not" has such discussions, 13% of the respondents indicated that the employer "definitely yes" engages in these discussions, also 13% of the respondents answered that the employer "definitely no" discusses the subject with them, and only 5% said that they had no clear opinion on the subject.
- 85% of respondents prefer in-house training. This may be due to the availability of such training, as well as the benefits of tailoring the content to the specific company and team. 10% indicated that they prefer training organised outside the company.

This in turn may be related to the search for diverse sources of knowledge and experience. 5% of respondents were not clear on this.

- The results of the survey indicate a diversity of approaches to training in small enterprises in terms of preferred training methods and techniques and frequency of use. The data are presented in Table 5.

Table 5.

Training methods and techniques, including their frequency of application

Training methods and techniques used in the company	Permanently (%)	Very frequently (%)	Often (%)	Sometimes (%)	Never (%)
Experiments	11	4	17,5	30	37,5
Lectures and demonstrations	44	32,5	17,5	5	1
Practical activities	65	20	11	3	1
Training based on case studies	1	1	1,5	14	82,5
Mentoring	1	12,5	21	37,5	28
Coaching	0	1,5	9	43	46
Instruction of the person responsible for implementing the skills	37,5	33	20	7	2,5
Trial and error method	0	0	3	17	80
Modeling on colleagues	16	50	24	6,5	3

Source: own graphic design based on (Habrzyk, Dudzik-Lewicka, 2023, p. 90).

Block 3 - Performance evaluation

- The vast majority of respondents believe that the training provided contributes to the development of professional skills and competences. As many as 55% expressed this opinion and an additional 17% said this was definitely true. 14.5% of respondents believe that the organised training does not contribute to their professional development and 13.5% had no opinion on the subject.
- 88% of respondents noted that the knowledge of trainees is not verified after the training. On the other hand, 32% of respondents indicated that knowledge is verified, but only 12 respondents stated how exactly this is done. The most common responses from respondents regarding verification of knowledge after training include: performing treatments on colleagues and/or employers and observing the number of clients signed up for a particular treatment and to a particular beautician.
- The majority of the beauty salons in which the respondents work - after the training - rather not (48%) or definitely not (23%) any analysis is carried out on what objectives have been achieved, whether the employees need further training, whether the intended effects have been realised. Only 12.5% of respondents hold the opposite view.

6. Summary

The research investigations carried out confirmed that the sophistication in the exploration of employee training issues and the level of involvement in their organisation on the part of small and large employers varies. The training policy from the perspective of the employees of these companies is not sufficiently developed, and the most important findings of the research include:

- in terms of improving their professional qualifications, the surveyed employees of both small and large companies show great interest in this matter,
- it is noticeable in the aspect of organising training and investing in employee development that a large group of surveyed employees of small companies are not sure whether their employer invests in their development - this may be an important area for further research, while in a large company managers are more willing and more likely to participate in training,
- it seems that people with higher education appreciate employers' efforts in terms of professional development more - this trend is noticeable in both research subjects,
- the company's policy on employee training is met with a great deal of dissatisfaction on the part of the employees of a large company, in the case of small companies - their employees - are not able to clearly assess their employer's activities in this regard, which may indicate that their knowledge of the training process is poor,
- training projects too rarely take into account the individual needs and preferences of employees, which means that a personalised approach to training is not a priority for employers of both small and large companies,
- employees of small companies strongly prefer on-the-job training, while employees of large companies show different opinions on the matter depending on their position - managers prefer training outside the organisation, while employees are in favour of on-the-job training,
- small cosmetics operators prefer training of a purely practical nature, large companies tend to use a variety of training methods and techniques in the learning process, best suited to the situation,
- employees of a large company, especially managers, express greater dissatisfaction in their assessment of the usefulness of the training provided,
- irrespective of the size of the company, they do not verify the effects of the training, they do not carry out any analysis of what objectives have been achieved, whether the employees require further training or whether the intended effects have been realised.

The presented conclusions cannot be generalised on a nationwide scale due to the lack of a representative research sample. Nevertheless, the presented research material exposes interesting problems appearing in the context of relatively low activity in the implementation of the full training process, therefore - in the author's opinion - the conducted research implies the possibility of both continuing and broadening the undertaken issues in the future.

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REVIEW OF STRATEGIC MANAGEMENT METHODS FOR THE PURPOSES OF DEVELOPING A MODEL OF ORGANISATION CONTEXT ANALYSIS AS PER THE REQUIREMENTS OF ISO 9001:2015

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Purpose: The aim of this publication is to build a comprehensive model for determining organisation context as required by the standard ISO 9001:2015.

Design/methodology/approach: The starting point was to analyse the literature using the method of systematic review described in the first part of a series of articles. It identified proposed analysis methods and techniques for determining organisation context. The next step in the research procedure led to a comprehensive model for organisation context analysis using these methods.

Findings: The analysis of the organisation's context in the strategic management perspective focuses mainly on methods such as SWOT analysis and PEST analysis (sometimes extended by extracting additional factors for PESTEL analysis). The quality management perspective focuses on identifying customer requirements and substantiating stakeholders' needs. In contrast, the integrated perspective involves combining strategic and qualitative management methods for a comprehensive analysis of the organisation's context.

Originality/value: The research provides knowledge on designing the process of organisation context analysis for the requirements of ISO 9001:2015. It contributes to the development of a proprietary model for organisation context analysis using the methods identified in the course of the systematic literature review process. Not only will the use of the model help meet the requirements of ISO 9001:2015 at a minimum level, but it will also enable organisations to properly prepare for market operations and improve skills to respond to changes in the environment.

Keywords: context of organisation, method, technique, ISO 9001:2015.

Category of the paper: Literature review, conceptual article.

1. Introduction

Each scientific discipline uses numerous research methods to solve scientific problems. As noted by H. Dźwigoł, changes in and the development of research methods and techniques have been observed in recent years (Dźwigoł, 2015). Frequently, various classifications and definitions of the concepts of research method and technique are found in the literature. Some authors classify a procedure as a method, while others consider it a technique. The distinction between method and technique is often unclear. It is assumed that a method is more general than a technique, but the distinction is intuitive. Z. Martyniak believes that a method characterised by a high degree of specific details amounts to a technique or procedure (Martyniak, 1999). Some authors emphasise that it is of lesser importance whether a set of rules is called a method or a technique because it is most important to use it in a proper manner and as per requirements (Czechowska et al., 2016).

The concepts of method and technique are definitely more often explained in the context of scientific research than methods of organisation and management. According to J. Such, a method is a systematic research mode that determines the successive stages of a procedure and is characterised by a conscious *modus operandi* that can be repeated in each case of the same type – a mode of solving problems and a set of activities and measures applied in a specific manner for a given cognitive objective (Such, 1969). This view is shared by Z. Mikołajczyk, who adds that a specific manner of acting should be used multiple times, whereas research results should be used to verify the adopted hypotheses and to construct ‘theoretical generalisations’ (Mikołajczyk, 1995).

W. Czakon perceives a research method as a ‘composition and arrangement of stages in the research procedure repeatable in examining a specific class of problems due to its efficiency’ (Czakon, 2020). A method may also be defined as a manner of research procedure involving the examination of objects and phenomena in accordance with specific rules (Matwiejczuk, 2009). M. Łobocki understands a research method as a system of rules or a series of cognitive and practical operations, the order of their application and special measures and actions aimed at a pre-defined research objective (Łobocki, 1982). Research methods are used both to solve theoretical problems (scientific method) and practical problems (practical method) (Lisiński, Szarucki, 2020).

A research technique is a narrower concept than a research method. Research techniques are used to gather the necessary data, and their proper selection depends on the research method, research problem and hypothesis being applied (Kamiński, 1970). As pointed out by Z. Mikołajczyk, ‘techniques are subordinated to a procedure used in a given method’ (Mikołajczyk, 1995). A research technique is defined as a specific manner and skill of using selected research methods, activities or operations which have an influence on learning about properties of the research subject (Nachmias, Frankfort-Nachmias, 2001). Research techniques

include available tools, measures, skills and procedures used to empirically examine methodological assumptions in scientific work (Krzykała, 2001). T. Pilch and T. Wujek point out that a research technique is an action, while an object/instrument used in technical data collection is defined as a research tool (Pilch, 1998).

2. Research Method

The method of systematic literature review was the basis of this research. The procedure was based on methodological guidelines suggested by W. Czakon (Czakon, 2011) and H. Snyder (Snyder, 2019). The procedure is described in detail in the first part of a series of publications titled ‘Perspectives of the Analysis of Organisation’s Context in the Light of the ISO 9001:2015 Standard and the Subject Literature’. Based on the methods and techniques selected during the literature review, the frequency of their occurrence in the literature was analysed. Research was also conducted to indicate whether a given method or technique has a clearly specified methodological procedure and an attempt was made to specify its fitness and mutual connections. The research procedure led to a proprietary general model for organisation context analysis for the purposes of the standard ISO 9001:2015.

3. Identification of Methods, Techniques and Areas of Analysis

As a result of the literature review, methods and techniques which may be used in organisation context analysis were selected. They are presented in Table 1.

Table 1.
Methods and techniques of organisation context analysis

	PEST	Analysis of stakeholders	SWOT	BSC	Scenarios	Management analysis
Abuhav, 2017	X	X*	X			
Dobrowolska, Kołodko, 2023	X					
Hrbáčková, Tuček, 2019			X			
Makolov, Levina, 2017	X				X	X
Matuszak-Flejszman, 2016	X	X*	X			
Novakova, et al., 2016		X*				
Pokora, Gręziński, 2018						
Wahyudin, et al	X					
Saborit, et al., 2012			X*			
Santiago, et al., 2016		X	X	X		
Wolniak, 2019	X	X				

* – name proposed after the analysis of information which the authors recommend to collect.

Source: self-elaboration.

The proposed analytical procedures do not include Porter's Five Forces Analysis model because the model presented in the final part of the article contains specific elements taken from this model that appear in individual methods of strategic analysis.

In the context of ISO 9001:2015, PEST analysis is a key tool for identifying external factors that affect the organisation. This is confirmed by the number of publications which make use of this analysis. The purpose of PEST analysis is in line with the assumptions of ISO 9001:2015, and it is intended to lead to a comprehensive understanding of factors related to politics, economy, society and technology. In turn, this helps organisations better predict changes to the external environment and adapt their strategies to changing conditions.

Several variants of PEST analysis have appeared due to several key reasons. Firstly, along with the evolution of the business environment, there is a need to take into account significant aspects in addition to standard political, economic, social and technological factors. Environmental, legal, ethical, demographic or cultural factors also affect organisations, so it was necessary to exclude them. Secondly, the variable nature of a business environment that is subject to constant changes and trends inclined the researchers to introduce variants of PEST analysis which consider new trends, events and factors impacting on the strategies of organisations. The third reason lies in the diversification of industries and sectors which are exposed to variable external factors. Therefore, adjustment and modification of variants of PEST analysis according to the specifics of a given industry becomes necessary and allows unique factors that affect its functioning to be included. Finally, some variants of PEST analysis attempt to broaden the traditional method, thus enabling a more comprehensive analysis of the external surroundings. They go beyond the original structure, which is advantageous to the organisation in making strategic decisions and provides opportunities for more specific and diversified factors that affect the functioning and developmental strategy.

PEST analysis usually uses information and data from other methods and tools, such as analyses of market trends, economic forecasts or social research. This suggests that PEST analysis is an element of a greater process of strategic analysis. It is frequently the first step in the process of strategic planning, and it provides key information to the organisation. The results of PEST analysis may give grounds for further analysis, such as SWOT analysis or scenario-building. Many authors conclude that PEST analysis supports Porter's Five Forces Analysis, allows for market development scenarios to be developed and is a starting point for SWOT analysis (Antonowicz et al., 2018; Gierszewska, Romanowska, 2014; Penc-Pietrzak, 2003). Even though the process of data collection is complex, the use of PEST analysis may provide important support in updating strategies and taking decisions regarding changes to an organisation's functioning.

An analysis of stakeholders plays a key role in strategic management through identifying, understanding and taking into account the needs of various stakeholders (both external and internal ones) (Lisiński, 2004; Penc-Pietrzak, 2003, 2010), enabling an organisation's strategy to be better adapted to the changing business environment. It is a dynamic process which goes

beyond the identification of stakeholders and attempts to understand their needs, expectations and influence on the organisation. It is a significant element of strategic management, and allows organisations to identify the key entities affecting their functioning and strategic goals as well as to assess their influence. An analysis of stakeholders is classified as a strategic analysis method. It is characterised by a well-grounded and clearly described methodological approach that encompasses several steps, from identifying stakeholders and their individual objectives with respect to the organisation, to mapping them, taking into account, for example, their power and level of interest, which are dimensions on Mendelow's power-interest matrix (Ferretti, 2016). An analysis of stakeholders in this context enables enterprises to detect key stakeholders, define their needs and expectations of products or services, and then adapt the organisation's activities to their needs (Abuhav, 2017; Matuszak-Flejszman, Pochyluk, 2016; Novakova et al., 2016; Santiago et al., 2016; Wolniak, 2019).

It is unclear whether SWOT analysis should be treated as a method, technique or tool. R. Krupski argues that there are numerous varieties of classic SWOT analysis, known as TOWS, TOWS/SWOT or WOT'S. In his opinion, they are quite well-structured methods which may be classified as strategic analysis methods (Krupski, 2012). However, he uses the term 'SWOT analysis'. In numerous Polish- or English-language publications, SWOT analysis is also referred to as a method for assessing the internal weaknesses and strengths of organisations as well as any threats and opportunities coming from its external surroundings (Taherdoost, Madanchian, 2021; Szmitka, 2015; Nazarko, 2013).

In various publications, especially those in English, SWOT analysis is classified as a strategic planning technique (Benzaghta et al., 2021; Ingaldi, 2017; Taherdoost, Madanchian, 2021). Authors of these publications also call it a strategic analysis tool (Nowicki, 2015). In reality, SWOT analysis uses information resulting from the application of other methods and tools. Questionnaires, PEST analysis and its variants, the AHP method or Porter's Five Forces Analysis are used to prepare it (Benzaghta et al., 2021). The fitness of the PEST model for identifying external factors which may be an opportunity or may pose a threat to the organisation are especially emphasised (Antonowicz et al., 2018; Christodoulou, Cullinane, 2019).

G. Gierszewska and M. Romanowska do not treat SWOT analysis as a method. They believe it is a 'unique algorithm of a strategic analysis process, a systemic proposal and a broad assessment of external and internal factors which define the current condition of an enterprise and its developmental potential' (Gierszewska, Romanowska, 2009). It should also be noted that numerous publications on SWOT analysis use the concepts of method, technique and tool interchangeably, which makes it even more difficult to clearly define its nature.

Doubts as to whether SWOT analysis is a method have also been voiced by L. Minsky and D. Aron, who argue that the list of factors and their division into categories are often outcomes of brainstorming. They even call SWOT analysis an organisational tool. They propose using

PEST analysis or its variants first in order to indicate significant external factors. They recommend subsequently proceeding to list internal attributes without dividing them into strengths and weaknesses, as this will result from confronting them with external factors (Minsky, Aron, 2021). The fact that SWOT analysis only indicates areas which should be covered by it (or the interior of the organisation and its surroundings), and also includes recommendations on how to proceed with the lists of factors but does not define the method for obtaining or creating them, seems to confirm that it should not be called a method.

The balanced scorecard is a set of goals and measures of their performance developed by R. Kaplan and D. Norton to enable a quick, multi-faceted evaluation of functioning in terms of a company's strategic goals and visions by higher-level executives. The authors emphasise that control is not the most important application of this tool. By combining four various perspectives, the balanced scorecard is supposed to help managers understand various mutual connections and lead to better decision-making and problem-solving, which should facilitate looking into the future (Kaplan, Norton, 1992). The application of this tool in defining an organisation's context may result from the fact that the balanced scorecard takes into account the customer's perspective, which is very important to context. It requires answers to four important questions: How do customers view us (customers' perspective)? What should we be distinguished by (internal perspective)? Can we continue developing and creating value (perspective of innovation and learning)? and How do we look at shareholders (financial perspective)? Thanks to this, the organisation may take into account its stakeholders as well as internal developmental factors, including factors based on quality.

Scenario analysis results from the growing complexity of an organisation's surroundings and its variability. H. Kahn and A.J. Wiener, who popularised the concept of scenarios, defined them as a set of projections of any system or situations expected in the future (Stabryła, 2002). According to P. Schoemaker, scenario planning is a disciplined method of imagining possible variants of the future (Schoemaker, 1995). When it comes to scenario planning, it is most frequently classified as a method even though some authors believe it should be identified as a technique (Grant, 2010).

For a scenario analysis, an extensive range of methodological instruments is proposed. Links to other method of strategic analysis, such as STEEPVL (Awedyk, 2016), are also indicated. There are also literature sources stating that scenario planning has several methodological defects, even though it has been used in practice for many years (Amer et al., 2013). This indicates a need to take efforts in order to ensure further development on a methodical and methodological basis.

Management analysis, proposed by Makolov and Levin to determine an organisation's context, is an element of economic analysis (Skybinska, Hryniv, 2016). It is based primarily on internal data, including financial information, and it enables decisions regarding, for example, the determination of strategic and tactical directions of enterprise development, the purpose behind the sale of new products or recalls of specific products from the market and optimised

use of fixed assets and other resources of the organisation (Herasymchuk, Tendyuk, 2013). The analysis and evaluation of economic factors is an important element in the strategic management of organisations. Management analysis may be mostly used as an element of a balanced scorecard, especially in the dimension of financial perspective and internal processes (Safonov et al., 2021).

4. Conclusions

Organisations which analyse their organisational context only to fulfil the requirements of the standard often prefer a simpler approach to context analysis. They usually avoid extended analysis because they see no need to use the methods presented in the article for broad strategic management of the entire organisation. Such an approach may be perceived as an attractive option because it focuses on process simplification. However, exploration beyond the minimum requirements may bring fascinating results. Not only do these results satisfy the minimum standards, but they also prepare the company for various options and scenarios.

The research enabled the development of a proprietary model of analysis of an organisation's context in which the general sequence of proposed actions is based on the identified methods and techniques of analysis. It is presented in figure (Figure 1).

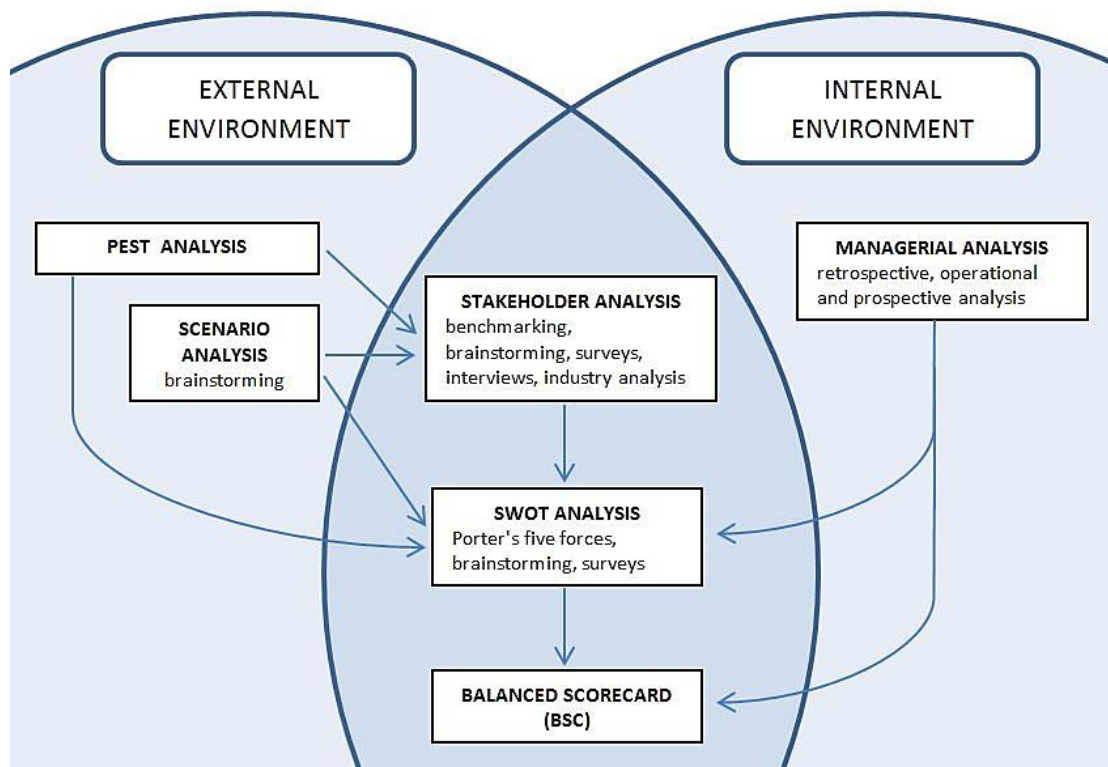


Figure 1. Model of analysis of an organisation's context.

Source: self-elaboration.

PEST analysis, stakeholder analysis and SWOT analysis, which are general analysis methods, are key in determining organisation context. Scenario analysis, the balanced scorecard and management analysis are supportive elements which can reveal information necessary to properly pursue three key general methods. The BSC serves as an ongoing assessment of the organisation's context.

The scheme also signals specific analytical methods and techniques which may support the process of defining organisation context.

Further stages of the research process will involve proposing specific procedures for each of the key analysis methods in order to specify an optimum approach to defining organisation context which will not only help meet the requirements of ISO 9001:2015, but will also allow for broader and more comprehensive knowledge which in turn will make it possible for managers of organisations to take accurate strategic decisions.

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ANALYSIS OF FINANCIAL INTERESTS UNDER THE INTERNATIONAL TREATY UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE UNFCCC

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Purpose: This article aims to analyze the financial contribution from the European Union countries' annual budget, the European Commission, and the European Investment Bank to financing activities related to climate change under the United Nations Framework Convention on Climate Change (UNFCCC).

Design/methodology/approach: Based on statistical data, an analysis was made of changes in financial shares under the treaty; the largest and smallest shareholders among the European Union countries were identified, and the changes in subsequent years in all European Union countries.

Findings: Based on the analysis, it was indicated that countries such as Germany and France are the countries with the most significant shares in budget spending under the UNFCCC, followed by the largest shareholders are the European Commission and the European Investment Bank.

Research limitations/implications: The possibilities of analyzing data on the shares of European Union countries under the UNFCCC Treaty were limited due to the lack of availability of data from some periods.

Practical implications: The analysis may be the basis for more significant mobilization of countries in climate support that do not participate financially enough under the UNFCCC.

Social implications: Society should be made aware of the issue of caring for the environment, it should introduce ecological habits in its own home, encourage friends to take actions to protect the environment and encourage them to change their diet, habits, conscious purchasing, saving water and energy.

Originality/value: Analyzing the spending of European Union countries to improve the climate is of fundamental importance to find out to what extent all parties to the treaty are involved and what financial resources are available to enhance the negative consequences of climate change.

Keywords: climate change, UNFCCC treaty, climate finance under the United Nations Framework Convention.

Category of the paper: Research paper, general review.

1. Introduction

What is of concern is that, as a result of human activity, there is an increase in greenhouse gases, intensifying the greenhouse effect and increasing the average temperature of the earth's surface and atmosphere, negatively affecting the entire ecosystem. Disturbing phenomena resulting from global warming, such as the melting of natural ice sheets and glaciers, an increase in sea levels and sea levels, a greater frequency and intensity of extreme weather phenomena such as prolonged heat, sudden rainfall, storms or intense hurricanes, droughts, and floods, should involve the governments of countries to prevent the deepening of the adverse human impact on the climate. The consequence of the analysis and dialogue was the accession of countries to the international treaty - the United Nations Framework Convention (<https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19960530238/O/D19960238.pdf>) on Climate Change (UNFCCC) in 1992, to jointly consider how to prevent harmful human interference in the climate system, how to limit average global temperature increases and the resulting climate change, as well as how to deal with the changes that have already occurred (<https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#adaptation-communications>). The UNFCCC entered into force on March 21, 1994. One hundred ninety-five countries have ratified the convention. The convention's main objective is to stabilize the concentration of greenhouse gases at a level that prevents dangerous, human-induced interference in the climate system, which may cause severe disruptions in the functioning of this system. The success of the treaty's activities depends on the governments of the countries party to the convention, the active and sustained involvement of national, regional, multilateral, and international organizations, the public and private sectors, and civil society itself (<https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#Facilitative-Working-Group-FWG>). The world is already experiencing changes in average temperatures and an increasing frequency of extreme weather events. Adaptation action is a crucial element of the long-term global response to climate change and should be country-, community- and ecosystem-focused and based on the best available science and knowledge (<https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#Adaptation-Committee>).

This article aims to analyze the total amount spent from the annual budget of the European Union countries, the European Commission, and the European Investment Bank to finance actions related to climate change under the United Nations Framework Convention on Climate Change (UNFCCC). The presented data are reported to the European Commission based on the Regulation on the Monitoring Mechanism (Regulation (EU) No. 525/2013) for the period until 2019 and based on the Management Regulation (Regulation (EU) 2018/1999) for subsequent years. One of the goals is to achieve a climate-neutral world by mid-century, to limit global warming to well below 2°C and to aim for 1.5°C (compared to pre-industrial times), as well as to strengthen countries' resilience and capacity adaptation to climate-related natural hazards and resulting disasters.

2. Summary and analysis of the budget shares of European Union countries under the UNFCCC Treaty

The table (Table 1) below presents the shares of individual European Union countries as well as the European Commission and the European Investment Bank in financing activities related to climate change under the UNFCCC Treaty (the ":" sign means that the data is unavailable).

Table 1.

Shares of European Union countries and the European Commission and European Investment Bank in financing activities related to climate change under the UNFCCC Treaty in 2014-2022

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Austria	141.27	117.62	199.26	164.14	239.47	332.82	257.95	248.61	401.29
Belgium	142.74	46.83	100.92	104.92	80.68	99.71	119.25	282.57	395.52
Bulgaria	0.07	0.10	:	:	0.00	:	0.14	0.03	0.00
Croatia	0.03	:	:	0.02	0.05	0.03	0.12	0.17	0.02
Cyprus	0.00	:	:	:	:	:	0.00	0.00	0.00
Czechia	7.66	8.19	7.55	7.07	7.20	7.47	12.23	11.51	8.49
Denmark	222.04	143.79	172.98	181.72	198.16	246.90	272.66	386.14	264.54
Estonia	0.53	1.21	0.38	0.62	0.97	0.53	1.97	2.77	2.79
Finland	132.25	115.43	43.04	119.38	46.59	146.76	125.46	146.51	161.52
France	2 921.43	2 792.83	3 334.84	4 377.38	5 088.76	5 958.78	6 715.53	5 781.84	7 667.73
Germany	5 130.61	7 406.15	8 534.08	6 729.60	6 611.98	6 811.79	7 698.28	7 844.73	9 476.29
Greece	0.04	0.23	0.23	4.59	3.77	0.69	1.11	8.28	1.98
Hungary	2.71	41.34	35.29	13.98	3.09	3.39	11.79	19.01	8.23
Ireland	41.44	36.00	52.70	64.47	77.21	70.23	89.16	91.78	118.19
Italy	143.23	327.34	242.95	632.62	451.96	417.59	582.81	731.4	957.81
Latvia	0.42	0.01	0.01	:	0.04	0.00	0.00	0.00	0.09
Lithuania	0.26	0.43	0.54	1.48	0.76	1.99	2.73	3.32	4.00
Luxembourg	36.26	45.65	129.53	40.43	40.98	51.43	31.5	39.13	66.03
Malta	0.08	0.16	0.20	0.16	0.10	0.10	0.10	0.10	0.20
Netherlands	339.98	425.84	471.89	405.44	577.83	580.79	1 109.70	618.93	804.44
Poland	4.19	5.67	5.38	4.29	49.49	12.88	22.49	8.44	19.45
Portugal	9.52	6.22	2.00	2.17	1.64	0.89	2.32	2.17	4.25
Romania	0.03	:	0.78	0.86	0.03	0.24	4.78	5.00	8.06
Slovakia	1.23	2.20	2.99	3.63	4.16	5.91	2.83	9.31	7.37
Slovenia	2.35	2.35	2.98	3.75	4.39	5.78	1.71	4.87	5.23
Spain	498.75	466.72	595.03	529.06	694.94	740.14	529.78	726.72	743.47
Sweden	384.75	341.43	402.40	515.04	608.59	708.92	507.50	1 004.62	793.85
European Commission	677.01	1 535.42	2 730.17	2 823.72	2 652.49	2 534.78	2 577.58	2 501.76	4 030.62
European Investment Bank (EIB)	2 098.50	2 214.70	1 947.72	2 640.36	2 972.44	3 184.30	2 711.51	2 563.36	2 523.44
European Union - 27 countries	10 163.87	12 333.74	14 337.95	13 906.81	14 792.83	16 205.77	18 103.89	17 977.97	21 920.86

Source: https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

In the analyzed period (range 2014-2022), Germany had the largest share of the total amount spent from the annual budget of EU Member States, as well as the European Commission and the European Investment Bank, amounting to PLN 66,243.51 (in 2022, this share was PLN 9,476.29), and the smallest is Cyprus. When analyzing the shares of European Union countries, attention should be paid to the lack of data on the allocated amount in countries such as Bulgaria (2016, 2017, 2019), Croatia (2015-2016), Cyprus (2015-2019), Latvia (2017), Romania (2015). The slightest difference between the amount spent on financing activities related to climate change under the United Nations Framework Convention was shown by France, comparing the value from 2022 - a share of 7,667.73 to the value from 2015 - a share

of 2,792.83. Noteworthy is the share of the European Commission - a share of 4,030.62 in 2022 (over the period 2004-2022, the share amounted to 22,063.55) and the European Investment Bank - a share of 2,253.44 in 2022 (over the years 2014-2022, the share amounted to 22856,33). Below is a chart of the percentage share of individual European Union countries (Figure 1), the European Commission, and the European Investment Bank in expenditure on financing activities related to climate change under the United Nations Framework Convention over the years 2014-2022.

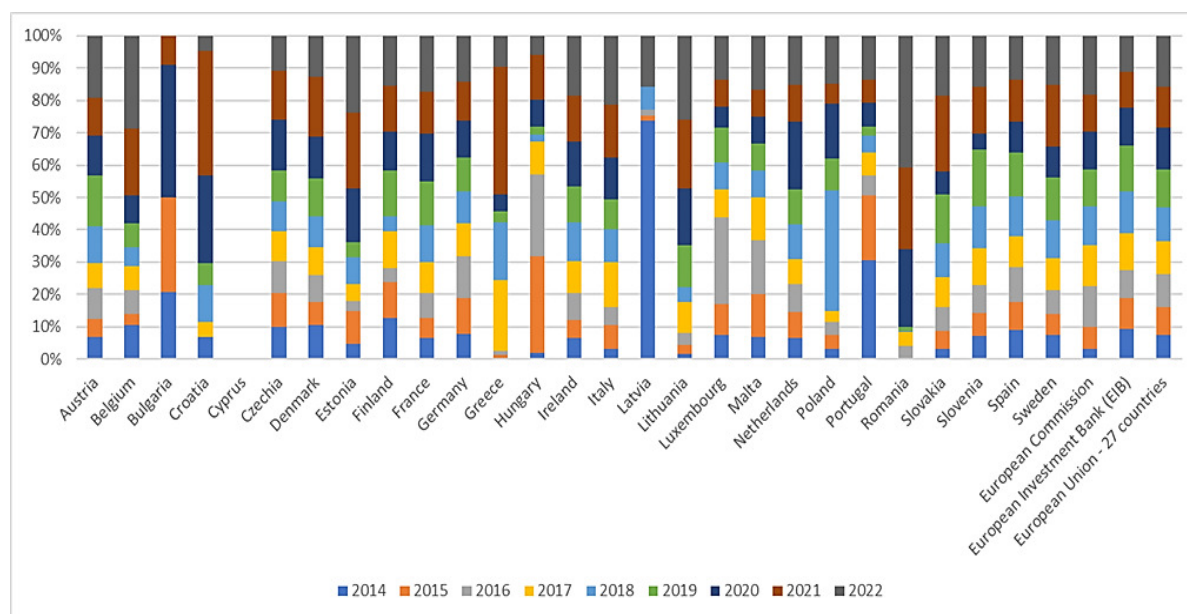


Figure 1. Chart the percentage share of individual European Union countries and the European Commission and European Investment Bank in expenditure on financing activities related to the UNFCCC Treaty in 2014-2022.

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

Below, in Figure 2, the share in millions of euros of the European Union countries, the European Commission, and the European Investment Bank in expenditure on financing actions related to climate change under the United Nations Framework Convention are visualized. It can be observed that the most significant increase in the share of the European Commission took place at the turn of 2014/2015, 2015/2016, and 2021/2022. Unfortunately, since 2020, the share of the European Commission has been declining. In European Union countries, increases in shares can be observed, especially at the turn of 2021/2022. In turn, a visual analysis of the share of the European Investment Bank does not indicate significant changes in the period under study but declines in shares can be observed in 2015/2016 and declines from year to year after 2019.

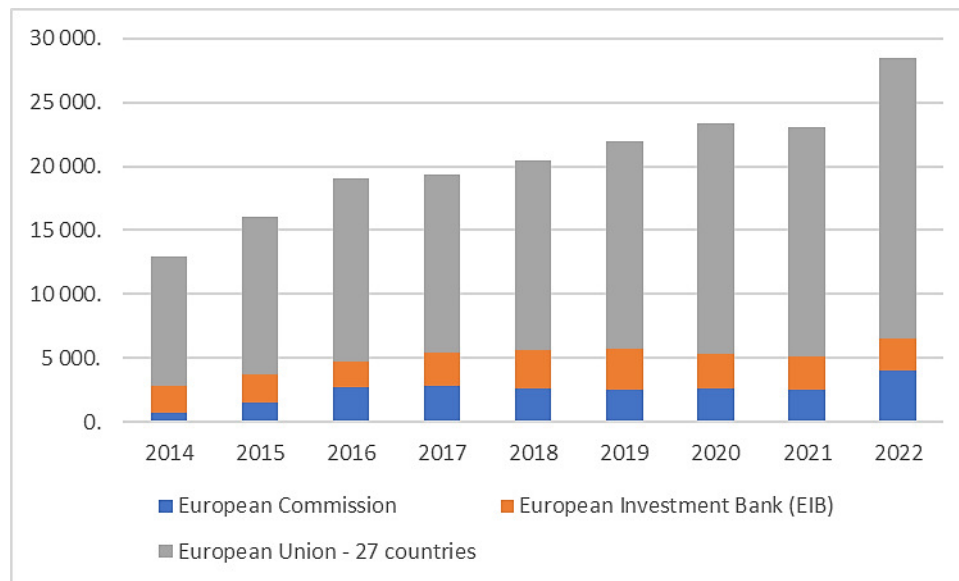


Figure 2. The relative share of European Union countries and the European Commission and European Investment Bank in expenditure on financing activities under the UNFCCC Treaty.

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

In addition to analyzing the share of individual European Union countries, the European Commission, and the European Investment Bank in expenditure on financing activities related to climate change, the formation of minimum and maximum shares is interesting. The table below (Table 2) lists the minimum and maximum share values with the year this value was achieved.

Table 2.

Presentation of the minimum and maximum shares of financing under the UNFCCC Treaty with an indication of the years and their differences

	Minimum value	The year the minimum value was reached	Maximum value	The year the maximum value was reached	The difference between the minimum and maximum values
Austria	117.620	2015	401.290	2022	283.670
Belgium	46.830	2015	395.520	2022	348.690
Bulgaria	0.000	2018	0.140	2020	0.140
Croatia	0.020	2017	0.170	2021	0.150
Czechia	7.070	2017	12.230	2020	5.160
Denmark	143.790	2015	386.140	2021	242.350
Estonia	0.380	2016	2.790	2022	2.410
Finland	43.040	2016	161.520	2022	118.480
France	2792.830	2015	7667.730	2022	4874.900
Germany	5130.610	2014	9476.290	2022	4345.680
Greece	0.040	2014	8.280	2021	8.240
Hungary	2.710	2014	41.340	2015	38.630
Ireland	36.000	2015	118.190	2022	82.190
Italy	143.230	2014	957.810	2022	814.580
Latvia	0.000	2019-2021	0.420	2014	0.420
Lithuania	0.260	2014	4.000	2022	3.740
Luxembourg	31.500	2020	129.530	2016	98.030
Malta	0.080	2014	0.200	2022	0.120
Netherlands	339.980	2014	1109.700	2020	769.720
Poland	4.190	2014	49.490	2018	45.300
Portugal	0.890	2019	9.520	2014	8.630
Romania	0.030	2018	8.060	2022	8.030
Slovakia	1.230	2014	9.310	2021	8.080

Cont. table 2.

Slovenia	1.710	2020	5.780	2019	4.070
Spain	466.720	2015	743.470	2022	276.750
Sweden	341.430	2015	1004.620	2021	663.190
European Commission	677.010	2014	4030.620	2022	3353.610
European Investment Bank (EIB)	1947.720	2016	3184.300	2019	1236.580

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

An analysis of expenditure in recent years also seems essential. 2020 Germany recorded the largest share (77,698.28), increasing to 7,844.73 in 2021 and 9,476.29 - in 2022. France is the second country to achieve the highest share after Germany, whose share value reached 6715.53 in 2021. France's share decreased to 5781.84 and increased in 2022 to 7667.73. In 2020, the European Investment Bank took the next place in share value with a share value of 2,711.51 and the European Commission with a share value of 2,577.58. The next place (with a much smaller share) is the Netherlands - 1109.7. In 2021, the largest shares were recorded by Germany, France, the European Investment Bank (down to 2,563.36), and the European Commission (down to 2,501.76), respectively. Sweden takes fifth place, increasing its share from 507.50 in 2020 to 1004.62. In 2022, the first place in terms of share is again taken by Germany, increasing its share to the value of 9476.29, France - also increasing its share to the level of 7667.73, the next place is taken by the European Commission, increasing its share compared to the previous year to the value of 4030.62, and the European Investment Bank slightly increasing the share to 2523.44. The lowest shares in recent years were recorded in Cyprus, Latvia, Croatia, and Bulgaria.

Table 3.

Analysis of expenses in recent years: 2020, 2021, 2022 in descending order

	2020		2021		2022
Germany	7 698.28	Germany	7 844.73	Germany	9 476.29
France	6 715.53	France	5 781.84	France	7 667.73
European Investment Bank (EIB)	2 711.51	European Investment Bank (EIB)	2 563.36	European Commission	4 030.62
European Commission	2 577.58	European Commission	2 501.76	European Investment Bank (EIB)	2 523.44
Netherlands	1 109.70	Sweden	1 004.62	Italy	957.81
Italy	582.81	Italy	731.4	Netherlands	804.44
Spain	529.78	Spain	726.72	Sweden	793.85
Sweden	507.50	Netherlands	618.93	Spain	743.47
Denmark	272.66	Denmark	386.14	Austria	401.29
Austria	257.95	Belgium	282.57	Belgium	395.52
Finland	125.46	Austria	248.61	Denmark	264.54
Belgium	119.25	Finland	146.51	Finland	161.52
Ireland	89.16	Ireland	91.78	Ireland	118.19
Luxembourg	31.5	Luxembourg	39.13	Luxembourg	66.03
Poland	22.49	Hungary	19.01	Poland	19.45
Czechia	12.23	Czechia	11.51	Czechia	8.49
Hungary	11.79	Slovakia	9.31	Hungary	8.23
Romania	4.78	Poland	8.44	Romania	8.06
Slovakia	2.83	Greece	8.28	Slovakia	7.37
Lithuania	2.73	Romania	5.00	Slovenia	5.23
Portugal	2.32	Slovenia	4.87	Portugal	4.25
Estonia	1.97	Lithuania	3.32	Lithuania	4.00
Slovenia	1.71	Estonia	2.77	Estonia	2.79
Greece	1.11	Portugal	2.17	Greece	1.98
Bulgaria	0.14	Croatia	0.17	Malta	0.20
Croatia	0.12	Malta	0.10	Latvia	0.09

Cont. table 3.

Malta	0.10	Bulgaria	0.03	Croatia	0.02
Latvia	0.00	Latvia	0.00	Bulgaria	0.00
Cyprus	0.00	Cyprus	0.00	Cyprus	0.00

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

The chart below clearly shows the difference between the shares of Germany, France, the European Commission, the European Investment Bank, and other shareholders financing activities related to climate change under the United Nations Framework Convention on Climate Change (UNFCCC).

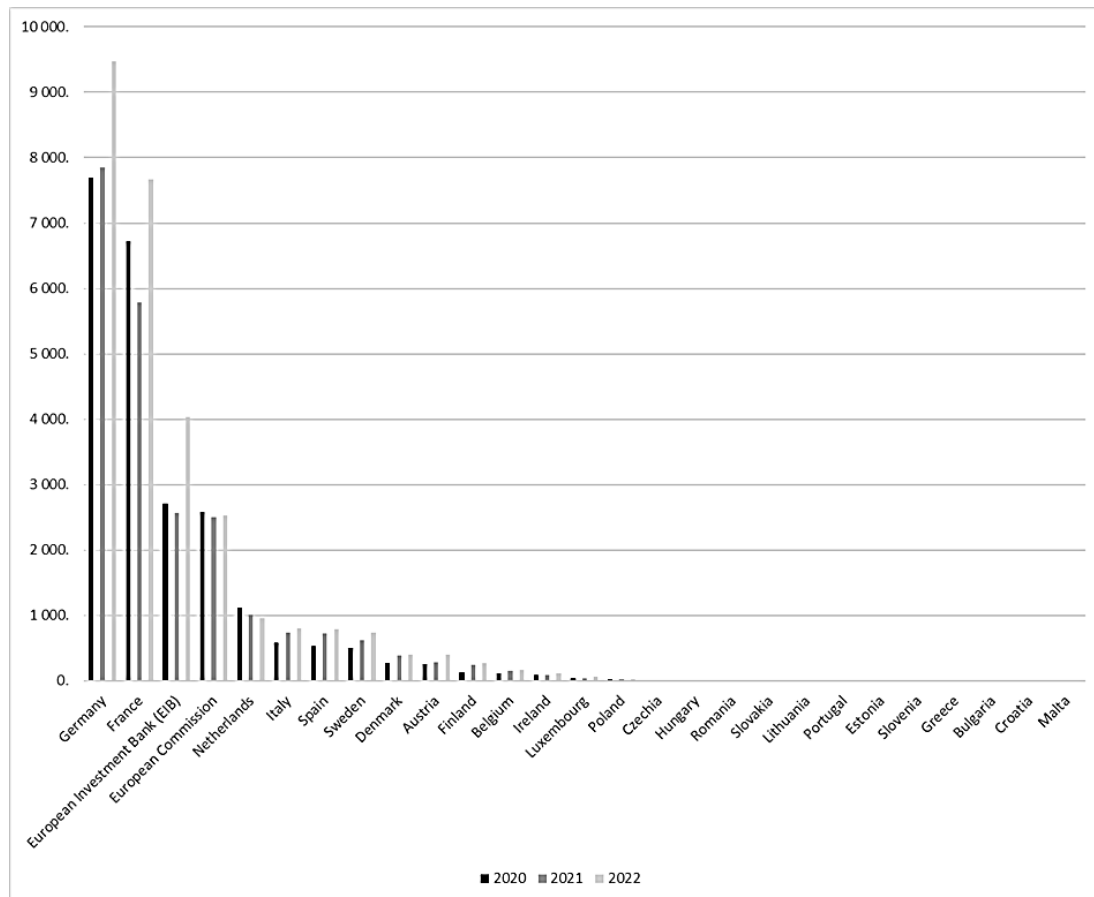


Figure 3. Financial participation of the European Union, the European Commission, and the European Investment Bank in the last three years (2020-2022).

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

Analyzing the last year, the shares of European Union countries, the European Commission, and the European Investment Bank are as follows (Figure 4):

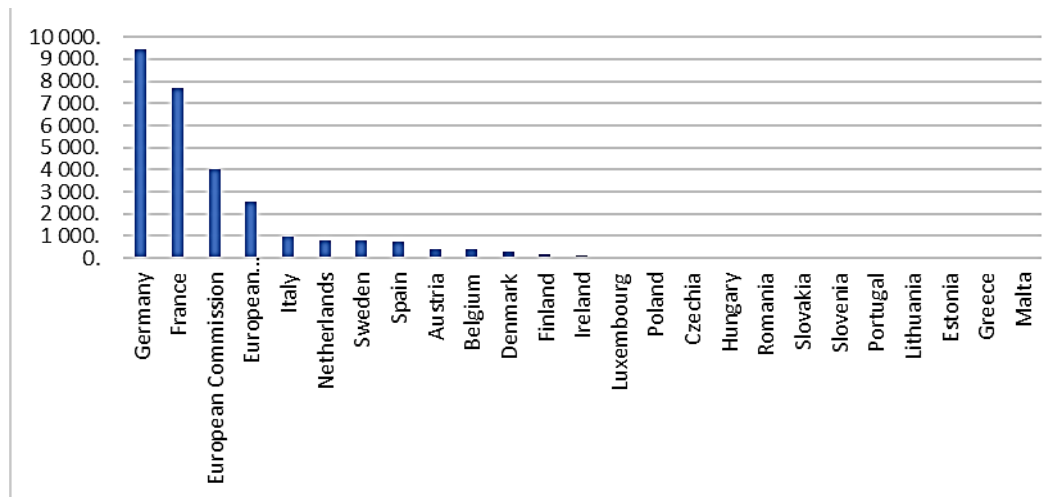


Figure 4. Shares of European Union countries, the European Commission, and the European Investment Bank in 2022.

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

It is also worth analyzing the shares due to percentage changes from year to year, as presented in the table below (Table 4).

Table 4.

Financial contributions under the UNFCCC treaty due to percentage changes from year to year

	2015	2016	2017	2018	2019	2020	2021	2022	Min	Max
Austria	-16.74%	69.41%	-17.63%	45.89%	38.98%	-22.50%	-3.62%	61.41%	-22.50%	69.41%
Belgium	-67.19%	115.50%	3.96%	-23.10%	23.59%	19.60%	136.96%	39.97%	-67.19%	136.96%
Bulgaria	42.86%	-	-	-	-	-	-78.57%	-100.00%	-100.00%	42.86%
Croatia	-	-	-	150.00%	-40.00%	300.00%	41.67%	-88.24%	-88.24%	300.00%
Cyprus	-	-	-	-	-	-	-	-	0.00%	0.00%
Czechia	6.92%	-7.81%	-6.36%	1.84%	3.75%	63.72%	-5.89%	-26.24%	-26.24%	63.72%
Denmark	-35.24%	20.30%	5.05%	9.05%	24.60%	10.43%	41.62%	-31.49%	-35.24%	41.62%
Estonia	128.30%	-68.60%	63.16%	56.45%	-45.36%	271.70%	40.61%	0.72%	-68.60%	271.70%
Finland	-12.72%	-62.71%	177.37%	-60.97%	215.00%	-14.51%	16.78%	10.25%	-62.71%	215.00%
France	-4.40%	19.41%	31.26%	16.25%	17.10%	12.70%	-13.90%	32.62%	-13.90%	32.62%
Germany	44.35%	15.23%	-21.14%	-1.75%	3.02%	13.01%	1.90%	20.80%	-21.14%	44.35%
Greece	475.00%	0.00%	1895.65%	-17.86%	-81.70%	60.87%	645.95%	-76.09%	-81.70%	1895.65%
Hungary	1425.46%	-14.63%	-60.39%	-77.90%	9.71%	247.79%	61.24%	-56.71%	-77.90%	1425.46%
Ireland	-13.13%	46.39%	22.33%	19.76%	-9.04%	26.95%	2.94%	28.78%	-13.13%	46.39%
Italy	128.54%	-25.78%	160.39%	-28.56%	-7.60%	39.57%	25.50%	30.96%	-28.56%	160.39%
Latvia	-97.62%	0.00%	-	-	-100.00%	-	-	-	-100.00%	0.00%
Lithuania	65.38%	25.58%	174.07%	-48.65%	161.84%	37.19%	21.61%	20.48%	-48.65%	174.07%
Luxembourg	25.90%	183.75%	-68.79%	1.36%	25.50%	-38.75%	24.22%	68.75%	-68.79%	183.75%
Malta	100.00%	25.00%	-20.00%	-37.50%	0.00%	0.00%	0.00%	100.00%	-37.50%	100.00%
Netherlands	25.25%	10.81%	-14.08%	42.52%	0.51%	91.07%	-44.23%	29.97%	-44.23%	91.07%
Poland	35.32%	-5.11%	-20.26%	1053.61%	-73.97%	74.61%	-62.47%	130.45%	-73.97%	1053.61%
Portugal	-34.66%	-67.85%	8.50%	-24.42%	-45.73%	160.67%	-6.47%	95.85%	-67.85%	160.67%
Romania	-	-	10.26%	-96.51%	700.00%	1891.67%	4.60%	61.20%	-	-
Slovakia	78.86%	35.91%	21.40%	14.60%	42.07%	-52.12%	228.98%	-20.84%	-52.12%	228.98%
Slovenia	0.00%	26.81%	25.84%	17.07%	31.66%	-70.42%	184.80%	7.39%	-70.42%	184.80%
Spain	-6.42%	27.49%	-11.09%	31.35%	6.50%	-28.42%	37.17%	2.30%	-28.42%	37.17%
Sweden	-11.26%	17.86%	27.99%	18.16%	16.49%	-28.41%	97.95%	-20.98%	-28.41%	97.95%
European Commission	126.79%	77.81%	3.43%	-6.06%	-4.44%	1.69%	-2.94%	61.11%	-6.06%	126.79%
European Investment Bank (EIB)	5.54%	-12.05%	35.56%	12.58%	7.13%	-14.85%	-5.46%	-1.56%	-14.85%	35.56%

Source: own study based on https://ec.europa.eu/eurostat/databrowser/view/sdg_13_50/default/table?lang=en&category=cli.cli_act

Due to the lack of data on the shares of some countries over the years, the analysis was based on recorded data. On this basis, it can be determined that the most significant decrease in share was recorded by Greece in 2019 compared to 2018 at the level of -81.7%, while the country that achieved the most significant increase in share was also Greece, increasing its share in 2017 compared to 2016 by 1895.65%.

3. Summary

The critical task in the current climate change crisis is to stop the negative impact of humans on the climate and work on the possibilities of reversing the changes that have already occurred. The activities of the parties to the treaty through, among others, reporting on anthropogenic emissions of all greenhouse gases, implementing programs including measures to mitigate climate change and measures to facilitate appropriate adaptation to climate change, cooperation in the development and dissemination of technologies and experiences allowing to control, reduce and prevent anthropogenic emissions of greenhouse gases provide hope for changing the alarming trend of climate change and its negative impacts on the ecosystem. It seems reasonable that everyone should be aware of the need to take care of the climate and that each country should participate in climate protection expenses. Unfortunately, not all European Union countries participate at a sufficiently high level in financial expenditure under the UFCEEE treaty.

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EFFECTS OF INFORMATION TECHNOLOGY ON ORGANIZATIONAL CULTURE AND MANAGEMENT IN A BANKING SECTOR – A CASE STUDY

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Purpose: The article deals with the analysis of the use of information technology (IT), and its effects on organizational culture and management within the banking sector, with a particular emphasis on First City Monument Bank in Nigeria. Today, information technology plays a part that is becoming increasingly significant in organizations, especially in their mode of operation, and structure. The study focuses on the impact that information technology has on the structure of organizations and how that impact affects cultural perspectives, values, hierarchies, and norms. A method of research that forms the basis for analyzing the effects of information technology on organizations has been developed on the basis of a framework for the analysis that is composed of four areas in which IT was used.

Design/methodology/approach: A method of research that forms the basis for analyzing the effects of information technology on organizations has been developed on the basis of a framework for analysis that is composed of four areas in which IT was used. The study adopted the models of: Technology Acceptance Model (TAM), According to the Trade-Off Matrix (TAM), a system's Perceived Usefulness (PU) is the extent to which an individual think that using that system, improves his or her job performance, while its Perceived Ease of Use (PEOU) is the extent to which an individual thinks that using that system requires no effort on his or her part (Davis, 1989). Technology-Organization-Environment (TOE) framework, according to their logic, these three factors must be taken into account in any decision regarding the adoption and implementation of technological innovations within an organization. Formal and informal approaches, linking structures, communication processes, scale, and wiggle room are all mentioned as components of the organizational context.

Findings: The study gives the recommendations that due to globalization, no financial institution can afford to ignore the importance of customer satisfaction, a productive workplace enabled by information and communication technology (ICT), and keeping up with the competition. Commercial banks could miss out on these advantages if workers resist the change. In order to achieve a positive effect of information technology on organizational culture and help foster a culture of learning, some suggestions have been elaborated. The recommendations are grounded in research and real-world examples.

Research limitations/implications: The research limitations are due to a banking sector in Nigeria, which is known for its cumbersome bureaucracy and lengthy decision-making processes. This issue made it more difficult to collect appropriate set of data in a timely manner.

Another limitation is insufficient prior research studies on the selected topic. This limitation prevented the authors from citing previous research studies, which would have provided a solid foundation for the literature review of this study and would have been helpful in laying the groundwork for an understanding of the underlying research topic that was addressed.

Practical implications: The undertaken analysis enabled to formulate recommendations that FCMB needs to establish more regional IT hubs to decentralize its operations. That helps in improving network efficiency and relieve load on their primary server, resulting in fewer system link disruptions typical of banking operations. FCMB needs to find ways to make their online services more available to the general public. Because of this, concerns and feedbacks regarding electronic banking services from customers could be addressed.

Originality/value: The value of the research is the identified elements concerning the significance of electronic commerce in light of the fact that the globe as a whole is embracing e-commerce interfaces of all kinds in commercial establishments of all sizes brought about by globalization. Not only banks are crucial in commercial activities, but also as key players in the development of new jobs in Nigeria, and as a result they play such an important role in the national economy.

Keywords: information technology, organizational culture, banking sector, project management.

Category of the paper: research paper, case study.

1. Introduction

Today, information technology (IT), plays a very important role in most organizations, especially in their mode of operation, and structure. Researchers give different meanings on the concept of IT as how it is used or interpreted from one organization to the other. This paper focused on the impact of IT on organizational culture which by extension, also includes its structure and how IT is adopted and implemented, affects the cultural outlook, values, hierarchy and norms. Furthermore, all organizations and businesses, regardless their size and scope of operation, currently face severe competitive challenges now more than ever. In order to cope with this phenomenon, business owners, executives and managers are turning to information technology and other digitally powered tools in their respective organizations to help them stay afloat with current happenings, meet up with competitions, maximize profit and ultimately remain in business without losing the purpose and vision for starting the business in the first place and maintain organizational structuring, communication amongst and with staff at all levels within the organization as well as external stakeholders.

Corporate culture is usually created with the founders of the company. The founders' actions and behaviors typically set the stage for the future culture coupled with its mission and vision for the organization. That is not to say that cultures do not change over the years, they definitely do. Implementing new techniques and methods for getting things done within an organization will re-shape existing corporate culture (Erdurmazlı, 2020). This study aimed at analyzing and explaining the use of IT and its effect on organizational structures and cultures in a banking sector, with a focus on First City Monument Bank (FCMB), a leading Bank in Nigeria.

The use of IT alters the way in which businesses function, as well as the way in which customers make purchases from those businesses and the way goods are distributed. The study's goals are to shed light on the factors that contribute to successful IT integration into an organization's culture, and to explain how such integration impacts the business and its leadership. These effects, which can have either a positive or a negative impact, are examined using First City Monument Bank (FCMB), which is located in Nigeria.

The originality of the research is the identified elements concerning the significance of electronic commerce in light of the fact that the globe as a whole is embracing e-commerce interfaces of all kinds in commercial establishments of all sizes brought about by globalization.

2. The characteristics of issues concerning organizational culture and management

The advancement of information technology necessitates a reevaluation of investment decisions for the effectiveness of project management. Before implementing an organizational innovation, it is necessary to acknowledge the obstacles of an Information Technology project (Fonseca, Letouzé, Pompeu et al., 2017). The adoption of IT service management processes can be challenging for businesses of any size due to a number of factors, most notably the network of diverse players with divergent objectives and conceptions of the function of services within the organization (Gottschalk, Karlsen, 2005). Knowledge barriers and varying degrees of involvement from supply-side institutions, according to Alharbi and Saad (2013), are responsible for the disparate opportunity to adopt technologies. They identified three distinct types of informational hurdles:

- technology-related knowledge barrier: caused by a lack of familiarity with the required hardware and software architecture, technological capabilities, security measures, and industry standards in light of the unique business environment in which the company operates,
- lack of project-related knowledge, such as the amount of (financial and human) resources needed to develop technology, the time the development process takes, who shall lead the project and what roles each team member is to play,
- an application-related knowledge barrier: To what extent the application is to be integrated with existing IT applications; what effects the application is to have on the future of the business; the value of the various technology features for the adopting unit; what key business assumptions are required for deploying the technology.

The culture of a firm can be influenced by the founders' business goals and operating principles. Wanyama, et. al (2022) hypothesized that the founding team's assumptions may have resulted from their own histories and perspectives. A company's culture is a driving force behind its success and a long-term competitive advantage (Abbasi et al., 2021).

3. The characteristics of IT tools and methods applied in a banking sector

The corporate world is changing fast as a result of technological advancements. The literature on organizational culture, (Flamholtz, Randle, 2011; O'Reilly et al., 2014), provides information on how company managers may employ effective tools and technologies to increase performance and productivity. In the corporate sector, managers tend to see a productive company culture as an advantage and a dysfunctional one as a liability (Flamholtz, Randle, 2011). According to Eaton and Kilby (2015), in order to maintain order and harmony throughout the company, managers rely on technological means of communication, particularly information and communication technologies (ICT) that improve the organization of the company's culture. According to Hartnell and Kinicki (2011), successful IT is facilitated by a company's culture:

1. Shape employee attitudes. Share messages and other useful information faster, simultaneously, and spontaneously.
2. Improve operational and cross departmental effectiveness. Operational effectiveness contains information on how management uses an effective organizational culture to introduce and innovate new products and to improve process and service.
3. Increase financial performance in the organization. Financial performance includes information regarding the achievement of profitability, productivity, and growth in the organization.

4. The brief characteristics of a selected bank's activity

First City Monument Bank (FCMB) is a wholly owned subsidiary of FCMB Group Plc., a Nigerian financial services provider located in Lagos (Obaseki, 2021). FCMB Group Plc.'s nine companies are divided into commercial and retail banking, investment banking, mortgage banking, asset and wealth management, and the relatively new microfinance service. FCMB Group PLC annual report and accounts (2020) showed that the group's entire assets were valued US \$5 billion (NGN: 2 trillion). When IFC, the private investment arm of the World Bank, heard about FCMB in November 2010, they committed \$70 million and invested into First City Monument Bank to foster development, Small and Medium Enterprise (SME) Funding 2021.

First City Monument Bank (FCMB) and FinBank, another undercapitalized Nigerian commercial bank, both made announcements in the same month that FCMB was interested in acquiring stock and becoming FinBank's strategic investor. Funding from the International Finance Corporation (IFC) helps First City Monument Bank provide loans to small and

medium-sized businesses. In February 2012, FCMB purchased all of Finbank's outstanding shares and, following regulatory permission, began integrating Finbank into its current operations. As of 2017, FCMB operated out of 220 branches and through a UK banking affiliate. It has 4.3 million clients that it helped. In 2021, the bank catered to around 8 million clients.

A single standard for open Application Programming Interface (API) in the Nigerian financial ecosystem is being promoted by the non-profit group Open Banking Nigeria, which the bank joined in October 2020. FCMB was named best SME Bank in Africa and best SME Bank in Nigeria at the 2021 Asian Banker Middle East and Africa Regional Awards.

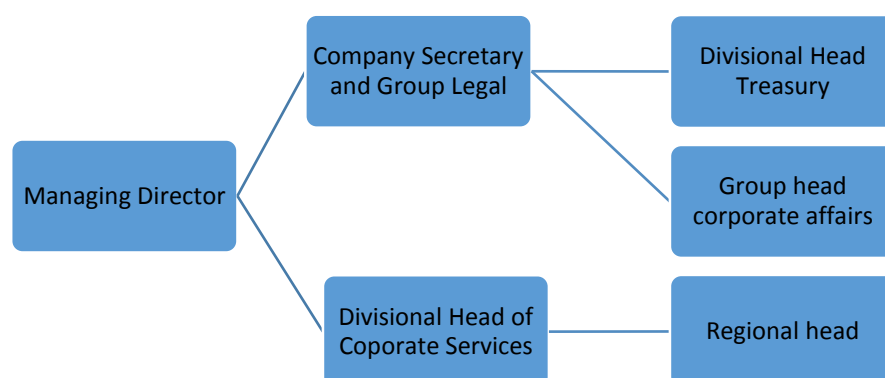


Figure 1. The organigram of First City Monument Bank (FCMB) Ltd.

Source: (Information Nigeria, 2022).

5. The research analysis on the effects on organisational culture and management in FCMB

As in the rest of the world, Nigeria's banking system has benefited from the development of more advanced forms of communication. However, things did not look like this 10 years ago. Banking has undergone a gradual transformation in the wake of the impact that IT has had on the financial services industry (Daily Post Nigeria, 2010). The best part is that the adjustment has been made cheaply. It was not until the 1990s that IT began providing backend support for banks. Nigeria's banking sector was reformed with the help of IT to promote banking sector self-sufficiency, competency, and flexibility and to raise the quality of Nigerian banking on the global market (Shemi, 2012). In recent years, thanks to advances in technology and the consolidation of previously separate banking services, new opportunities and revenue streams have emerged in the banking sector. Therefore, it is not inappropriate to think of the new banking sector as the financial supermarket for its clients. However, there are both benefits and drawbacks to implementing IT in financial institutions.

Some of the benefits, as described by Alharbi and Saad (2013) are discussed below:

1. The introduction of IT to the banking sector in Nigeria was the catalyst for the country's most significant digital revolution. The country's banking system has improved in both speed and reliability. Even the process of retrieving and updating documents has been simplified and accelerated by advances in IT.
2. As a result of advancements in IT, the core banking system has become more unified, and all of a bank's branches now share some centralized data.
3. Bank customers can now anticipate that their checks are cleared and funds credited to their accounts at a more expedited rate thanks to the MICR cheque processing system.
4. Information can be shared, problems solved, and facilitated trainings improved at a lower cost and in a shorter time.
5. Customers can now check their balances and make other banking-related transactions online, thanks to the rollout of Unstructured Supplementary Service Data (USSD).
6. Every bank nowadays provides its customers with the option of doing their banking online. With the help of an internet connection, customers of a bank can view their entire account history and conduct any necessary transactions without ever having to set foot inside a bank branch.
7. Every business deal is now more open and honest.
8. Bank fraud risk is better managed when two-factor authentication and passwords are used for online transactions.
9. Better and more efficient customer service is one result of the increased competition between banks made possible by advances in IT.
10. Mobile banking has made it possible for customers of financial institutions to access their accounts from virtually any mobile device, at any time. All banks are now able to provide better and faster services to their customers thanks to innovations like automatic cheque book printing, cash deposit machines, cheque deposit machines (Alharbi, Saad, 2013).

Nevertheless, there are some negative impacts IT poses to banks and organizations in general (Arbussà i Reixach, 2001) highlights them thus:

1. A major drawback of the IT-enabled banking system is the loss of jobs that has resulted from its widespread adoption. As a result of widespread automation, fewer bank jobs are available across the country, increasing the workload for the remaining employees. Many banking industry jobs have been eliminated due to automation.
2. The vulnerability of the banking system to cyber-attacks is a growing source of concern in today's digitally driven economy. If security is mismanaged, millions of records are at risk and could be lost in the blink of an eye.
3. As a result, some employees have been let go.
4. While these technologies do save time, they can also make users — whether they are IT professionals, customers, or employees — lax about protecting sensitive information.

5. IT flaws frequently lead to the theft of debit card information from major banks.
6. Because most IT gear requires access to the web, people living in remote areas of developing countries may be unable to use online banking services.

5.1. Methodology and models of the study

The models reviewed were chosen for their relevance to the study's goals and because they are among the most common model frameworks used in studies of the adoption of IT generally and of IT in businesses with an eye toward preserving corporate culture. The Technology Acceptance Model (TAM), the Technology-Organization-Environment (TOE) framework, the model developed by Edgar Schein, and the competing values framework (CVF) are discussed in light of the study's objectives.

The Technology Acceptance Model (TAM) and its relevance to the study

The Technology Acceptance Model (TAM) is a prominent theory that has been studied extensively in the field of IT adoption. Davis created TAM in 1986 to shed light on why and how people adopt technology in the workplace. According to TAM, the main determinants of system usage in organizations are perceived usefulness and perceived ease of use (Taylor, Todd, 1995; Davis, 1989) cited in Shemi (2012) organizational cultural contexts.

The Technology-Organization- Environment (TOE) framework and its relevance to the study

Organizational context, technological context, and external task environment are the three factors that Tornatzky and Fleischer (1990) identified as having an impact on technological innovation (industry). According to their logic, these three factors must be taken into account in any decision regarding the adoption and implementation of technological innovations within an organization. Formal and informal approaches, linking structures, communication processes, scale, and wiggle room are all mentioned as components of the organizational context.

Edgar Schein's model of organizational cultural change and its relevance to the study

A useful framework for this sort of inquiry is Edgar Schein's theory of organizational culture. The model was introduced initially by Schein (2010). The model is meant to explain the nuances between cultures. Experts in the field have studied and praised Edgar Schein's theory of organizational culture. Edgar Schein researched company culture and subsequently wrote extensively on the subjects of business management and leadership. Other authors and institutions have investigated Edgar Schein's ideas and work on culture as a tool to mold an organization.

The competing values framework (CVF) and its relevance to the study

The Competing Values Framework (CVF) is commonly used by organizational and management experts to assess the impact of a company's culture on factors including quality improvement initiatives, employee and customer happiness, and effective teamwork (Ostroff, Kinicki, Tamkins, 2003). Most commercially available CVF instruments boast of the validity and reliability of their summated scales.

5.2. Research methodology

Research method

Researchers need to be well-versed in the various research methodologies and designs because each method takes a slightly different approach to the study process (Yin, 2014). Choosing the right research method for a study requires an understanding of the reasons behind the various options available. It is acknowledged that comparing and contrasting different research strategies is crucial for understanding the merits and limitations of each strategy. Different methods - quantitative, qualitative, and mixed make up the trifecta of primary research techniques. According to Welch, Piekkari, Plakoyiannaki, Paavilainen-Mäntymäki (2011), a quantitative approach is most useful when testing hypotheses about the relationship between multiple variables.

Population of the study

The sample for a qualitative study needs to be representative of the population of interest (Poortman, Schildkamp, 2012; Cleary, Horsfall, Hayter, 2014). The intended population is represented by a statistically valid sample (Poulis et al., 2013). According to Frels and Onwuegbuzie (2012), researchers should base their sample size on the characteristics of the topic and the amount of data that is readily available. FCMB, currently has two hundred and twenty (220) branches with 3610 employees nationwide (FCMB Ltd, 2020). The study's data was collected from four different locations' senior managers, IT and operation staff in the corporate group and, more specifically, the operations unit. Quality data is important for getting to data overkill (O'Reilly, Parker, 2013).

Sample size

The sample population for this study consisted of 150 members of staff of FCMB out of 3610 employees of the bank. The branches of focus study were: Lekki Admiralty, Ajah, Lekki Jakande and Surulere branches, all in Lagos, in the commercial hub of Nigeria. This group entails both the managerial branch heads, senior and operation's staff, cutting across all ages, and includes males and females in the survey.

Sampling technique

This study selected its participants using a method of purposive sampling. Purposive sampling was crucial for determining the appropriate sample size and accurately representing the target population (Cleary, Horsfall, Hayter, 2014).

5.3. Results and discussions of survey findings

Overview of the study

This part contains findings and their respective discussions. Examination of FCMB's empirical and statistical findings and data analysis. Next, the relevant hypotheses are presented. All empirical findings are consistent with the research questions and objectives of the study. The researcher sampled a total of 150 respondents; 120 questionnaires were returned, representing 80% response rate. Included among the respondents were the branch manager, relationship officers, branch IT support staff, customer service managers, customer service representative officers and support, the branch head of operations, in-branch operations control, marketers, and tellers. The analysis was therefore conducted using the completed questionnaires. The Statistical Package for the Social Sciences (SPSS) was used to analyze the valid study copies returned for analysis. Each branch has a distinct mode of operation based on the types of customers who live or work nearby and the size of the location. When discussing the analyzed data, the researcher also employed descriptive methods for better comprehension.

Questionnaire distribution and response rates per branch

Table 1.

Copies of questionnaire distributed (N = 150) and retrieved (N = 120)

S/N	Branch location	Total staff population sampled per branch	Number of questionnaires distributed per branch	Number of questionnaires retrieved par branch
1.	Lekki Admiralty	24	24	17
2.	Ajah	36	36	27
3.	Lekki, Jakande	45	45	37
4.	Surulere	45	45	39
5.	Total	150	150	120

Source: Field Survey (2023).

Table 1 displays the copies of the questionnaire distributed to respondents and returned by them. With the assistance of a research assistant, 150 questionnaires were distributed digitally and physically to all respondents. Lekki Admiralty received 24 copies, Ajah branch received 36, lekkiJakande received 45 copies as well as Surulere also received 45 copies. After the respondents had completed the questionnaire, a total of 120 copies were recovered, which represents 80% response rate. They were appropriately populated and deemed useful for analysis.

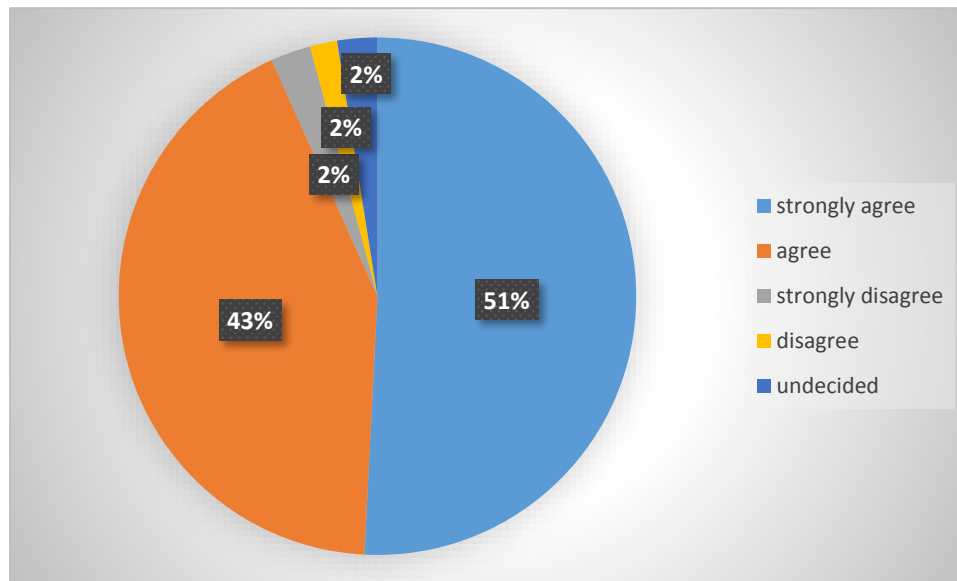


Figure 2. IT implementation in the bank has resulted to increase in the efficiency and productivity of the employees as it has enhanced better teamwork, enhanced swift decision making.

Table 2.

Effect of technical change and automation through information technology in bank's organization culture

Statement	SA strongly agree (%)	A agree (%)	SD strongly disagree (%)	D disagree (%)	U undecided (%)
The use of Banking Automations Technology like artificial intelligence, Chat bots, etc. has led to improvements and efficiency in the quality of work output, especially as it concerns with dealing with customers' requests and minimizing complaints.	83 (69.2%)	15 (12.5%)	1 (0.8%)	10 (8.3%)	11 (9.2%)
IT implementation in the bank has resulted to increase in the efficiency and productivity of the employees as it has enhanced better teamwork, enhanced swift decision making.	61 (50.8%)	51 (42.5%)	3 (2.5%)	2 (1.7%)	3 (2.5%)
Customer satisfaction or otherwise are easily tracked with the Bank's approved Know Your Customer (KYC) software and this has helped customer retention.	71 (59.2%)	40 (33.3%)	2 (1.7%)	7 (5.8%)	0 (0%)
Technological change and ICT tools I work with has resulted in reduction in error rate.	71 (59.2%)	40 (33.3%)	2 (1.7%)	7 (5.8%)	0 (0%)
I am able to effectively process and control my workload and other work process due new technologies.	60 (50%)	47 (39.2%)	3 (2.5%)	8 (6.7%)	2 (1.7%)
The rate of successive and interconnected activities under on job title (Complex duties) has improved with IT implementation	49 (40.8%)	39 (32.5%)	5 (2.5%)	9 (7.5%)	20 (16%)
Customer waiting time and queues have drastically reduced in the banking halls since adoption and changes in technologies	71 (59.2%)	40 (33.3%)	2 (1.7%)	7 (5.8%)	0 (0%)
Service quality has improved with ICT adoption.	47 (39.2%)	60 (50%)	3 (2.5%)	8 (6.7%)	2 (1.7%)

Cont. table 2.

FCMB holds its place in the banking industry and inspires the competitive landscape of the financial services market given its embrace of new Technologies.	51 (42.5%)	61 (50.8%)	3 (2.5%)	2 (1.7%)	3 (2.5%)
Technologies improves teamwork, bridges hierarchy gaps and effectively improves branch and bank organogram	39 (32.5%)	49 (40.8%)	20 (16%)	9 (7.5%)	5 (2.5%)

Source: Field Survey (2023).

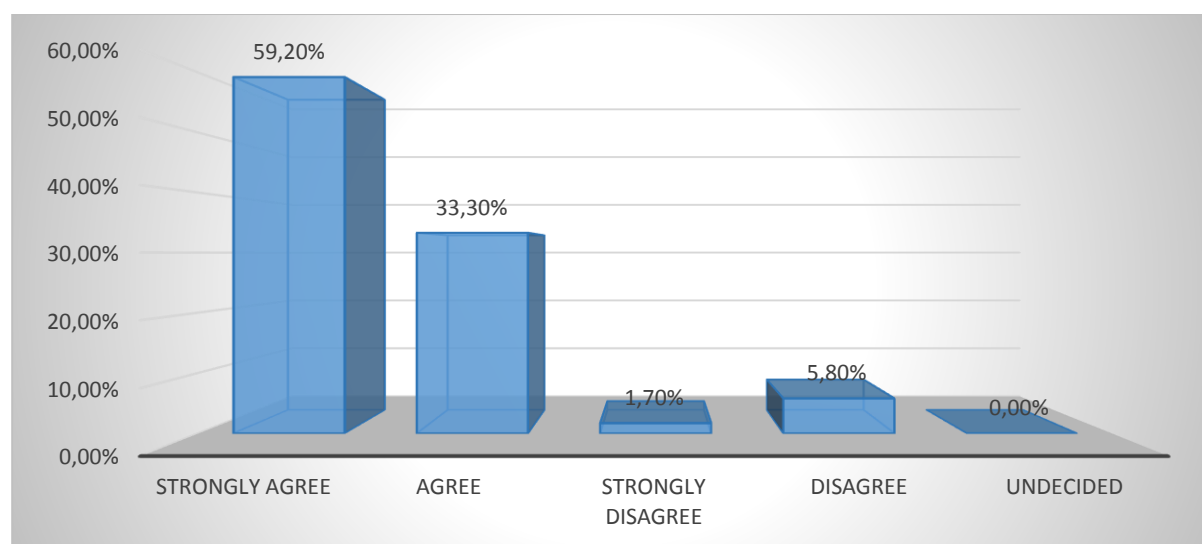


Figure 3. Technological change and ICT tools I work with has resulted in reduction in error rate.

Results discussion

Significant findings of this study are discussed in this section. The effects of Information Technology on organizational culture and management have been analyzed. From the table 2, it can be deduced that the majority of respondents, which are 83 people, (69.2%) strongly agree that the use of Banking Automations Technology has led to improvements and efficiency in the quality of work output, especially as it concerns with dealing with customers' requests and minimizing complaints.

61 respondents (50.8%) are in strong agreement that IT implementation in the bank has resulted in an increase in the efficiency and productivity of the employees as it has enhanced better teamwork, enhanced swift decision making.

71 respondents (59.2%) agree with IT implementation increasing customer satisfaction or otherwise are easily tracked with the Bank's approved Know Your Customer (KYC) software and this has helped customer retention same percentage agrees with Technological change and ICT tools resulting in reduction in error rate.

This corroborates the findings of a study by (KadianWanyonyi Wanyama, Ruth Mitalo, 2022) which indicated that technological change in organizations had statistically significant effect on overall employee's performance in commercial banks. The majority of the respondents were also in strong agreement that Customer waiting time and queues have drastically reduced in the banking halls since FCMB adopted and made changes in technologies, 71 respondents, (59.2%) agree.

The majority of respondents also agree and strongly agree that service quality has improved with ICT adoption. Technologies improves team work thereby bridging hierarchy gaps and effectively improves branch and bank organogram.

This finding also supports a report of a work from (Arbussa Reixach, 2001) that indicated that a great majority of participants (86%) reported that ICT use in the workplace improves their work and reduced banking hall congestion. Her findings also indicated that error rates reduced drastically.

5.4. Recommendations dedicated to the analyzed bank

FCMB should prioritize the following findings in the use of ICT to provide banking services:

1. The bank needs to find ways to make their online services more available to the general public. Because of this, concerns and feedbacks regarding electronic banking services from customers could be addressed.
2. The bank must ensure that they have a stable network system and, if possible, adopt the best and fastest network system in the country for their operations. It should also adopt the most up-to-date versions of the mobile system of banking in order to serve customers better and reduce dispense error complaints and overcrowded branches.
3. The bank should encourage its customers to adopt a habit of banking online rather than visiting a branch, as the latter often experiences long queues and delays due to the high volume of customers waiting to complete their transactions. Zugeldar et al. (2000), noted that consumer protection is the most pressing legal concern in internet advertising.
4. The bank needs to establish more regional IT hubs to decentralize its operations. That helps in improving network efficiency and relieve load on their primary server, resulting in fewer system link disruptions typical of banking operations.
5. The bank needs to carry out periodic marketing research studies on FCMB's own customers, such as creating a database containing both demographic and psychographic profiles of its customer base, would help FCMB's management. Having such a database would help management determine the optimal mix of personnel and technology resources to provide consistent, high-quality service at all times. Despite the need for extensive further research to be done to fill in the gaps in knowledge in this area, the current study hopefully provides future researchers with some basic areas in which to begin.

6. Conclusions

The undertaken research shows that the study of the effects of information technology on organizational culture and management, which focused on Nigeria's First City Monument Bank (FCMB) results in the following conclusions:

1. The customers are able to confirm their account numbers and get information on when and how to pick up their credit cards, debit cards, point-of-sale services, and other financial services made possible by information and communication technologies.
2. The employee productivity could rise as a result of better handling of technological developments like mobile banking, mobile money transfer, automated teller machine use, online banking, service automation, marketing automation, Real-Time Gross Settlement (RTGS), block chain technology, and social media platforms.
3. The organizational loyalty is influenced by employees' shared values and beliefs as well as their individual contributions to the company. Internalizing cooperative connections is made easier by the organization's culture, which in turn allows for the administration of efficient organizational processes.
4. According to the research, a bank's entire business plan should include spending money on IT. Bank management must enhance spending on information and communication technology goods to boost service speed, convenience, and accuracy. They would boost Nigerian banks' productivity, income, and competitiveness, making them more resilient to the opportunities and threats of an ICT-driven globalized economy.
5. The study suggests that each bank in Nigeria should not only invest heavily in ICT, particularly POS, but also in a research team specializing in informatics and business management, as well as periodic surveys.

The research limitations are due to a banking sector in Nigeria, which is known for its cumbersome bureaucracy and lengthy decision-making processes. This issue made it more difficult to collect appropriate set of data in a timely manner. Another limitation is insufficient prior research studies on the selected topic.

The future research should be focused widely on the global banking system to determine key success factors concerning the synergy effects of information technology and organizational culture and management.

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IMPACT OF SAFETY – SPECIFIC TRANSFORMATIONAL LEADERSHIP ON PROJECT SAFETY CLIMATE: A STUDY ON PAKISTAN TEXTILE INDUSTRY

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Purpose: The impact of transformative leadership on the atmosphere of safety in projects is the focus of this research. In the high-risk textile business, the safety climate is crucial.

Design/methodology/approach: Questionnaires were used to gather information from 270 people working in the textile industry. These people were asked about their experiences with machinery used in different textile plants. Using moderated mediation, the data were evaluated.

Findings: According to the findings, transformational leadership is an important factor in ensuring a safe climates for projects. The findings reveal that transformational leadership had an effect on project safety climate, but that attitude towards safety completely moderated that effect, and that safety compliance mediated the relationship between the two. Project safety climate was shown to be positively correlated with safety-specific transformational leadership.

Practical implications: Frontline supervisors may use the study's results to better manage safety on the job and ensure the safety of their employees.

Originality/value: There has been little research on how different leadership styles among project managers affect final results, but this study fills that gap. In particular, we shed light on how a transformational leadership style that is safety-specific may improve the project safety climate as a crucial border condition. The scope of social exchange theory's applicability to project settings is further expanded upon.

Keywords: Safety Specific Transformational Leadership, Project Safety Climate, Attitude Towards Safety, Safety Compliance.

Category of the paper: Case study.

1. Introduction

The goal of this research was to identify the traits shared by effective leaders who inspire complete obedience from their followers. A leader's duty to create a risk-free work environment is what's known as safety-specific transformational leadership (SSTL) (Kelloway, Mullen, Francis, 2006). Executive leadership is more important than formal rules and procedures when it comes to maintaining a safe workplace (Zohar, 2000). Employee health and safety are directly impacted by an organization's safety rules and practices (Neal et al., 2000). Workers' reactions to and compliance with workplace policies and procedures directly affect the degree of safety in that setting (Michaelidou, Hassan, 2008).

This study emphasizes the significance of establishing safety standards, especially in the energy sector, based on historical data and losses that happened due to the lack of such implementations. If you want to make sure your company or workplace is financially stable, follow these rules (Flin et al., 2000). Rather of focusing on leadership's role, this study compares two variables: knowledge-domain safety and field-based employee motivation towards safety (Jiang, Probst, 2016). Research on the effects of leadership on company culture and the success of safety programs is expanding (Smith et al., 2016). One of the most critical aspects of a safe workplace is the safety atmosphere, which may be defined as the degree to which employees adhere to safety protocols (Huang et.al, 2016). Businesses should prioritize safety protocols, particularly for jobs where employees face high threats to their health and safety (Lee, Dalal, 2016). To prevent harm to people, property, or the environment, many critical systems must be operated in accordance with established safety standards (Vara et.al, 2016). Prior research has shown that when employees see new safety practices with optimism, the overall safety climate in the workplace improves (Kvalheim, Dahl, 2016).

According to the findings, two different leadership styles are associated with the effectiveness of safety measures implemented by employees (Kelloway et al., 2016). Although there have been earlier comparative studies on safety measures, none of them have specifically targeted Pakistan's textile sector (Shen et al., 2017). Transformative and transactional leadership and conduct are very necessary in life-or-death situations (Willis et al., 2017). The psychological safety environment is directly related to the overall health, happiness, and efficiency of the workforce via the words and actions that comprise it (Dollard, Idris, 2017). The impact of elements such as safety performance, conduct, and mindset is mitigated by SSTL (Mullen et al., 2017).

Decisions that might have fatal consequences call for both transformational and transactional styles of leadership and conduct (Willis et al., 2017). The psychological safety environment is directly related to the overall health, happiness, and efficiency of the workforce via the words and actions that comprise it (Dollard, Idris, 2017). The impact of elements such as safety performance, conduct, and mindset is mitigated by SSTL (Mullen et al., 2017).

Along with the connection between safety-related knowledge and motivation, this study does not investigate the role of leadership in the realm of safety involvement (Jiang, Probst, 2016). Many critical systems must operate in accordance with stringent safety standards at all times to avoid endangering people, property, or the environment (Vara et al., 2016). No studies have examined safety compliance (SC) or attitude towards safety (ATS) in a mediating or moderating capacity. The topic of whether forms of revolutionary leadership are possible in the safety sector is now quite topical. The outcomes of applying transformational leadership methods and tactics with a focus on safety have been the subject of much research and analysis by experts in the field as well as in academia. Nevertheless, there is a dearth of literature on the topic of transformational leadership's potential applications in the management and mitigation of risk exposure inside organizations.

Few studies have focused on the issue of project risk. Although there have been earlier comparative studies on safety measures, none of them have specifically targeted Pakistan's textile sector (Shen et al., 2017). The significance of employees' and workers' involvement in organizational safety is well-established, but there is still a gap in our understanding of how context and culture affect businesses' safety environments (Petitta et al., 2017). As a result, there is a dearth of literature on the topic of the area we are studying for our project.

1.1. Social exchange theory

Human relations may be better understood by analyzing people's trading behavior (Homans, 1958). People figured out how to talk to one other and work together via social trade (Blau, 1964). The process of exchange has consistently gained traction in several academic domains, despite the fact that its theoretical validity has been questioned (Emerson, 1976). Psychology, sociology, and organizational behavior are just a few of the academic disciplines that back up research on human interpersonal relationships. A pattern of exchange behavior underpins this contact between management and employees, as it does other human interactions. When leaders and employees have fruitful conversations, it strengthens their bond and motivates them to understand each other's perspectives. The way a person acts determines the nature and trajectory of one's relationships and interactions with them. It may help project-based companies create a safe workplace by facilitating two-way communication between employees and management.

The fact that SC is built on social interaction lends credence to its position as a mediator between safety outcomes and revolutionary leadership. Managers and employees are more likely to engage in SC behavior when they are able to trust one another, which allows leaders to provide effective help. The success of a leader in implementing safety protocols depends on the social connection between the boss and their workers.

Keeping employees safe while projects are underway is a leader's top priority. As far as taking care of employees is concerned, leaders put their safety first. And therefore, SSTL, project safety climate (PSC), SC and ATS are all related. If leaders' instructions to their teams do not result in complete compliance with all safety requirements, then they should resort to whatever tactics are required to ensure compliance.

2. Preliminary studies

2.1. Safety specific transformational leadership and project safety climate

The presence of rules and regulations is less important in ensuring a safe workplace than the behavior of leaders inside the organization (Zohar, 2000). This study rests on three primary tenets: The leader's leadership style dictates the level of effect it has on subordinates, the leader's style guides those subordinates, and employees are more likely to be enthusiastic about the effort if the leader announces safety precautions (Zohar, 2002). Workers' propensity to adopt safety measures and their output were both measured by the study's two leadership styles (Kelloway et al., 2006).

This study looks at the leadership style and how well it manages the safety measures that the company has in place for its employees. A strong relationship existed between the ways leaders led and the things their employees did. A capable and effective manager will make sure that his employees follow these safety measures (Clarke, Ward, 2006). The leaders of 21 healthcare organizations were evaluated both before and after they received training on transformational leadership and the rules and regulations that control how their firms execute safety measures. According to the results of the post-test, there was a significant improvement in the safety procedures put in place by businesses after the trainings (Mullen, Kelloway, 2009).

This study's findings show how the variables are related to one another and to the other known components, as well as to the mediators and moderators. Although these links have been there for quite some time, it is only in the last 30 years that scholars have started to look at them in more detail, including the potential impact of leadership as a climatic antecedent (Zohar, 2010). This article delves at the reasons of the many accidents and injuries that have occurred in Dutch warehouses in the last several years (Koster et al., 2011). A recent study shows that effective leadership styles of supervisors positively affect the safety protocols that employees follow. Unexpected payoffs and transformational leadership are tested in several sectors where PSC is put to the test (Kapp, 2012).

Research on the effects of leadership on company culture and the success of safety programs is expanding (Smith et al., 2016). Companies should strongly urge their employees to adopt safety measures if their projects might put their health and safety at risk (Lee, Dalal, 2016). Research has shown that when employees see new safety practices with optimism, the overall safety climate in the workplace improves (Kvalheim, Dahl, 2016). In addition to safety performance, attitude, and behavior, SSTL moderates (Mullen et al., 2017).

Hypothesis 1: The correlation between safety specific transformational leadership (SSTL) and project safety climate (PSC) is significant.

2.2. Mediating role of safety compliance

The newly-initiated study set out to examine the link between SC, safety performance, and accidents on the job. There is a dearth of information on project-related workplace accidents, despite the abundance of literature on the topic of SC's effect on safety performance. As a result, this study establishes a link between construction site and organizational safety behaviors, worker performance, and injuries on the job (Clarke, 2006). Research on safety climate persisted for decades, maintaining its level of depth throughout. The main goal of this study is to compare safety climates at the organizational and group levels. On several fronts, this study advances the notions around the safe environment (Dov, 2008).

The leaders of 21 healthcare organizations were evaluated both before and after they received training on transformational leadership and the rules and regulations that control how their firms execute safety measures. According to the results of the post-test, there was a significant improvement in the safety procedures put in place by businesses after the trainings (Mullen, Kelloway, 2009). This new study investigates the relationship between effective managers' leadership styles and the safety measures their employees take. Both the manufacturing and construction sectors put revolutionary leadership and uncertain remuneration to the test in PSC-specific situations (Kapp, 2012). Organizational, leadership, and safety studies are seeing a boom in research on the effects of leadership on safety culture and the outcomes of safety programs in the workplace.

Numerous safety projects have shown improved results when led by transformational leaders with a focus on safety. Having said that, these links have not been thoroughly discussed by their service. Research on the effects of leadership on company culture and the success of safety programs is expanding (Smith et al., 2016). In particular, companies should push their employees to adopt preventive safety precautions if their jobs put them in danger of health and safety (Lee, Dalal, 2016). What employees do and how they behave in a dangerous work environment is the greatest indicator of how important that environment is. According to recent research, fostering a good safety culture may enhance the efficacy of safety measures while decreasing the probability of accidents and injuries.

We start by exploring various scenarios and determining safety climate. The next step is to look at the research on the effects of a safe workplace on employees' motivation, decision-making, and performance (Grin, Curcuruto, 2016).

Hypothesis 2: The connection between safety specific transformational leadership (SSTL) and project safety climate (PSC) is mediated by safety compliance (SC).

2.3. Moderating role of attitude towards safety

Scientists in the domains of psychology and related disciplines have long been curious about attitude strength. The findings provide light on how a person's perception of a product affects their behavior (Howe, Krosnick, 2017). Many consider the construction business to be among the most dangerous globally. There may be fewer instances if workers are more familiar with the ATS. The purpose of this study was to determine how often accidents were directly caused by workers' activities and how inclined workers were to be safe on the job (Gharibi et al., 2016).

Employees have serious reservations about the quality of service they get from any business (Wilcock et al., 2004). A rapidly expanding area of research is the effect of leadership on the culture of organizations and the outcomes of safety programs (Smith et al., 2016). To be more specific, companies should push for preventive safety measures from employees whose jobs are known to be hazardous to health and safety (Lee, Dalal, 2016).

Research has shown that when employees see new safety practices with optimism, the overall safety climate in the workplace improves (Kvalheim, Dahl, 2016). In order to prevent harm to people, property, or the environment, it is essential that several critical systems follow stringent safety rules when placed into operation (Vara et.al, 2016). There must be an alignment between words and actions about the psychological safety climate if an organization cares about its employees' health, happiness, and productivity (Dollard, Idris, 2017). Safety performance, behavior, and attitude are all impacted by many elements, but SSTL acts as a moderator (Mullen et al., 2017).

Hypothesis 3: As attitude towards safety (ATS) acts as a moderator between safety specific transformational leadership (SSTL) and safety compliance (SC), a higher ATS strengthens the correlation between SSTL and SC.

Figure 1 shows the relationships between safety specific transformational leadership (SSTL), project safety climate (PSC), attitude towards safety (ATS), and safety compliance (SC).

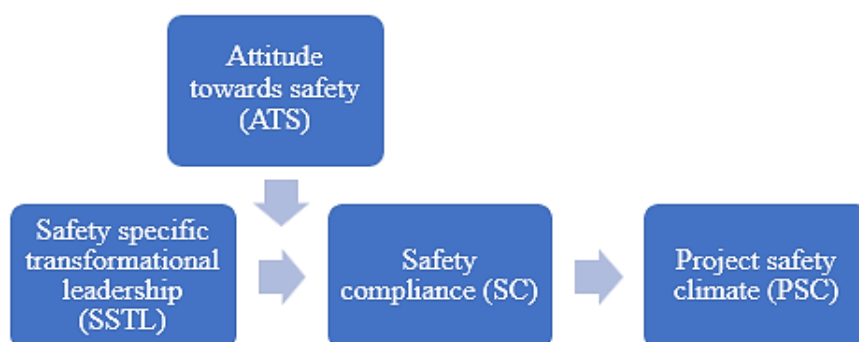


Figure 1. Theoretical Framework.

3. Methodology

3.1. Sample and population

The study was hosted by Gul Ahmad, a textile maker from Karachi, Pakistan. A group of people who had previously worked together in a cooperative formed the company to test the waters of the new free-market economy. The label makes high-quality, reasonably priced clothing for women. When customers shop online, the brand also offers international shipping to the United States, the United Kingdom, and Canada. The rapidity with which fashions come and go makes it critical for businesses to maintain a customer-centric focus at all times. The plus-size market has received little attention due to the traditionally difficult-to-please nature of this population. Hence, the company has to update its products with new designs and state-of-the-art technologies. The company employs 350 people. The workforce is dominated by women. Sewers, designers, tailors, and sewing technologists are just a few of the many occupations that use them. A shortage of skilled workers, particularly in rural parts of Pakistan, is slowing the company's growth. Problems in the Pakistani area are exacerbated by the lack of vocational schools. The fashion industry is one that is always changing and adapting. Businesses in the apparel industry may benefit from human resources since their workers' expertise determines how well the firm does. The knowledgeable and competent employees are the company's greatest asset. Issues with human resources pose the greatest threat to the company's growth. The overall apparel sector is based on very innovative products and cutting-edge technological developments. The competence and commitment of the employees determine the company's competitiveness. Consequently, managers' capacity to exhibit a transformational leadership style to their employees determines the organization's performance.

Those who worked for the Gul Ahmad apparel line made up the bulk of the review's sample. This is why the workers were brought closer together via the personal interactions. There were a total of 350 representatives who were contacted and requested to complete the questionnaires. On a widely agreed upon time, 291 of these surveys were collected in their whole. The lack of complete information prevented the inclusion of 21 out of 290 surveys. The research included the remaining 270 surveys.

3.2. Instrumentation

3.2.1. *Safety specific transformational leadership*

Safety specific transformational leadership (SSTL) was measured by using Smith, Eldridge, and DeJoy (2016) questionnaire developed a 10-item scale to measure SSTL; this scale was based on previous work by Barling et al. (2002). "My immediate supervisor shows pleasure when I execute my job safely", "My immediate supervisor acts in a manner that indicates a commitment to a safe workplace" and "My immediate supervisor encourages me to

communicate my thoughts and views regarding safety at work". A 5-point Likert-type scale, ranging from "strongly disagree" to "strongly agree" was used to evaluate the items. In this particular sample, the Cronbach alpha value is 0.95.

3.2.2. Safety compliance

Griffin and Neal's (2000) safety performance measure served as the basis for self-reports about safety compliance and involvement. For each item, respondents used a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Ensuring the maximum degree of safety while carrying out my job, using all essential safety equipment, reporting that I carry out work in a safe way, and following the right safety procedures were the four elements that participants were asked to rate in terms of their personal safety compliance. In this particular sample, the Cronbach alpha value is 0.92.

3.2.3. Attitude towards safety or safety attitude

In an attitude survey, people are asked to express their opinions on a variety of statements on various events or behaviors. This formal attitude evaluation made use of a 25-item occupational safety attitude questionnaire that has previously been validated in a number of Iranian research. Hemmatjoo Y. (2004) found a significant Cronbach's alpha value of 0.86 for the questionnaire. In order to quantify the safety attitude, the questionnaire was scored using Likert 5-degree scales.

3.2.4. Project safety climate

Four components of safety atmosphere were found by DeJoy et al. (2000) and included 16 items: management's dedication to safety, supervisors' feedback on performance, employees' participation in safety, and norms of conduct among coworkers. Our brief safety climate assessment is based on these four characteristics, and we selected six questions from them: one for supervisory performance feedback, one for worker engagement in safety, and one for colleague behavior standards; three for management commitment to safety. The aspects of engagement, feedback, and behavior standards were selected as individual items because they are clear and easy to understand. However, additional criteria were deemed essential for appropriate assessment of management commitment, a larger construct. We incorporated the item(s) with the greatest loading in the exploratory factor analysis for each of the four variables into the 6-item measure (DeJoy et al., 2000). On a 5-point scale from "Strongly agree" to "Strongly disagree" each question was answered. The Cronbach's alpha value for this scale is 0.85.

4. Results and analysis

The translation, detailing, and combining of precise review results make up this section. It goes over the methodologies for charts and tables, which allow for explaining and detailed evaluation of the data. The overall reliability of the instrument and all dependent and independent variables are also handled in this part. One way to look at the interplay between the variables is via the link and relapse.

Table 1.

Taking age, education and work experience as control variables

Structural Path		Dependent Variable	Path Coefficients
SSTL	→	Project safety climate	0.610***
Age	→	Project safety climate	0.044
Education	→	Project safety climate	0.023
Experience	→	Project safety climate	0.056

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, specific safety transformational leadership (SSTL).

Control variables are those that remain unchanged during an experiment in order to measure the correlation between other variables. We tested the effect of demographic variables on our suggested model using an analysis of variance (ANOVA). Results showed no statistically significant correlation between any of the model variables and respondent age, education level, or years of job experience. We tested the posited model once we were sure it had enough discriminating validity. Table 1 explained that employees age, education, and work experience as control variables. As the path coefficient values for age, education and experience are 0.044, 0.023 and 0.066 respectively are lesser than 0.05 they show that there is no effect of the above mentioned factors on the overall model.

Table 2.

Relationship between Specific Safety Transformational Leadership and Project Safety Climate (Correlation)

S.no	Variables	1	2	3	4
1	SSTL	1			
2	PSC	0.59**	1		
3	SC	0.61**	0.63**	1	
4	ATS	0.59**	0.57**	0.67**	1

Note. * $p < .05$, ** $p < 0.01$, *** $p < 0.001$, specific safety transformational leadership (SSTL), safety compliance (SC), attitude towards safety (ATS), project safety climate(PSC).

Determining the strength of associations between a dependent variable and several independent variables is the goal of regression analysis, a collection of statistical procedures. In addition to simulating potential future relationships between variables, it may be used to evaluate the strength of existing ones. According to Table 2, we used regression analysis to check the significance between SSTL and PSC and we found that they are positively associated. We adopted the first hypothesis. $B = 0.59$, $t = 16.50$, $p = 0.001$ indicates a statistically significant connection. A t-value of 16.50 for SSTL indicates a very significant connection. There is

a statistically significant relationship between SSTL and PSC, according to this hypothesis, with a t-value of 16.50. The B-coefficient value of .59 indicates that the association between SSTL and PSC will strengthen by 59% if SSTL is changed by one unit, strengthening the relationship. Therefore, the aforementioned findings are supported by previous research that also indicates a favorable correlation between SSTL and PSC (confirmation of hypothesis 1).

Table 3.

Mediating Role of Safety Compliance between Specific Safety Transformational Leadership and Project Safety Climate

Model	Un-standardized Coefficients		Significance Level	
	B	Std. Error	t-ratio	Sig.
(Constant)	1.823	0.434	4.259	0.001
Safety Compliance	0.610	0.099	6.912	0.000
(Constant)	1.823	0.434	4.259	0.001
Safety Compliance	0.473	0.250	2.140	0.039
Safety Specific Transformational Leadership	0.095	0.198	0.0485	0.640

Note. Dependent variable: project safety climate: $R^2 = 0.15$, $p = 0.000$.

Table 3 shows the relationship between the independent variables SSTL and the dependent variables PSC, with safety compliance serving as a mediator. It became clear that SC completely mediates the link between SSTL and PSC when the value of B for relational SSTL decreased from 0.473 to 0.095, which was close to 0. After adjusting for M, there was no further significance for either X or M, suggesting complete mediation. Hypothesis 2 was therefore confirmed and the mediation role of Safety Compliance was acknowledged by these results.

Table 4.

Moderating role of attitude towards safety among specific safety transformational leadership and safety compliance

Model	Unstandardized Coefficients		T	Sig.
	B	Std. Error		
(Constant)	0.863	0.968	0.892	0.374
SSTL_MEAN	0.279	0.266	1.047	0.002
ATS_MEAN	0.375	0.282	1.328	0.015
ATS_SC	0.532	0.075	7.093	0.003

Note. Dependent Variable = safety compliance (SC) MEAN $R^2 = 0.42$, $F = 57.279$, $P = 0.000$ attitude towards safety (ATS).

Table 4 tests the hypothesis 3 (attitude towards safety moderates and strengthens the link between safety specific transformational leadership and safety compliance) moderation regression analysis was run by using the Barron and Kenny (1986) method. To test the hypothesis 3 (attitude towards safety moderates and strengthens the relation between safety specific transformational leadership and safety compliance) moderation regression analysis was run by using the Barron and Kenny (1986) method. In the table 4 results shows that the association among SSTL and SC, the ATS of the organization moderates this relationship significantly. F value is 57.279 shows model fitness with $p = 0.000 \leq 0.05$ which indicates that data was fitting overall model. The regression results show that the R square value is .42 which

means that 42% fluctuation was clarified by psychological climate in innovative work behavior. B carries a value of .375 and p value was significant at $\alpha = 0.05$ which means that the association among ATS and SC was significant. The p value was 0.015 which is significant and ≤ 0.05 which means that the third hypothesis that is (ATS moderates and strengthens the relation between SSTL and SC) was accepted.

5. Discussions

To ensure the project's success, SSTL in a project-based company will promote safety standards and norms for workers, which will immediately enhance morale. This is because managers play a crucial role in guiding all tasks and activities towards success. This means that the project's overall level of safety is enhanced when SSTL plays a supporting role in recognizing and rewarding personnel for their efforts to mitigate risk. In order to ensure that all personnel adhere to the project's safety protocols, SSTL has instituted stringent safety procedures.

In project-based companies, SSTL is crucial for maintaining a safe environment. Workers look up to their leaders and follow their example if those leaders are charismatic and successful. The only way for a leader to ensure that his people follow safety protocols is for him to do the same. To ensure that his employees or workers adhere to such safety protocols, a leader might use a variety of methods. In a project-based company, the leader is responsible for implementing safety measures and should be aware of the techniques that will enable him to do so. In the Polish setting in particular, it is an absolutely necessary quality for a project to be a success.

Together, SSTL and SC form a favorable correlation. The hypothesis was declared true and accepted. With a significant connection ($B=0.59$, $t=16.50$, $p=0.001$), it might be concluded that. The link is very significant, as shown by the t value of 16.50 for SSTL. With a t-value of 16.50, this hypothesis proves that SSTL and PSC are significantly related. Because the B-coefficient was 0.59, we can see that a one-unit change in SSTL will result in a 59% shift in the connection between SSTL and SC, further strengthening the association. All of the aforementioned findings are consistent with the positive correlation between SSTL and PSC that has been reported in the literature. As a leader, you should always keep in mind that effective communication is a crucial skill for guiding your team and the project to success. Those rules and regulations are meant to be followed by staff working on the projects, and the person accountable for this is known as a project leader. The boss must communicate or coerce the employees into following safety procedures if the employees do not care about them. As a corollary, a project manager is the one who must inform all team members of the safety protocols that must be followed in order for the project to be executed successfully,

and this can only be done with the full support and involvement of the project manager. In order to ensure that all workers are well-informed on all critical aspects, plans, and policies pertaining to safety measures, SSTL is essential for enforcing the rules across all levels of a project-based business. The leader of any given enterprise or organization must ensure that his workers are secure from harm. A leader in a project-based company, and particularly one in Pakistan, needs the personality traits that will ensure his team members adhere to the established norms and policies. Simply put, this matter has been almost disregarded by Pakistani groups.

The results demonstrate a strong correlation between SC and SSTL and PSC, suggesting that SC mediates this relationship. The unstandardized regression coefficient shows positive limits of 0.41, and the bootstrapped 95% interval around the indirect effect of this relationship between SSTL and PSC through SC does not contain zero.

Results show that safety compliance improves when leaders use a transformative approach that focuses on safety. But researchers haven't looked at these connections in depth. Research in organizations has shifted its focus to the leadership's impact on safety atmosphere and the results of safety measures (Smith et al., 2016). These findings corroborate the extensive literature demonstrating SC's mediating function between SSTL and PSC.

It is crucial to have a work environment that reflects safety, and workers' actions and reactions assist to shape this view. Accident and injury rates, as well as other safety-related outcomes, may be better predicted by creating an environment that encourages and rewards safe practices, according to studies conducted in recent years. We begin by investigating the potential applications of safety-related circumstances to various levels of analysis and by examining the basis of a safety atmosphere that represents safety. As a result, we may see that the safety-conscious work environment influences employee actions (Grin, Curcuruto, 2016). Leaders may improve the degree of safety in a project by actively participating and being present, and by implementing effective SC rules and regulations that they inculcate in their staff via good counseling inside the project-based organization. According to the data, ATS acts as a mediator between SSTL and SC, supporting this idea.

Consistent with previous research, these findings provide credence to SC's mediating function between SSTL and PSC. The degree of safety atmosphere in a company is influenced by the attitude of its workers towards the execution of safety measures, according to previous study (Kvalheim, Dahl, 2016).

5.1. Practical and theoretical implication

In the existing literature, this work has contributed to a new area by testing and analyzing the association of SSTL with other factors like Safety Compliance and Project safety climate. This research has contributed significantly to the existing knowledge on SSTL by examining its effects on PSC. This research has shown a new way for leaders to solve safety problems in projects by being proactive and actively involved, which is great since safety is the most popular demand in the project industry right now. In this research, we looked at new types of

relationships that are crucial for startups to get an edge in today's dynamic and innovative market. This work makes a significant contribution to the literature by elucidating the functions of SC and ATS in mediating the relationship between SSTL and PSC and SSTL and SC, respectively. Because ATS is both distinctive and critically important, studies that focus on it have made substantial contributions to the literature and will likely continue to do so in the future.

Managers, subordinates, supervisors, and employees can all benefit from this study because, as the most pressing need of this century, Pakistan is grappling with a number of safety-related issues that necessitate additional research into how to address these cultural norms. The study's findings will shed light on the concepts of SSTL, subordinates, and supervisors, which can improve the relationship between leaders and employees through the use of effective communication channels and procedures to ensure project safety.

Researchers should devote more time and energy to studying SSTL and PSC because these variables can be applied to other fields that place a premium on safety, such as the electrical and civil engineering industries, by drawing comparisons to other fields where safety is an essential component of the job description. This work might be improved and expanded upon by following the provided suggestions for future research.

6. Conclusion

When it comes to completing tasks successfully, SC is crucial. In a nutshell, they are the policies and procedures that govern the implementation of safety measures in project-based companies. An organization's procedures for compliance with these laws and regulations should be rather stringent. Strict action must be taken against any employee who demonstrates any degree of negligence with respect to these safety measures. In project-based organizations in Pakistan, in particular, SC mediates the relationship between SSTL and PSC, and leaders are expected to adhere rigidly to those guidelines in order to ensure the success of their projects. The link is very significant, as seen by the ATS values.

Because it is the employee's actions that lead him to adhere to those laws and regulations concerning the safety measures of the workers, the ATS is particularly crucial. The degree of safety in projects may be enhanced if personnel adhere to certain safety precautions, which are implemented for their own protection.

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PERCEPTION OF INDUSTRY 4.0

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Purpose: The purpose of this study is to understand opinions, beliefs and expectations regarding the introduction of new technologies and innovations related to the Industry 4.0.

Design/methodology/approach: The research tool was a structured survey questionnaire prepared by the author of the article. The survey was conducted in the first quarter of 2024 among 112 entrepreneurs from the Silesian Voivodeship.

Findings: The research results confirm that as the company grows, so does the knowledge about 4.0 technology and the assessment of the benefits of introducing modern technological solutions into company operations.

Originality/value: The value of the article is a look at the benefits, opportunities and factors inhibiting the implementation of 4.0 technology from the point of view of micro, small and medium-sized entrepreneurs.

Keywords: Industry 4.0, SME sector, new technologies.

Category of the paper: Research paper.

1. Introduction

Industry 4.0, referred to as the fourth industrial revolution, belongs to an advanced stage of using digital solutions in companies related to expanding the possibilities of simple automation (Schwab et al., 2019). This is the next stage of company development based on digital transformation, in which value chains, products, services and business models change. The development of Industry 4.0 (I4.0) is a model of ongoing transformation that has significantly influenced production capabilities used in various industries (Frank et al., 2019). The idea of Industry 4.0 was to implement the 2011 project as part of the German government's high-tech strategy in response to the needs of entrepreneurs to modernize production lines (Lee, 2013). Within this concept, intelligent systems, artificial intelligence, the Internet of Things and advanced robotics are the key elements of changes taking place in the industry. Thanks to this, production becomes more flexible, effective and automated (Vaidya et al., 2018). It should be mentioned that the latest industrial revolution has influenced not only industries, but also

people's everyday lives. For this reason, discussions on this topic are common - from scientists to entrepreneurs, governments and social organizations.

The purpose of this study is to understand opinions, beliefs and expectations regarding the introduction of new technologies and innovations related to Industry 4.0. The considerations are complemented by the identification of barriers and challenges related to the adaptation of Industry 4.0. Conducting such a research analysis would allow us to better understand current trends and challenges related to industry transformation and better prepare companies, employees and society for the new digital reality.

2. Perception of Industry 4.0 in the light of literature research

Industry 4.0 is a term used to describe a new phase of industry development, characterized by the intensive use of digital technologies and process automation. One of the key elements of this transformation is the growing role of perception in the context of technology, management and work (Sanders et al., 2016; Chen et al., 2017; Yang, Gu, 2021).

Literature research on the perception of Industry 4.0 focuses on various aspects of this phenomenon, including: in the context of: employees (e.g.: Kadir et al., 2019; Louw, Deacon, 2020), information and communication technologies (e.g.: Sanders et al., 2016; Zhou, Cardinal, 2019; Javaid, Haleem, 2020), innovation (e.g.: Bassanini et al., 2000; Nagy et al., 2022; Wolniak, 2023), sustainable development (e.g.: Ejsmont et al., 2020; Ghobakhloo, 2020), smart cities (e.g.: Prosser, 2018; Yun, Lee, 2019) or various aspects of production (e.g.: Sanders et al., 2016; Frank et al., 2019). In a holistic approach, Beier et al. (2020) divided Industry 4.0 into four categories: people, technology, organization and features.

In response to the needs of the industry in relation to the development of digital technology, it is necessary to analyze the earlier stages in the development of the production industry, which contributed to the creation and development of Industry 4.0 (PwC Report, 2017):

- the first industrial revolution, which began in the 18th century, was based on the use of energy from watercourses and steam machines for the production of everyday products;
- the second industrial revolution began at the turn of the 19th and 20th centuries and was the result of electrification with the first use of modern production lines, which enabled the reduction of production costs and its massification;
- the third industrial revolution came in the 1970s with the use of the first industrial automation systems based on electronic circuits.

The fourth industrial revolution is the beginning of the 21st century and further automation of production using advanced robots based on three pillars:

- integration of IT systems vertically (between departments in the company) and horizontally (with suppliers, customers and cooperators);

- digitization of the product and service offer - adding elements of the Internet of Things to manufactured products;
- new, digital business models - replacing traditional industrial products with comprehensive solutions tailored to the needs of a specific customer, combining products and services, using electronic contact and sales channels.

Previous industrial revolutions were driven by single technological inventions such as the steam engine (1.0), electricity (2.0), and computers (3.0). In contrast, the ongoing fourth industrial revolution is driven by existing technological developments and the ability to process large amounts of data (Rupp et al., 2021).

In terms of the solutions undertaken, Industry 4.0 has transformed into a multi-faceted approach aimed at strengthening the competitiveness of the industry (Frank et al., 2019; Xu et al., 2021). It should be emphasized that activities within Industry 4.0 are based on technology, which is driven by the constant pursuit of higher efficiency. As an umbrella term, it encompasses a group of interconnected technological advances while emphasizing an increasingly digitized business environment (Xu et al., 2021). This perceived end-to-end technology integration not only transforms manufacturing processes, but also has profound implications for the broader industrial landscape.

Industry 4.0 therefore acts as a sophisticated digital system prepared to collect and interpret data at every stage of the production process, thus generating the acquired knowledge for decision-making (Chofreh et al., 2020). The digital efficiency of the system enables real-time monitoring and improved data and process integration. The specificity of the system thus obtained facilitates the exchange of live information between individual levels of organization in the corporation and the production environment (Morgan, O'Donnell, 2018).

The most important distinguishing features of Industry 4.0 include:

- combining the physical and virtual spheres of production,
- use of artificial intelligence and machine learning,
- integration of machines and production processes through digital technologies and the Internet (IoT),
- human-machine interaction (HMI technologies – Human Machine Interface),
- data analysis (Big Data).

The implementation of advanced IT techniques, information and communication technologies, as well as the virtualization of business models should be seen in the requirements and preferences of customers (Bembenek, 2017). It should be noted that these activities provided access to advanced tools, which in particular brought benefits to small and medium-sized enterprises (SMEs) (Dassisti et al., 2019). In addition to monitoring functions, Industry 4.0 tools also facilitate the collection of data on material flows, energy consumption and water consumption (Jena et al., 2020). These activities strengthen the competitive position of SMEs on the market and allow for updating data on an ongoing basis. When introducing Industry 4.0

solutions, enterprises focus on faster, smarter and more sustainable productivity. Implementing modern production and operations techniques combined with digital technology creates networked organizations that have the ability to use data to conduct intelligent physical activities, potentially transforming entire sectors. By introducing the latest technologies (robots, artificial intelligence, quantum computing, additive manufacturing and IoT) as intelligent technological connections are integrated in companies and assets (Zakoldaev et al., 2019).

Industry 4.0 allows SMEs to streamline their operations by using intelligent, technology-enabled machines. The resulting data is a key element used to gain expertise to perform operations faster and increase efficiency. The use of intelligent equipment and gadgets provides the opportunity to produce huge amounts of data, which are then used to gain insightful knowledge for the needs of excellent business analysis (Tayibnapis et al., 2018; Kempegowda et al., 2018). Industry 4.0 is characterized by the complex integration of intelligent devices, machines, and information technologies to create a digital production system (Javaid, Haleem, 2020). This paradigm aims to establish a controlled and intelligent network, using innovative digital technologies to meet consumer demands for high-quality and customized products (Bonilla et al., 2018).

One of the main advantages of Industry 4.0 is the integration of various modern technologies, culminating in the creation and implementation of Cyber-Physical Systems (CPS) (Frank et al., 2019). These systems are innovative "I4.0" solutions (Benitez et al., 2020), playing a fundamental role in transforming production landscapes. Examples include production lines that include reconfigurable production and mass customization into an integrated solution. These lines integrate sensors, flexible machines, real-time production planning systems, and collaborative robots, providing insight into the future of manufacturing systems that then enable seamless vertical integration between manufacturing and company information systems.

Although the concept of digitization, i.e. Industry 4.0, has different applications in different economic sectors, it has disrupted the work of all of them (Pedone et al., 2018). Industries that have embraced digitalization have benefited from improved both internal and external value chains, streamlined transactions and more accurate product delivery. Companies can benefit from the adoption of Industry 4.0, digital manufacturing and related connectivity, including increased flexibility, operational efficiency (Zakoldaev et al., 2019; Lobanov et al., 2019). Leveraging the digital revolution of Industry 4.0 by manufacturers provides opportunities to create digital twins of processes, production lines, factories and supplier networks. Information from IoT sensors, devices, PLCs and other entities connected to the Internet is collected to create a digital twin. Digital twins constructed in this way help companies increase productivity, improve processes and create innovative products. A properly shaped process allows manufacturers to make changes to the production process, for example to determine methods to reduce downtime or increase efficiency (Bhagat et al., 2022). Another advantage of Industry 4.0 is the ability to modify production lines, adapting them to customer expectations. The availability of 3D printing, software-based business models and cutting-edge technologies

enable manufacturers to quickly produce goods tailored to the individual needs of their customers. The advantage of Industry 4.0 technologies is the reduction of downtime, thereby providing real-time data that can then be used to quickly locate and solve problems (Rizvi et al., 2023). It is therefore expected that as manual factories are transformed into smart factories and Industry 4.0 is implemented, production will increase, which will result from better connections between entire organizations. In addition, businesses will benefit from the ability to increase flexibility, creativity, efficiency and customer satisfaction. Enterprises will have the advantage of providing highly personalized, custom-made and contextualized goods and services, which will ultimately increase value for the customer. It is therefore expected that Industry 4.0 will play a key role as an element of every organization in the processing industry (Alvan, Umarbeyli, 2023).

Although the implementation of integrated Industry 4.0 solutions has great potential, their implementation is complex and therefore requires specialized knowledge of a diverse set of technologies and skills. These tasks include proficiency in hardware, software, and digital technologies such as big data and artificial intelligence (Kahle et al., 2020). The complexity of modern solutions results from the multi-faceted nature of Industry 4.0, which affects a comprehensive understanding of the interdependence between various technological modules.

3. Methodology, research assumptions and characteristics of the research group

The aim of this study is to investigate the perception of Industrial Revolution 4.0 and to assess its perception. In this context, the study assumed:

- PB1 - assessment of knowledge and degree of readiness of companies from the SME sector to adapt 4.0 technology,
- PB2 - identifying the main benefits related to the implementation of innovative technologies in production processes and company management,
- PB3 - identification of factors that may inhibit or accelerate the transformation process.

To achieve the above assumptions, the author prepared a structured survey questionnaire. In accordance with the principle of disclosing respondents' data, the questionnaire was completed anonymously. It should be mentioned that simple, one-dimensional, balanced scales were used to present the measured values, which reflected the values assigned by respondents to the assessed features.

The prepared survey questionnaire was sent to 200 entrepreneurs running their businesses in the Silesian Voivodeship. Due to the low return rate, the study was conducted among working students of part-time studies at the Faculty of Management of the Czestochowa University of Technology in the following fields: Occupational health and safety, Management and

production engineering and Management. Ultimately, 112 (N = 112) correctly completed questionnaires were obtained for analysis. Characteristics of the research group in terms of such variables as: enterprise size, area of operation, business profile, duration on the market and market position show Table 1.

Table 1.
Characteristics of enterprises

Category	Variables	Number of enterprises	Percentage value
size of the enterprise	micro-enterprises	12	10,7%
	small enterprises	24	21,4%
	medium-sized enterprises	76	67,9%
area of operation	local market	11	9,8%
	regional market	41	36,6%
	domestic market	52	46,4%
	international market	8	7,1%
business profile	production	23	20,5%
	trade	12	10,7%
	services	33	29,5%
	mixed	44	39,3%
duration on the market	up to 10 years	7	6,3%
	10-20 years	77	68,8%
	over 20 years	28	25,0%
market position	start of business	9	8,0%
	average share	74	66,1%
	significant share	26	23,2%
	dominant position	3	2,7%
Σ		112	100%

Source: own study.

Only enterprises from the SME sector participated in the study, of which the largest group were medium-sized enterprises - less than 68% of the total. The second largest group of surveyed enterprises were small enterprises (21.4% of the total) and then micro-enterprises (10.7% of the respondents). Taking into account the area of operation, the largest group of respondents were enterprises operating on the domestic market - 46.45 respondents, then on the regional market - 36.6% of the total. The study also included enterprises operating on the local market - 9.8% of the total and international market - 7.1%.

Taking into account another variable, i.e. business profile, it should be noted that the largest group of enterprises were mixed profile enterprises - less than 40% of the respondents, followed by service enterprises - less than 30% of the total. The next largest group were manufacturing enterprises (20.5% of respondents), while the smallest group consisted of trading enterprises (10.75 respondents). Taking into account the duration on the market, it can be noted that the dominant group in this category of variables is the group of enterprises operating on the market for 10 to 20 years - 68.8% of respondents, then over 20 years - 25% of respondents and up to 10 years - 6.35 respondents. The last selected variable, i.e. market position, showed that 66.1% of the surveyed enterprises are one of many with a similar, average market share, 23.2% stated

that they have a significant market share, 8% are in the initial stage of development and 2.7% have a dominant market position.

Taking into account the above characteristics, it can be concluded that various enterprises of various sizes, industries and market experience took part in the study. This makes the results more representative and can be generalized to a wide range of companies. The diversity of the companies participating in the study allows for a better understanding of the different perspectives and problems faced by companies in different sectors. Thanks to this, the study can provide more comprehensive and valuable information and recommendations for business practice.

4. Results and discussions

Based on the research of Taurino, Villa (2019), Kolla et al. (2019), the analysis of the obtained research results was related to the first category of variables characterizing the research group, i.e. the size of the enterprise. As stated by Rupp et al. (2021), small and medium-sized enterprises play a special role in research. This is due to the fact that this sector is characterized by reduced financial possibilities and the use of available technologies.

Therefore, this article interprets issues related to the perception of Industry 4.0 from the point of view of micro, small and medium-sized enterprises. Thus, reference was made to PB1 first, and the obtained results are presented in Table 2.

Table 2.
Test results for PB1

Analysis area	categories	N	%	MI	M	Ś	MI%	M%	Ś%
Level of knowledge	very low	7	6,3%	2	1	4	16,7%	4,2%	5,3%
	low	23	20,5%	5	9	9	41,7%	37,5%	11,8%
	medium	38	33,9%	4	12	22	33,3%	50,0%	28,9%
	high	35	31,2%	1	2	32	8,3%	8,3%	42,1%
	very high	9	8,0%	0	0	9	0,0%	0,0%	11,8%
Σ		112	112	100%	12	24	76	100%	100%
Level of readiness for adaptation I 4.0	very low	4	3,6%	1	1	2	8,3%	4,2%	2,6%
	low	26	23,2%	6	8	12	50,0%	33,3%	19,7%
	medium	39	34,8%	5	12	22	41,7%	50,0%	28,9%
	high	32	28,6%	0	1	31	0,0%	4,2%	40,8%
	very high	9	8,0%	0	0	9	0,0%	0,0%	11,8%
Σ		112	100%	12	24	76	100%	100%	100%

N - 112, MI - micro, M - small, Ś - medium.

Source: own study.

The obtained research results showed that there are differences both in the level of knowledge and the degree of readiness to adapt I 4.0. Micro-entrepreneurs are characterized by the highest level of knowledge (41.7% of responses). In their opinion, they are familiar with the assumptions of Industry 4.0, but have no knowledge of their practical use. The results regarding the degree of readiness for adaptation are similar. Also in this case, micro-entrepreneurs are mostly not convinced to use 4.0 technology, but nevertheless declare that they may decide to do so over time.

In the case of small enterprises, it should be noted that they:

- have a fairly good understanding of the idea of Industry 4.0, being able to indicate examples of implementations (50% of answers),
- are open to new technologies and willing to learn more about them and more about 4.0 technology (50% of responses).

The results for medium-sized entrepreneurs are completely different. The analysis of their answers shows that they are most ready to adapt 4.0 technology, planning to start using its possibilities as soon as possible. For this reason, they have the highest level of knowledge in this field. According to Pacchini et al. (2019), it is mainly interesting for those producers who are focused on technology in their operations. It is also worth emphasizing that SMEs often do not adopt new solutions, mainly because they fear investing in the wrong technologies or adopting inapt practices (Mittal et al., 2018). At the same time, the research results indicate that SMEs do not have the economic resources to implement Industry 4.0 technologies (Tubis, Grzybowska, 2022).

Taking into account PB2 and PB3 (Table 2, Table 3), it can be noticed that the opinions of individual entrepreneurs (micro, small and medium-sized) are at a similar level, i.e. having a significant impact. This means that both micro-entrepreneurs, small enterprises and medium-sized companies express similar opinions and positions regarding both the benefits and factors inhibiting the implementation of 4.0 technologies. This may indicate some uniformity in the approach to specific business issues or problems in the context under study. It is worth noting that each of the selected types of entrepreneurs has individual experiences and perspectives, which is why there are differences of views even within a given group of companies. Nevertheless, consistency of opinion among different types of entrepreneurs can be an important factor influencing decision-making and shaping business strategies. The issue of the impact of the Industry 4.0 phenomenon (positive as well as negative) has also been the subject of research by Adamik, Nowcki (2018), and Basl (2017), among others, indicating a growing interest in Industry 4.0.

Table 3.
Benefits related to the implementation of 4.0 technology

Analysis area	Categories	N	%	MI	M	Ś	MI%	M%	Ś%
increasing competitiveness	I have no opinion	8	7,1%	1	1	6	8,3%	4,2%	7,9%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	4	3,6%	0	0	4	0,0%	0,0%	5,3%
	significant	62	55,4%	8	18	36	66,7%	75,0%	47,4%
	definitely significant	38	33,9%	3	5	30	25,0%	20,8%	39,5%
product personalization	I have no opinion	20	17,9%	1	7	12	8,3%	29,2%	15,8%
	definitely insignificant	1	0,9%	0	0	1	0,0%	0,0%	1,3%
	insignificant	7	6,3%	2	0	5	16,7%	0,0%	6,6%
	significant	56	50,0%	7	13	36	58,3%	54,2%	47,4%
	definitely significant	28	25,0%	2	4	22	16,7%	16,7%	28,9%
building closer relationships with customers	I have no opinion	15	13,4%	1	5	9	8,3%	20,8%	11,8%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	significant	64	57,1%	9	13	42	75,0%	54,2%	55,3%
	definitely significant	33	29,5%	2	6	25	16,7%	25,0%	32,9%
better adjustment to market requirements	I have no opinion	16	14,3%	2	5	9	16,7%	20,8%	11,8%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	1	0,9%	0	1		0,0%	4,2%	0,0%
	significant	64	57,1%	10	8	46	83,3%	33,3%	60,5%
	definitely significant	28	25,0%	0	7	21	0,0%	29,2%	27,6%
faster response to changes	I have no opinion	29	25,9%	2	8	19	16,7%	33,3%	25,0%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	1	0,9%	0	0	1	0,0%	0,0%	1,3%
	significant	56	50,0%	8	11	37	66,7%	45,8%	48,7%
	definitely significant	27	24,1%	2	6	19	16,7%	25,0%	25,0%
integration of processes in the enterprise	I have no opinion	10	8,9%	1	3	6	8,3%	12,5%	7,9%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	significant	72	64,3%	7	16	49	58,3%	66,7%	64,5%
	definitely significant	30	26,8%	4	5	21	33,3%	20,8%	27,6%
increasing employee productivity	I have no opinion	24	21,4%	0	8	16	0,0%	33,3%	21,1%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	significant	52	46,4%	5	14	33	41,7%	58,3%	43,4%
	definitely significant	36	32,1%	7	2	27	58,3%	8,3%	35,5%

N - 112, MI - micro, M - small, Ś - medium.

Source: own study.

The analysis showed that the most frequently mentioned benefit (Table 3) was the integration of processes in a social enterprise - 64.3% of the total indicated the answer "a significant factor". The next highest rated benefits (significant factor) were the impact of building closer relationships with customers and better adaptation to market requirements. Both benefits were received by 57.1% of all respondents, followed by increased competitiveness - 55.4% of the total. Looking at the detailed results, it can be noted that for micro-entrepreneurs the greatest benefit is increased employee productivity (58.3% of responses are: definitely important), followed by better adaptation to market requirements (83.3% of responses are: significant). For small companies, the main benefit of using 4.0 technology is increased competitiveness (75% of responses are: significant). and integration of processes in the enterprise (66.7% of responses are: significant). In the case of medium-sized

companies, the greatest benefit is the integration of processes in the enterprise (64.5% of responses are: significant), followed by better adaptation to market requirements (60.5% of responses are: significant).

According to all entrepreneurs, unclear economic benefits from investing in digital technologies are the greatest factor hindering the transformation process (57.1% of responses are: significant), the second most important factor is insufficiently qualified staff (50.9% of responses: significant).

Table 4.
Factors inhibiting the transformation process

Analysis area	Categories	N	%	MI	M	Ś	MI%	M%	Ś%
high financial investment requirements	I have no opinion	16	14,3%	1	2	13	8,3%	8,3%	17,1%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	3	2,7%	0	2	1	0,0%	8,3%	1,3%
	significant	54	48,2%	3	11	40	25,0%	45,8%	52,6%
	definitely significant	39	34,8%	9	9	21	75,0%	37,5%	27,6%
insufficiently qualified staff	I have no opinion	9	8,0%	1	2	6	8,3%	8,3%	7,9%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	significant	57	50,9%	4	13	40	33,3%	54,2%	52,6%
	definitely significant	46	41,1%	7	9	30	58,3%	37,5%	39,5%
lack of support from management	I have no opinion	26	23,2%	1	6	19	8,3%	25,0%	25,0%
	definitely insignificant	1	0,9%	0	1	0	0,0%	4,2%	0,0%
	insignificant	8	7,1%	4	4	0	33,3%	16,7%	0,0%
	significant	49	43,8%	5	8	36	41,7	33,3%	47,4%
	definitely significant	28	25,0%	2	5	21	16,7	20,8%	27,6%
unclear economic benefits from investing in digital technologies	I have no opinion	22	19,6%	5	8	9	41,7%	33,3%	11,8%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	7	6,3%	2	0	5	16,7%	0,0%	6,6%
	significant	64	57,1%	4	14	46	33,3%	58,3%	60,5%
	definitely significant	20	17,9%	2	2	16	16,7%	8,3%	21,1%
lack of digital standards, norms and certification	I have no opinion	30	26,8%	6	5	19	50,0%	20,8%	25,0%
	definitely insignificant	1	0,9%	1	0	0	8,3%	0,0	0,0%
	insignificant	4	3,6%	2	1	1	16,7%	4,2	1,3%
	significant	48	42,9%	3	8	37	25,0%	33,3	48,7%
	definitely significant	26	23,2%	0	7	19	0,0%	29,2%	25,0%
concerns around losing control over the company's intellectual property	I have no opinion	24	21,4%	2	6	16	16,7%	25,0%	21,1%
	definitely insignificant	0	0,0%	0	0	0	0,0%	0,0%	0,0%
	insignificant	10	8,9%	1	0	9	8,3%	0,0%	11,8%
	significant	52	46,4%	7	13	32	58,3%	54,2%	42,1%
	definitely significant	26	23,2%	2	5	19	16,7%	20,8%	25,0%
lack of digital knowledge and training	I have no opinion	27	24,1%	4	4	19	33,3%	16,7%	25,0%
	definitely insignificant	4	3,6%	1	0	3	8,3%	0,0%	3,9%
	insignificant	10	8,9%	1	0	9	8,3%	0,0%	11,8%
	significant	47	42,0%	5	13	29	41,7%	54,2%	38,2%
	definitely significant	25	22,3%	2	7	16	16,7%	29,2%	21,1%
unresolved issues around data security and data privacy	I have no opinion	28	25,0%	4	9	15	33,3%	37,5%	19,7%
	definitely insignificant	1	0,9%	1	0	0	8,3%	0,0%	0,0%
	significant	12	10,7%	1	0	11	8,3%	0,0%	14,5%
	significant	45	40,2%	4	10	31	33,3%	41,7%	40,8%
	definitely significant	26	23,2%	2	5	19	16,7%	20,8%	25,0%

N - 112, MI - micro, M - small, Ś – medium.

Source: own study.

By making a detailed analysis, it can be noticed that the biggest barrier is:

- in the case of micro companies: insufficiently qualified staff (58.3% of responses are: definitely important) and concerns about the loss of control over the company's intellectual property (58.3% of responses are: significant),
- in the case of small companies: insufficiently unclear economic benefits of investing in digital technologies (58.3% of responses are: significant) and insufficiently qualified staff, concerns about the loss of control over the company's intellectual property, lack of digital knowledge and training (54.2% each of responses are: significant).
- in the case of medium-sized companies: unclear economic benefits from investing in digital technologies (58.3% of responses are: significant), high financial investment requirements, insufficiently qualified staff (52.6% of responses are: significant).

Based on the results obtained, it is possible to distinguish the perception of Industry 4.0 by the surveyed groups of enterprises (Figure 1).

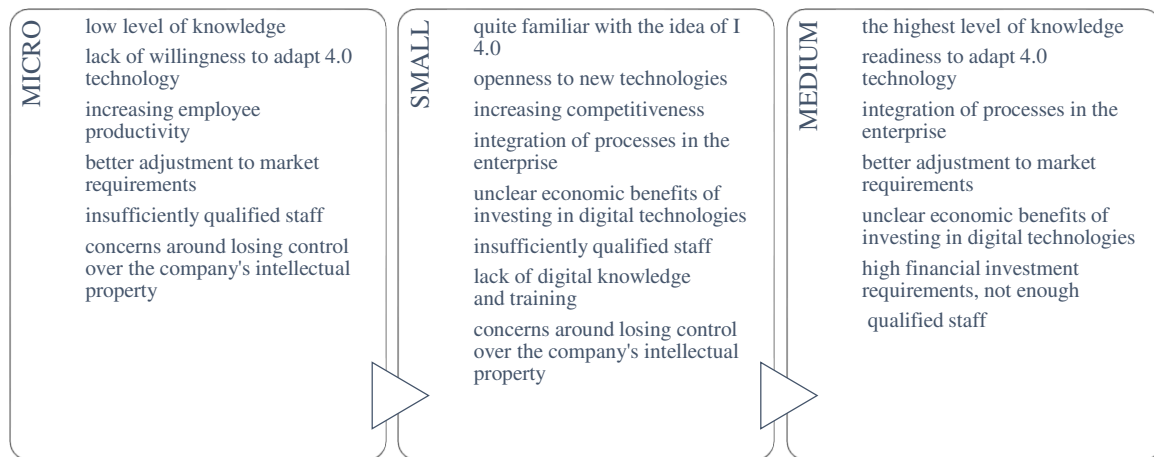


Figure 1. Perception of Industry 4.0.

Source: own study.

Based on Figure 1, it can be said that the larger the company, the better the perception of Industry 4.0, especially in terms of knowledge as well as willingness to make changes in this area. Also the question of benefits or limitations can be indicated that the larger the company, the greater the awareness of the positive as well as negative aspects associated with it.

Summary

Industry 4.0, also called the fourth industrial revolution, is based on the combination of traditional production processes with the latest digital technologies. As part of this production model, enterprises use advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI), robotization, Big Data or computing cloud to improve production processes,

increase efficiency and optimize costs. Research shows that for small and medium-sized companies, Industry 4.0 is an opportunity to increase market competitiveness, increase employee productivity, better adapt to market requirements and integrate processes in the enterprise. However, many of these companies do not have adequate financial, technological or human resources to implement modern technologies on their own. For small and medium-sized companies, it is crucial to participate in training, workshops and conferences on Industry 4.0 to acquire the necessary knowledge and skills. Moreover, it is extremely important to build partnerships and cooperation with other companies, research institutions and scientific institutions to exchange experiences, jointly develop innovations and conquer new markets. Companies are increasingly realizing that investing in 4.0 technology brings real benefits and contributes to increasing efficiency, competitiveness and innovation. Therefore, more and more enterprises decide to modernize their processes and systems to adapt to the requirements of the modern market.

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AGILE CUSTOMER SERVICE PRACTICES IN THE E-COMMERCE DEVELOPMENT PROCESS

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Purpose: The goal is to understand how organizations adapt to the requirements of digitalization and what actions they take to remain competitive in a dynamically changing environment.

Design/methodology/approach: The study is based on an analysis of data collected through a survey conducted in April and May 2023 among 303 respondents.

Findings: An organization's agile practices in the e-commerce development process are closely related and mutually supportive. Strong correlations between different practices indicate that success in e-commerce depends on a comprehensive and integrated approach to the use of digital technologies, which enables organizations to respond effectively to changing market conditions and customer needs.

Research limitations/implications: Limitations of the study include the potential lack of representativeness of the research sample, the reliance on self-assessment data, and the lack of long-term data. Further research may focus on expanding the research sample, conducting long-term studies, and exploring success factors in the implementation of agility.

Practical implications: The article offers recommendations for companies on how to develop organizational culture, invest in training, adopt new technologies, and increase operational agility through agile practices to improve competitiveness and resilience in the digital age.

Social implications: The importance of fostering a culture of continuous learning and innovation in organisations is highlighted, which can contribute to economic growth and job creation in the digital economy.

Originality/value: The article stands out for its comprehensive analysis of agile practices in the context of digitalization, combining a literature review with empirical research. Practical recommendations provide valuable guidance for companies seeking to effectively transform the challenges of digital transformation.

Keywords: agile practices, customer, e-commerce, organization, organizational agility.

Category of the paper: research paper.

1. Introduction

The modern business world is characterized by an increasing pace of change, which forces organizations to constantly adapt to evolving trends, especially in the area of digitalization. The rise of e-commerce, a direct result of increasing digitalization, is radically changing the way businesses do business, communicate with customers, and manage internal processes. Organizational agility is an important element that enables companies to remain competitive in such a dynamic environment (Mrugalska, Ahmed, 2021; Žitkienė, Deksnys, 2018; Joiner, 2019), understood as the ability to respond quickly to change, innovate and effectively implement new technologies (Jones, Adam, 2023; Prieto, Talukder, 2023; Harraf, Wanasika, Tate, Talbott, 2015; Wendler, 2014).

The article presents the results of research on the application of agile practices in the area of customer service in the process of e-commerce development, emphasizing their impact on the ability of organizations to adapt in the digital ecosystem. The analysis focuses on identifying ways in which enterprises are using modern technologies and ways of working to improve customer interactions, data management and optimize business processes. The results of the research point to the key role of an organizational culture that promotes adaptation, continuous learning, investment in digital skills training, adoption of new technologies, and improving operational agility through agile practices. Research constraints and practical implications point the way for companies to improve their competitiveness and resilience in the digital age, while also suggesting directions for future research in this area.

This article stands out from other research due to its unique combination of agile practices in customer service with the challenges of digitization in e-commerce. Unlike most available analyses that focus on single aspects of agility or e-commerce, this study integrates these two elements to understand how they can be used to transform digitization challenges into concrete strategies that strengthen the market position of enterprises. Moreover, this approach allows for a deeper understanding of how the integration of modern technologies can lead to real changes in customer interactions, which is critical in the era of rapid market changes. The conclusions presented are based on a comprehensive empirical study, which further enhances the substantive value of the work and enables the application of the results in practical e-commerce management contexts.

2. Literature Review

2.1. The essence and development of E-commerce in the era of digitalization challenges

The growth of e-commerce is closely linked to the process of digitalization, which has revolutionized the way people buy and sell products and services over the past decades. The essence of e-commerce is the use of the internet and digital technologies to carry out commercial transactions, which is a significant departure from traditional sales methods. Digitalization, which is driving the growth of e-commerce, is not only about the introduction of online transactions, but also about transforming supply chains, business models, and customer interactions (Lambri, Sironi, Teti, 2024).

E-commerce has developed in several key stages, ranging from simple websites for listings, through platforms that enable fully online transactions, to complex digital ecosystems that integrate a wide range of additional services, such as logistics, online payments, digital marketing and data analytics. The impact of digitalization on e-commerce is observed not only in terms of increasing efficiency and reducing costs, but also in terms of innovation in business models, which allows companies to reach new customer groups and offer products and services on customized terms (Zou, Cheshmehzangi, 2022).

One of the most important aspects of e-commerce growth is to increase the accessibility and convenience of shopping for consumers. Digitalization has enabled shoppers to access global markets, offering a wide range of products and services available from anywhere, anytime. This, in turn, has forced enterprises to focus on optimizing the user experience by designing intuitive interfaces, personalizing offers, and ensuring transaction security (Jones, Adam, 2023).

At the same time, digitalization challenges such as data security, user privacy and cybercrime have become key areas of focus for e-commerce enterprises. Enterprises need to invest in advanced security technologies to protect customer data and maintain trust, which is fundamental to staying competitive in the marketplace (Masoud, Basahel, 2023).

Another important issue is the adoption and integration of new technologies such as artificial intelligence (AI), machine learning, blockchain and the Internet of Things (IoT), which offer new opportunities for personalization of offers, automation of customer service, supply chain management and anti-fraud. The use of these technologies allows for the creation of a more personalized and engaging shopping experience, as well as increasing the operational efficiency of companies (Rosário, Raimundo, 2021).

In the context of globalization and increasing competition, e-commerce faces the challenge of constantly adapting to changing consumer preferences and dynamically developing technology. The future of e-commerce is likely to be shaped by further digitalization, the development of mobile technologies, the increased use of big data to better understand customers, as well as further cross-platform integrations, enabling broad collaboration between

different market players, including manufacturers, logistics and financial service providers, as well as marketplaces (Attar, Almusharraf, Alfawaz, Hajli, 2022).

To sum up, the essence and development of e-commerce in the era of digitalization challenges is a dynamic area that is constantly evolving under the influence of technological progress, changes in consumer behavior and adaptation to global economic and social challenges. The future of e-commerce will be shaped by further innovation, integration, and collaboration at various levels, while requiring accountability and a sustainable approach to business, technology, and society.

2.2. Organizational Agility and Agile Practices

In the context of a dynamically changing business environment, influenced by the development of e-commerce and advancing digitalization, organizational agility and agile practices are becoming increasingly important. Agility, understood as the ability of an organization to quickly adapt to changing conditions, innovate, and respond effectively to customer needs, is becoming a key success factor in the digital age (Akkaya, 2021; Kurnia, Chien, 2020; McNamee, Schoch, Oelschlaeger, Huskey, 2012). Originally derived from the IT sector and software development methodologies, agile practices are now gaining recognition in the broader context of management and business strategy (Sajdak, 2021; Kocot, Kwasek, 2022). Their adaptation beyond traditional application areas shows how agile techniques can contribute to increasing operational efficiency, innovation, and adaptability of organizations at various levels (Brown, Jones, 2018).

The application of agile practices in the context of e-commerce and broadly understood digitalization manifests itself through short planning cycles, iterative product development, a continuous feedback loop with customers, and a focus on multidisciplinary project teams (Chen, Li, 2021; Rahimi, Mansouri, 2019; Sedej, Justinek, 2021). These elements allow organizations not only to respond more quickly to changes in the market, but also to effectively explore new technologies and business models, which is essential in the face of rapid changes in consumer preferences and technology (Chen, Li, 2021).

Integrating organizational agility with agile practices makes it easier for companies not only to adapt to current trends, but also to anticipate future changes. This makes it possible to create a sustainable competitive advantage through innovation, personalization of the offer and optimization of the customer experience, which directly fits into the context of the challenges and opportunities arising from the growing role of e-commerce (He, Harris, 2021).

In the digital age, agile project and product management methods allow companies to make better use of big data, artificial intelligence (AI), and other digital technologies to create more personalized and engaging shopping experiences. Through an agile approach, organizations can experiment and bring new solutions to market faster while minimizing the risks and costs associated with failure (Prieto, Talukder, 2023).

Also in terms of supply chain and logistics management, agile practices enable a more effective and flexible response to changes in demand, which is crucial for maintaining continuity and operational efficiency in a rapidly changing environment (Ramadhana, 2021).

Thus, the integration of organizational agility with agile practices lays the foundation for building the resilience and competitiveness of companies in the digital world. This allows you to take advantage of the opportunities offered by e-commerce and digital technologies more effectively, while ensuring the ability to adapt and innovate in the face of constant change. Thus, agility and agile practices not only complement the business needs of digitalization, but are also the key to sustainable success in an increasingly globalized and digital ecosystem.

2.3. The role of agile practices in the customer service process

In the process of dynamic market changes, driven by the progressive digitization and expansion of e-commerce, the role of agile practices in the customer service process is emerging as an essential element in shaping an organization's competitive advantage. Adopting agile methodologies in the area of customer service fits into the broader perspective of organizational agility, responding to growing consumer expectations for personalization, responsiveness, and quality of brand interaction (Kt, Sivasubramanian, 2023).

Agile practices, adopting an iterative approach focused on feedback and continuous adaptation, enable organizations to build deeper relationships with customers by quickly and effectively responding to their needs and preferences. In the context of customer service, agility translates into the ability to quickly solve problems, personalize communications and offerings, and be proactive in anticipating and meeting customer expectations (Felipe, Leander, Roldan, Leal-Rodriguez, 2020).

The implementation of agile practices in the area of customer service often involves the use of advanced technologies such as artificial intelligence, data analytics or automation, which has already been highlighted in the context of e-commerce development. Thanks to these technologies, companies can not only respond more quickly to customer inquiries, but also offer personalized shopping experiences that are increasingly desired by today's consumers (Chen, Siau, 2020; Skyrius, Valentukevič, 2020; Bray et al., 2019).

An agile approach to customer service also stimulates a culture of continuous improvement and innovation within the organization. Teams are encouraged to experiment with new ideas and solutions that can increase customer satisfaction while minimizing risk through short iterative cycles and continuous feedback collection. Such a work environment not only increases employee motivation, but also builds a stronger market position for the company by offering exceptional value to customers (Sattler et al., 2022).

In the digital age, where customer feedback is readily available and can quickly impact a brand's reputation, agile practices in customer service allow organizations to effectively manage consumer experiences and expectations. Flexibility and speed of adaptation to changing customer preferences and market conditions, enabled by agile methodologies,

are therefore becoming key assets in building lasting and positive relationships with customers (Varshney, 2020).

Agile organizational practices in e-commerce development focus on key areas: the use of digital technologies for sales, customer data analysis, technological innovations in business processes, and strategies for the effective use of these technologies. These activities enable companies not only to better match their offer to the needs of the market, but also to quickly adapt to changing trends and consumer preferences. The use of digital tools to analyze data and monitor the market environment is becoming the foundation for effective management in a dynamic e-commerce environment. Innovative approaches to technology and continuous process optimization are key to maintaining competitiveness and innovation in the market (Masoud, Basahel, 2023).

To sum up, the integration of agile practices in the customer service process is a natural extension of organizational agility and agile methodologies used in the context of project and product management. This evolution not only responds to the challenges of digitalization and the growing role of e-commerce, but also sets new standards in terms of the quality of customer interaction, personalization of the offer and speed of response to market needs. As a result, companies that successfully implement agile customer service practices gain a significant competitive advantage by building stronger and more sustainable customer relationships.

2.4. Research Methodology

The focus of this article was to understand how organizations apply agile customer service practices in the context of the growing e-commerce sector. The aim of the research focused on identifying key agile strategies and practices that companies implement to improve sales processes, analyze customer data, innovate in business processes, develop strategies for the use of digital technologies, and analyze market trends and competitors using digital tools.

The research hypothesis was that organizations actively engaging in the use of digital technologies and agile working methods show better adaptation to the changing e-commerce environment and respond more effectively to the needs and preferences of their customers. The research method was based on a quantitative survey approach, where 303 respondents were asked to answer a series of closed-ended questions. The respondents rated their experiences and practices in the use of digital technologies and innovative solutions in their companies. These results made it possible to assess the current state of application of agile methods in the area of e-commerce and contributed to the verification of the research hypothesis.

In terms of positions held, the majority of respondents were employees at a lower level (57.4%), middle management represented 25.2% of the survey participants. Junior executives accounted for 11.1% and top management 6.4%. In terms of professional experience, 47.7% of the respondents had worked for up to 5 years, 33.4% had between 6 and 10 years of experience, 13.6% between 11 and 15 years, 3.6% between 16 and 20 years, and only 1.7% had worked for more than 20 years.

Analysing the size of the companies in which the respondents worked, most of them were employed in small enterprises (37.5%), while micro-enterprises accounted for 26.4%, medium-sized enterprises for 20.1% and large enterprises for 16.1%. Regarding the duration of the company's operation, 34.9% of the respondents worked in companies operating for 1 to 3 years, 27.1% for 4 to 7 years, 26.1% in companies with more than 8 years of experience, and 11.9% in companies operating on the market for more than a year.

In terms of industry, the majority of respondents were employed in the commercial sector (54.8%), followed by other industries (26.4%), education (10.4%), the automotive industry (5.4%) and the health sector (3%). In terms of the geographical scope of companies, 32.5% of respondents worked in companies with a regional scope, 31.5% at the national level, 18.3% at the international level, and 17.6% at the local level. The majority of respondents (55.6%) rated their company's financial situation as good, 19.9% as very good, 16.9% had difficulties with the assessment, 4.6% assessed it as bad, and 3% as very bad.

2.5. Presentation of Research Findings

The research sought to understand how organizations use agile customer service practices in the e-commerce development process (see Table 1). The study focused on five key areas: the use of digital technologies to sell products or services, the collection and analysis of customer data using digital technologies, the use of innovative digital technologies in business processes, the development of strategies for the effective use of digital technologies in commerce, and the analysis of market trends, customer preferences, and competitors with the help of digital technologies.

In the first area, concerning the use of digital technologies to sell products or services, 15 respondents (4.95%) definitely do not use such solutions, 20 (6.60%) rather do not, 30 (9.90%) have no opinion, 100 (33.00%) rather use them, and 138 (45.54%) definitely do. When it comes to collecting and analysing customer data, 10 people (3.30%) definitely don't choose to do so, 25 (8.25%) do not, 28 (9.24%) have no opinion, 90 (29.70%) rather do, and 150 (49.50%) definitely use digital technologies to analyse customer data.

When it comes to the use of innovative digital technologies in business processes, 5 respondents (1.65%) definitely do not use such solutions, 18 (5.94%) rather not, 40 (13.20%) have no opinion, 95 (31.35%) rather yes, and 145 (47.85%) definitely do.

Developing strategies for the effective use of digital technologies in trade is of similar interest, with 12 respondents (3.96%) definitely not engaging in such activities, 22 (7.26%) rather not, 35 (11.55%) have no opinion, 110 (36.30%) rather yes and 124 (40.92%) definitely do so.

When it comes to analysing market trends, customer preferences and competition with the use of digital technologies, 8 people (2.64%) definitely do not undertake such analyses, 15 (4.95%) rather do not, 45 (14.85%) have no opinion, 105 (34.65%) rather do, and 130 (42.90%) definitely use digital technologies to analyse external factors.

Table 1.*Agile Organizational Practices in the Ecommerce Development Process, N = 303*

	Definitely NOT	Rather not	I don't have an opinion	Rather YES	Definitely YES
Uses digital technologies to sell their products/services (1)	15	20	30	100	138
Collects and analyzes customer data using digital technologies (2)	10	25	28	90	150
Uses innovative digital technologies in business processes (3)	5	18	40	95	145
Develops a strategy for the effective use of digital technologies in trade (4)	12	22	35	110	124
Analyses factors such as market trends, customer preferences and competitors using digital technologies (5)	8	15	45	105	130

Source: In-house analysis based on research.

These figures indicate a strong trend among organizations to adopt digital technologies as a tool to increase efficiency and effectiveness in the area of customer service and e-commerce development.

Based on the research conducted and the data collected, the correlation table (Table 2) presents the relationships between different aspects of an organization's agile practices in the context of e-commerce development. Each of the correlation values, represented on a scale from 0 to 1, indicates the degree of relationship between the individual practices studied in the project. This analysis is based on the responses of 303 respondents.

Table 2.*Correlation table, N = 303*

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	1				
2	0,99	1			
3	0,99	0,99	1		
4	0,98	0,96	0,97	1	
5	0,98	0,96	0,98	0,99	1

Source: In-house analysis based on research.

High correlation values, hovering around 0.99 between the practices of using digital technologies to sell products/services (1) and the collection and analysis of customer data (2), as well as the use of innovative digital technologies in business processes (3), suggest a strong link between these areas. This means that organizations that use digital technologies extensively for sales are equally committed to collecting and analyzing customer data and implementing technological innovations in their business processes.

Similarly, the correlation values between the development of strategies for the effective use of digital technologies in trade (4) and other practices, with values ranging from 0.96 to 0.99, highlight that the development of effective digital strategies is closely related to the active use of these technologies at different levels of the company's operations. This indicates that these

strategies are not an isolated element, but a key component that supports and strengthens other aspects of the e-commerce business.

In addition, the analysis of external factors such as market trends, customer preferences or competition (5) shows a high correlation, especially with strategy development (0.99), suggesting that successful digital strategies are often developed taking into account external market factors and competition.

In general, the presented correlation table shows that the agile practices of organizations in the e-commerce development process are closely related and mutually supportive. Strong correlations between different practices indicate that success in e-commerce depends on a comprehensive and integrated approach to the use of digital technologies, which enables organizations to respond effectively to changing market conditions and customer needs.

Such high correlation coefficients, ranging from 0.96 to 0.99, may indicate a strong relationship between the agile practices applied in various aspects of e-commerce operations. A high correlation means that effectiveness in one area, such as online product or service sales, is closely linked with efficiency in other areas, for example in customer data analysis or the implementation of technological innovations in business processes. This indicates that individual agile practices do not function in isolation but reinforce each other, creating a coherent and integrated system that significantly contributes to increasing operational efficiency and building a competitive advantage for the organization. Furthermore, these results may suggest that the organizations studied have adopted a holistic and systematic approach to the implementation of digital technologies, which is crucial for achieving success in the rapidly changing e-commerce environment.

3. Discussion

The collected literature and empirical material allows us to draw conclusions on the importance and impact of agile customer service practices on the development of e-commerce in organizations. The analysis of the conducted research shows that the use of digital technologies in the areas of sales, analysis of customer data, business processes, strategy development and analysis of market trends, customer preferences and competitors is crucial for achieving operational efficiency and competitive advantage.

First of all, the collected data shows a strong tendency of organizations to adopt digital technologies as a tool to support agility in the area of e-commerce. The majority of respondents strongly agree with the use of such technologies, indicating a widespread awareness of their importance for effective customer service and business growth in the digital environment.

An analysis of the correlation between different aspects of the use of digital technologies shows strong links between them, suggesting that organizations perform better when they combine these practices into a coherent system. High correlation values indicate that the effective use of digital technologies in one area, such as selling products or services, is usually closely related to intensive involvement in other activities, such as analyzing customer data or implementing innovative technologies in business processes. This emphasizes that organizations must not view these practices as isolated activities, but as elements of an integrated strategy to support the entirety of e-commerce operations.

The findings also highlight that developing effective digital strategies is not a one-time task, but an ongoing process that requires regular analysis of market trends, customer preferences and competitor activities. The high correlation between strategy development and external factor analysis suggests that successful strategies are often conditioned by external factors, requiring an organization to be agile and adaptable.

Overall, the results of the research point to the important role of digital technologies in the development of agile customer service practices in the process of e-commerce development. The integration of these technologies in various areas of the business, along with continuous monitoring and adaptation to the changing environment, is the foundation for building a competitive advantage and achieving long-term success. Organizations that effectively implement and integrate agile customer service practices using digital technologies are more likely to effectively respond to market needs and customer expectations, which translates into their growth and development in the dynamically changing world of e-commerce.

The results of the research should be compared with the works of other authors to deepen the understanding of the importance and impact of agile customer service practices on the development of e-commerce in organizations. A literature analysis confirms that agile approaches and integration of digital technologies are essential for operational efficiency and competitive advantage.

According to the observations of Kumari and Kumar (2024) and Torres (2023), both sources of information highlight the important role of integrating digital technologies in achieving operational efficiency and gaining a competitive advantage. The collected empirical data shows a strong tendency of organizations to adopt digital technologies as a key tool to support agility in e-commerce. This observation is reflected in the literature, where Kumari and Kumar (2024) emphasize that adaptability and agility, aided by digital technologies, are essential for modern enterprises operating in the e-commerce environment.

The analysis of correlations between various aspects of the use of digital technologies, both in the presented empirical studies and in the analyzed studies, shows the complexity and multidimensionality of the impact of these technologies on the operational efficiency of the organization. As Torres (2023) points out, it was highlighted that the effective use of digital technologies in one area, such as sales, is closely linked to intensive engagement in other activities, for example, customer data analysis or innovation in business processes.

This indicates that developing effective digital strategies requires a continuous process of adaptation to changing market trends, customer preferences, and competitor activities, suggesting the need for flexibility and adaptability, as noted by Kumari and Kumar (2024) and Torres (2023).

The conducted research allows us to formulate recommendations for companies that aspire to effective use of digital technologies in the area of customer service and e-commerce development. A key takeaway is that companies should strive for a holistic approach to the use of digital technologies, including not only the sale of products and services, but also the analysis of customer data, business processes and strategy development. Such integration allows for the creation of a cohesive and flexible ecosystem that supports agile organizational practices and enables effective response to changing market conditions.

It is important to emphasize the importance of continuous monitoring and analysis of data, both internal (concerning the company's operations and customers) and external (market trends, competitors' activities). This information is essential for creating effective digital strategies that are dynamic and can adapt to new challenges and opportunities. High correlations between different aspects of the use of digital technologies indicate that success in e-commerce depends on a comprehensive and integrated approach to the use of these technologies.

In addition, companies should place a strong emphasis on innovation and readiness to experiment with new technological solutions. Innovation can range from introducing new products and services to optimizing existing business processes with advanced digital tools. Such an attitude is conducive to building a competitive advantage and increases the company's ability to adapt to a rapidly changing environment.

Finally, it is important that digital strategies are developed taking into account external factors such as market trends, customer preferences, and competitor activities. Successful digital strategies require not only internal coordination and an integrated approach, but also an understanding and adaptation to the external environment. This means that companies should regularly analyze and react to changes in the environment so that their activities are properly targeted and effective.

In conclusion, companies are advised to adopt an integrated and dynamic approach to the use of digital technologies that takes into account both the internal needs of the organization and the changing external conditions. Such an approach will allow you to increase operational efficiency, build a strong market position and effectively respond to the needs and expectations of customers in the dynamic world of e-commerce.

Although the research provided valuable conclusions on the use of digital technologies in the area of customer service and e-commerce development, it is also characterized by certain limitations that may affect the interpretation of the results and suggest directions for future research. One of the main limitations is the focus on a relatively narrow range of respondents, which may not reflect the full diversity of the e-commerce sector. The specificity of the research

sample, limited to a certain number of organizations, may not take into account all industries or sizes of enterprises, which affects the generalization of the results.

Additionally, the analysis focused mainly on quantitative aspects, leaving less room for a qualitative understanding of the reasons and mechanisms behind the adoption or rejection of agile customer service practices and the use of digital technologies. This limits the depth of interpretation of results and understanding of the business and organizational contexts that influence these processes.

4. Conclusions

In the context of future research, there are several directions that could add value and expand current knowledge on the role of digital technologies in e-commerce. First of all, expanding the research sample to include different industries and company sizes could provide a more representative picture of the use of digital technologies in the area of e-commerce and allow for a better understanding of the specificities of individual sectors.

The second direction is to conduct qualitative research, such as case studies or in-depth interviews, which could uncover detailed decision-making mechanisms, motivations and barriers to the implementation of digital technologies and innovative solutions. Such an approach would allow for a better understanding of the dynamic aspects of change management and technological adaptation in organizations.

Another area is the study of the impact of organizational culture, structure and strategy on the adoption and effective use of digital technologies. Understanding how these internal factors affect an organization's ability to innovate and adapt in a digital environment could provide clues for effective change management practices.

Finally, it is worth examining the long-term impact of digital technologies on business performance and organizational sustainability in the context of changing customer expectations and competitive pressures. Such research could provide valuable insights into the strategic benefits of digitalisation and agile business practices, while offering insight into potential challenges and risks.

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THE USE OF AGILE PRACTICES IN SHAPING THE ORGANIZATION'S COMPETITIVE ADVANTAGE

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Purpose: The aim of the study was to investigate the impact of implementing agile practices on shaping an organization's competitive advantage in a dynamically changing business environment.

Design/methodology/approach: The study was based on a quantitative analysis of data collected through a survey questionnaire among 303 respondents from different organizations to assess the extent to which the implementation of agile practices contributes to building a competitive advantage.

Findings: Research has shown that organizations that implement agile practices, such as continuous adaptation, learning, improvement, and rapid response to change, are able to build and maintain a competitive advantage in the marketplace more effectively. The strong correlation between organizational agility and competitive advantage suggests that agility is a key success factor in today's fast-paced business environment.

Research limitations/implications: The main limitation is the dependence on respondents' subjective assessments, which may affect the reliability of the results. In addition, the geographical and industry coverage of the survey may not be representative of all sectors.

Practical implications: For practitioners, the results highlight the importance of adapting agile practices in organizational management to effectively respond to changing market conditions and build a competitive advantage.

Social implications: The implementation of agile practices can also contribute to a better understanding of customer needs and preferences, which has a direct impact on the public perception of the value of the products and services offered by organizations.

Originality/value: The study contributes to the literature by empirically exploring the relationship between organizational agility and competitive advantage, emphasizing the holistic nature of agility as an integrated system influencing an organization's ability to adapt and innovate.

Keywords: agile practices, organizational agility, competitive advantage, organization, company.

Category of the paper: research paper.

1. Introduction

In the era of globalization, increasing competition and rapid technological change, organizations face the constant challenge of adapting to a changing environment. The ability to respond quickly to new market conditions, consumer preferences and technological innovation has become a key determinant of market success. In this context, organizational agility – the ability to adapt quickly and effectively to change, continuous learning and improvement – emerges as an essential characteristic of organizations seeking to achieve and maintain competitive advantage (Rahimi, Mansouri, 2019; Sajdak, 2021).

The concept of agility, originally associated with project management methodologies in the software industry, has gained widespread application in various areas of organization management. The adoption of agile practices has become a subject of interest not only for the IT sector, but also for companies operating in various sectors of the economy, which are looking for ways to increase their responsiveness and innovation (Kocot, Kwasek, 2022).

Nevertheless, despite the growing popularity and intuitive belief in the positive impact of agility on organizational performance, there is a need for in-depth empirical analysis to confirm this relationship. In particular, there is a lack of empirical research in the literature that would comprehensively assess the impact of implementing agile practices on an organization's ability to build and maintain a competitive advantage in a dynamically changing business environment.

Therefore, the aim of this article is to examine how the implementation of agile practices translates into a competitive advantage of an organization. Through an empirical analysis of data collected among organizations of various industries, this study seeks to verify the hypothesis that organizational agility is a key factor enabling effective response to market changes, which in turn contributes to building a sustainable competitive advantage.

2. Literature Review

2.1. Competitive advantage of enterprises and its determinants

The competitive advantage of companies is a key factor determining their success on the market. It is the ability of a company to create more value for its customers compared to the offerings of its competitors, which may manifest itself in the form of lower prices, higher quality of products or services, innovation, or unique features of the offer that are difficult to replace or copy by competitors. The determinants of competitive advantage are complex and multifaceted, encompassing both internal factors of the company and external elements resulting from the market environment (Mycka, 2023).

One of the fundamental determinants of competitive advantage is innovation, understood not only as the introduction of new products or technologies, but also as the ability to innovate in processes, business models and management methods. Innovation allows businesses to stay ahead of the competition by offering new value and a better customer experience (Bukowska, 2023).

Another important aspect is the quality of the products and services offered (Sulimowska-Formowicz, Chrupała-Pniak, 2010). Companies that emphasize high quality and continuous improvement often gain customer loyalty and build lasting relationships, which provides a solid foundation for competitive advantage. Quality is perceptual and subjective, but its high level is noticeable and appreciated by the audience. A significant determinant is also the uniqueness and differentiation of the offer, which may be related to the unique features of the product, patents, specialist knowledge or even the way of communication with the market (Erdil, 2014).

By differentiating, companies can avoid direct price competition by directing customers' attention to the aspects that make their offer unique. Nowadays, sustainable development and corporate social responsibility (CSR) are also gaining in importance, as they can contribute to building a positive image of the company and preferences among socially conscious consumers. Companies that engage in activities for the benefit of local communities, environmental protection, or ethical production often gain an advantage by building customer trust and loyalty (Adamik, 2019).

Ultimately, competitive advantage is the result of a complex interaction between multiple factors, with a deep understanding of customer needs and effective management of internal resources to meet them at the center (Urbanski, 2022). The key challenge for companies is therefore to continuously improve in all these areas in order to maintain and develop their position in the market in the face of unpredictable changes and increasing competition. Therefore, companies must demonstrate not only the ability to identify current and future market trends and consumer needs, but also have the organizational flexibility to quickly reorganize production, marketing, and management processes in response to these changes (Rut, Meyer, Andrzejczyk, 2022).

Customer relationship management (CRM) and data analytics are becoming invaluable tools for understanding consumer behavior and preferences, which in turn enables the creation of personalized offers and experiences. Effective use of data can significantly contribute to increasing customer satisfaction, building lasting relationships and, as a result, gaining a competitive advantage (Waśkowski, Kijewska-Ratajczak, 2023).

Strengthening the market position also requires a strategic approach to supply chain management. Efficient and sustainable supply chain management not only reduces operating costs, but also increases efficiency and flexibility in adapting the offer to current market needs. Companies that achieve high operational efficiency are able to bring new products and services to market faster, which is an important part of building an advantage over competitors (Kordecki, 2023). The importance of a strong brand, which in itself can be a source of

competitive advantage, cannot be overlooked. Building brand awareness, its positive image and trust among consumers requires consistent marketing and communication activities. A strong brand increases customer loyalty, enabling the company to maintain competitive prices and even reward its products or services (Ciszewski, 2023).

To sum up, competitive advantage is the result of conscious management of many aspects of the company's operations, including innovation, quality, uniqueness of the offer, sustainable development, customer relationship management, operational efficiency and building a strong brand. In the era of globalization and rapid technological change, companies must not only focus on improving these elements, but also on continuous adaptation and flexibility in order to respond effectively to dynamic market changes and maintain their competitiveness.

2.2. The Essence of Organizational Agility

Organizational agility is one of the key elements of modern business management, allowing for effective adaptation to the rapidly changing market environment. In the literature, the concept is often defined as the ability of an organization to quickly adapt its structures, processes, and resources in response to changing external and internal conditions, enabling it not only to survive, but also to thrive in an uncertain and dynamic environment (Bray et al., 2019; Yang, Liu, 2012).

Organizational agility is based on several foundations, including flexibility, responsiveness, innovation, and customer orientation. Flexibility is the ability to modify internal structures and processes, which enables an organization to quickly adapt to new conditions. The speed of response, on the other hand, emphasizes the need to respond immediately to changes, which requires the organization not only to monitor the environment on an ongoing basis, but also to have a well-developed internal communication system (Cappelli, Tavis, 2018). Innovation is essential to create new values and solutions that allow an organization to stay ahead of the competition and respond to changing customer needs and expectations. Ultimately, customer centricity emphasizes that all of an organization's activities should be geared towards understanding and meeting customer needs, which is made possible by flexibility, speed, and innovation (Ramadhana, 2021).

The challenges facing organizations in the context of agility are diverse and include both external and internal aspects. External challenges include rapid technological change, globalisation, volatility in demand and consumer behaviour, as well as increasing competition. Internal challenges, on the other hand, relate to the need to reorganize processes, change organizational culture, as well as develop employees' skills and competencies in such a way that they support agile operations (The First Pillar, 2020).

Realizing organizational agility requires leaders and managers to adopt a new mindset that is based on continuous learning, adaptation, and innovation. The role of transformational leadership is crucial here, as it can inspire employees to look for new solutions, foster a culture

of openness to change, and encourage collaboration and knowledge sharing within the organization (Akkaya, 2021).

In summary, the essence of organizational agility lies in the ability to adapt and innovate quickly, which enables organizations not only to survive but to thrive in the face of ever-changing external and internal conditions. However, implementing this approach requires profound changes in the structures, culture, and mindset of employees and leaders, which is both a challenge and an opportunity to build a sustainable competitive advantage.

2.3. Agile practices and shaping a competitive advantage

In the context of contemporary business challenges, the adaptation of agile practices to broadly understood business management is considered to be an important factor in shaping competitive advantage. Initially developed mainly in the software industry, agile methodologies have gained recognition in various sectors of activity as a way to increase adaptation to changing market conditions, accelerate the innovation process, and manage resources more effectively (Sherehiy, Karwowski, 2017).

The implementation of agile practices in the organizational structure and processes allows for dynamic adaptation to new challenges, while maintaining high reactivity and effectiveness (Jurczak, Konecka, Łupicka-Fietz, Pawlicka, 2024). Agile practices emphasize continuous adaptation, learning, and improvement, which in the context of building a competitive advantage means the ability of an organization to quickly identify changes in customer preferences, technologies, and the market. Thanks to flat organizational structures and short feedback cycles, companies can respond more quickly to changes, which is crucial in maintaining and increasing their competitive position (Brown, Jones, 2018).

One of the elements of implementing agility in an enterprise is the development of interdisciplinary project teams that, thanks to close cooperation and continuous communication, are able to effectively solve problems and quickly adapt to new project requirements. Such work organization is not only conducive to innovation, but also increases employee engagement and motivation, which has a direct impact on work quality and productivity (He, Harris, 2021).

Implementing agile practices also impacts the project and product management process, shifting the focus from long-term planning to short-term planning and task execution cycles, allowing you to test ideas faster and adjust directions in response to audience feedback (Sedej, Justinek, 2021). Such flexibility in project management is crucial for maintaining innovation and continuously adapting the offer to changing market needs (He, Harris, 2021).

In addition, agile practices promote a culture of openness, collaboration, and continuous learning, which contributes to better knowledge management within the organization and building strong, goal-oriented teams (Chen, Li, 2021). Organizations that successfully implement agile methodologies often report higher customer satisfaction, which is due to

a better understanding of their needs and faster delivery of solutions that meet those needs (Chen, Siau, 2020). The implementation of agile practices can also affect internal processes, improving operational efficiency and reducing operating costs, which also strengthens the company's competitive position in the long run (Felipe et al., 2020). By maximizing value with minimal waste of resources, businesses can better manage their resources, which directly translates into their ability to offer competitive prices and maintain margins (Kt, Sivasubramanian, 2023).

Certainly, agile practices play a key role in shaping competitive advantage, enabling organizations not only to respond effectively to dynamic market changes, but also to promote a culture of innovation, collaboration, and continuous improvement. The adoption of agile working methods contributes to increased operational agility, which is essential for quickly adapting business strategies and product offerings to current customer needs and expectations (Fiddler, 2017). Such adaptability thus becomes not only a source of competitive advantage, but also a foundation for building long-term success in increasingly globalized and competitive markets (Prieto, Talukder, 2023).

In addition to directly impacting internal processes and increasing customer satisfaction, agile practices also impact the ability of businesses to attract and retain talent. In today's work environment, where employees value flexibility, opportunity to grow, and participate in innovative projects, a culture that promotes agile behavior can help build an attractive workplace that attracts high-caliber professionals. The talent and creativity of teams thus become another important element strengthening the company's competitiveness (Kurnia, Chien, 2020).

Agility in project and product management also allows for better risk management by allowing you to react quickly to unforeseen changes and challenges, thus minimizing potential losses and maximizing the chances of success. Such a proactive attitude in the face of uncertainty and volatility in the business environment is a key differentiating factor for companies capable of maintaining and developing their market position (Seifollahi, Shirazian, 2021).

It is also worth emphasizing that the implementation of agile practices requires commitment and openness to change at all levels of the organization. Transformation towards an agile organization is a continuous process, requiring not only changes in processes and tools, but above all in the way of thinking and organizational culture. Success in implementing agility depends on a willingness to learn, experiment, and adapt, which in the long run allows you to build a strong, flexible, and innovative organization capable of maintaining a competitive advantage in a changing world (Prieto, Talukder, 2023).

Agile practices, when properly implemented and adapted to the specifics of the company's operations, can significantly contribute to its success. Therefore, they are not only a response to today's business challenges, but also a strategic investment in the future, enabling companies not only to survive, but also to dynamically develop in an increasingly demanding and

unpredictable market environment. The mutual relationship between building a competitive advantage and the use of agile practices is shown in Fig. 1.

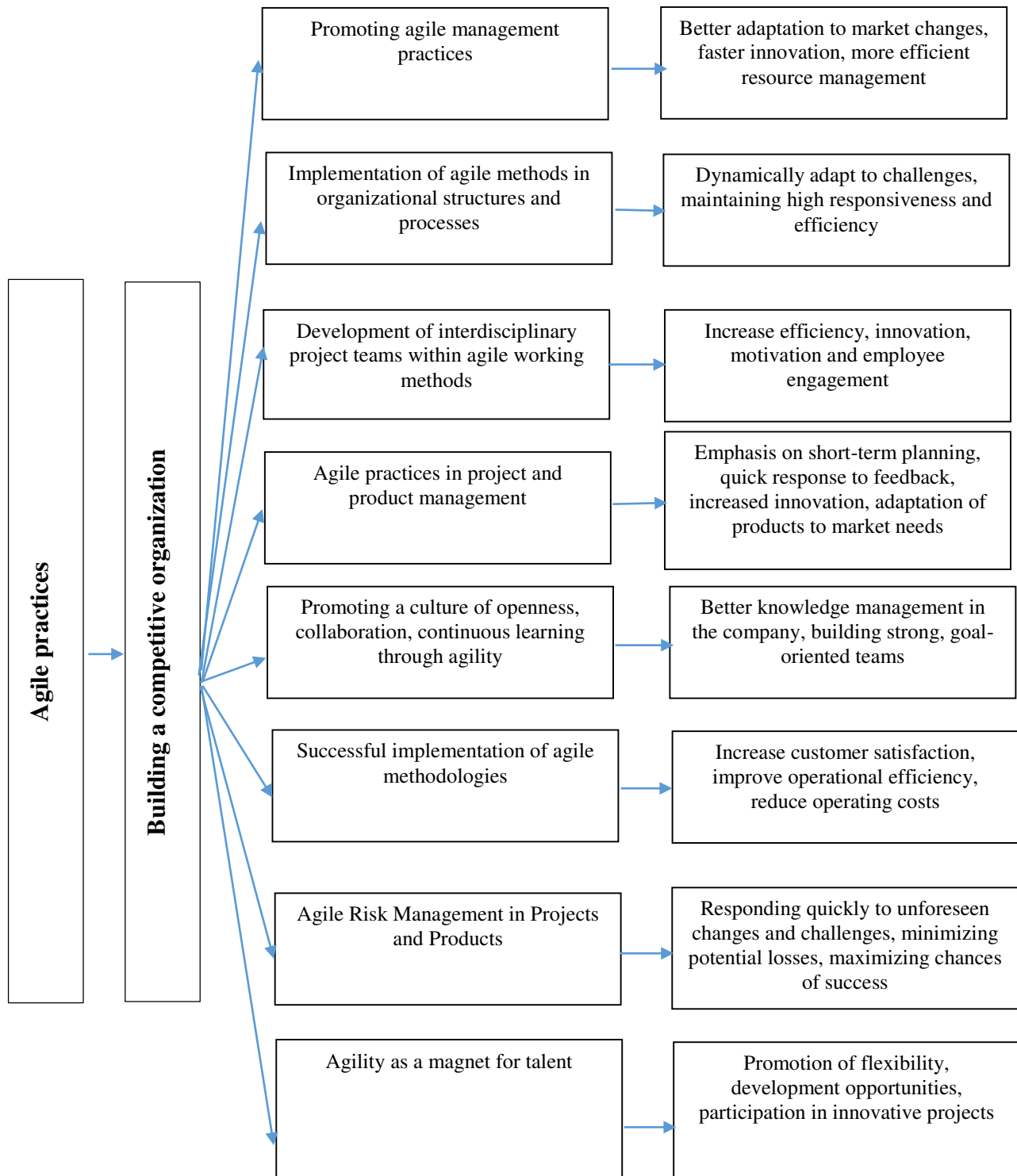


Figure 1. Agile practices and building an organization's competitive advantage in a relational perspective.

Source: Author's own elaboration.

The presented model of mutual relations indicates that the adaptation of agile practices in organization management affects various aspects that are crucial for achieving and maintaining a competitive advantage. The model illustrates how dynamic adaptation to changing market

conditions, effective resource management, quick response to feedback and development of interdisciplinary project teams support building a sustainable competitive advantage. The interrelationships shown in the figure highlight that agility in project and product management, better knowledge management within the company, and promoting a culture of openness, collaboration, and continuous learning are directly related to increased customer satisfaction, improved operational efficiency, and reduced operating costs. In addition, the model points out that agile risk management practices in projects and products allow for a quick response to unforeseen changes and challenges, which minimizes potential losses and maximizes the chances of success, while attracting talent and promoting flexibility and development opportunities.

2.4. Research Methodology

This article presents the results of a study that was conducted in April and May 2023. The aim of the study was to determine how agile behaviors of organizations affect building and maintaining their competitive advantage on the market. The research hypothesis assumed that there is a strong relationship between the use of agile practices in an organization and its ability to build a competitive advantage. The subject of the research was organizations of various industries that implement agile practices in their operations, focused on five key areas: internal analysis and business environment, offering unique products or services, minimizing production costs, adapting to changes, and providing products and services valued by customers.

The research methodology was based on a quantitative analysis of data collected through a survey questionnaire that was distributed among 303 respondents from different organizations. The responses to the survey questions were categorized based on a five-point Likert scale, allowing for an assessment of the degree to which organizations are engaging in each of the areas of agility studied. In addition, a correlation analysis was conducted to identify the relationship between various aspects of organizational agility and building a competitive advantage.

The following research questions were formulated: (1) To what extent are agile practices present in the activities of organizations of various industries?; (2) Is there a correlation between the level of implementation of agile practices and the perceived competitive advantage of the organization?; (3) Which areas of organizational agility have the greatest impact on building a competitive advantage?

In the course of the study, sociodemographic data were obtained. Men dominated among the study participants, accounting for 58.7% of the respondents, while women represented 41.3% of the study group. The largest age group were people under 25 years of age (47.2%), while the 26-35 and 36-45 age groups represented 30.4% and 19.5% of participants, respectively. People over 45 years of age accounted for only 3% of respondents.

In terms of professional position, employees predominated (57.4%), followed by middle management (25.2%), low-level management (11.1%) and top management (6.4%). In terms of seniority, 47.7% of respondents declared no more than 5 years of professional experience, 33.4% had worked for 6 to 10 years, and a minority had longer work experience. Respondents came from companies of various sizes and seniority in the market, with the dominance of small (37.5%) and micro (26.4%) enterprises.

The vast majority of survey participants came from the retail sector (54.8%), with smaller groups representing other industries, including education and the automotive industry. The company in which the respondents worked had a range of operations mainly at the regional and national level.

2.5. Presentation of Research Findings

As part of the conducted research on the agile behaviors of organizations building their competitive advantage, the answers of 303 respondents were examined (see Table 1). The study focused on five key areas that can impact an organization's ability to maintain and develop a competitive advantage. It looked at the extent to which organizations perform internal analysis and business environment, offer unique products or services, minimize production costs, adapt quickly and effectively to changes, and deliver products and services valued by customers.

A significant majority of respondents positively rated an organization's ability to adapt to change and deliver products and services valued by customers, with 119 and 116 responses in the "Somewhat YES" category, respectively, and 108 and 112 in the "Definitely YES" category. The internal analysis and the business environment were also highly rated, with 114 "Rather YES" votes and 110 "Definitely YES" votes. These areas show that organizations are perceived as effective in adapting their offerings to market requirements and in managing internal resources and analyzing the business environment.

Offering unique products or services that stand out in the market was also rated positively, albeit with a slightly lower score in the "Rather YES" category (102 responses) and the highest score in the "Definitely YES" category (121 responses), suggesting that while there are some fluctuations in ratings, in general, organizations are recognized as innovative and capable of offering added value through uniqueness.

Minimizing production costs, although important, was rated slightly lower than the other areas, with 107 "Rather YES" and 112 "Definitely YES" answers. This is still a high rating, but it indicates that although organizations are considered effective in cost optimization, other aspects of management and innovation may be seen as more critical for building a competitive advantage.

The answers "Definitely NO" and "Rather NO" received relatively low scores in all areas, which further confirms that the majority of surveyed organizations are perceived as operating effectively in the context of agile behaviors that build a competitive advantage. The answers in

the category "I have no opinion" were varied, which may indicate ambiguity in the perception of some areas of the organization's activity or the lack of sufficient knowledge of the respondents about the activities of the surveyed companies.

Taken together, the results of the research indicate that organizations are generally perceived as effective in key areas of agile behavior, which can contribute to building and maintaining a competitive advantage in the market. Their ability to adapt to change and to offer products and services that are valued by customers are particularly highly rated.

Table 1.

Agile behaviors of the organization building its competitive advantage, N = 303

	Definitely NOT	Rather not	I don't have an opinion	Rather YES	Definitely YES
Performs internal analysis (e.g. technology, employees) and business environment (analysis of competition, market trends and customer preferences) (1)	5	27	47	114	110
Offers unique products or services that stand out in the market (2)	8	33	39	102	121
Minimizes production costs	11	36	37	107	112
Adapts quickly and effectively to changes (3)	4	21	52	119	108
Provides products and services valued by customers (4)	6	26	43	116	112

Source: In-house analysis based on the conducted research.

Table 2, which presents the correlations between organizational agility and building a competitive advantage, shows exceptionally strong relationships between different aspects of organizational agility, suggesting that these aspects are closely related and together contribute to building a competitive advantage. The correlation values between the individual behaviors of an agile organization (described in Table 1) are very high, oscillating mainly around 0.96 to 0.99, which indicates a strong relationship between them. Such a strong correlation between the analysis of internal and business environment and offering unique products or services (correlation coefficient 0.98) emphasizes that a deep understanding of one's own resources and the market is fundamental for innovation and creating an offer that stands out from the competition. Similarly, the close relationship between minimizing production costs and the speed and effectiveness of adapting to change (correlation coefficient 0.99) indicates that operational efficiency is intrinsically linked to organizational flexibility, allowing firms to quickly adapt to evolving market conditions without undue burden on the cost structure.

The extremely high correlation between the delivery of products and services valued by customers and other aspects of organizational agility, such as internal and environmental analysis or offering unique products, suggests that customer satisfaction is directly related to continuous monitoring and adaptation to their needs and preferences. This is a reflection of the understanding that agility is not only an internal feature of an organization, but also a way to engage externally with the market and customers, which results in building a sustainable competitive advantage.

Table 2.*Correlations between organizational agility and building a competitive advantage, N = 303*

	1	2	3	4	5
1	1				
2	0,98	1			
3	0,98	0,99	1		
4	0,99	0,96	0,97	1	
5	0,99	0,98	0,99	0,99	1

Source: In-house analysis based on the conducted research

The correlations presented in Table 2 indicate the holistic nature of organizational agility, emphasizing that it is not a set of isolated activities, but an integrated system in which each element influences the others and contributes to the overall ability of the organization to adapt and innovate. This relationship shows that effective agility management requires a balanced approach to a variety of aspects of a company's operations, from strategy to operations to human resource management, which together contribute to the ability to create value for customers and maintain a competitive position in the market.

3. Conclusions

Theoretical analyses and scientific research have shown that organizational agility is a key factor in building and maintaining a competitive advantage in a dynamically changing business environment. The ability to adapt quickly and effectively to change, offer unique products or services, minimize production costs, and deliver products and services valued by customers is seen as essential to the effective functioning of an organization. Studies have shown that organizations that focus on these aspects are better able to respond to market demands and manage internal resources.

The significant correlation between the individual elements of agility indicates the holistic nature of this approach. It is not a set of isolated activities, but an integrated system in which each aspect affects the others and together contribute to the organization's ability to adapt and innovate. This understanding of agility emphasizes that it cannot be treated solely as an internal feature of an organization, but must also include how it engages with the market and customers. This is a reflection of the belief that customer satisfaction is directly linked to continuous monitoring and adapting to their needs and preferences.

The ability to analyze internal and business environments, including competition, market trends and customer preferences, has proven to be the foundation for innovation and creating an offer that stands out from the competition. This indicates the importance of understanding one's own resources and the market as a key factor in building a competitive advantage.

In addition, research has shown an intrinsic link between operational efficiency and organizational flexibility. Organizations that are able to optimize costs while maintaining the ability to quickly adapt to evolving market conditions demonstrate a strong competitive advantage. This shows that agile management requires a balanced approach to various aspects of a company's operations, from strategy to operations and human resource management.

In the light of the conducted research and theoretical analyses, it can be concluded that organizational agility plays a key role in building a sustainable competitive advantage. It is a complex process that requires constant adaptation and innovation, both within the organization and in its relations with the environment. Effective agility management enables organizations not only to survive in a changing environment, but also to succeed by building value for customers and maintaining a competitive position in the market.

On the basis of these considerations, several recommendations can be made for modern organizations, aimed at increasing their agility and strengthening their competitive advantage on the market. In the first place, companies should focus on continuous analysis of the internal and business environment. This will allow you to better understand changing market trends, customer preferences and the position of your competitors. This in-depth understanding of the market provides the basis for innovation and enables you to create an offering that stands out from the competition.

Another essential recommendation is to focus on offering unique products or services that provide clear added value to customers. Innovation and uniqueness of the offer are key to differentiating in the market and attracting the attention of consumers. Companies should therefore invest in developing products and services that not only meet customer expectations, but also exceed those expectations by offering something new and valuable.

Minimizing production costs, while maintaining the high quality of the products and services offered, is also crucial. Organizations should strive to optimize operational processes in such a way as to minimize unnecessary expenses without compromising the value they provide to their customers. Operational efficiency allows for better management of resources and can contribute to increased profit margins.

The ability to adapt quickly and effectively to change is another key component of organizational agility. Companies need to develop flexibility in their strategies, processes, and organizational structures to be able to respond quickly to evolving market conditions. This requires not only the right tools and processes, but also an organizational culture open to change and innovation.

Finally, businesses should continually focus on providing products and services that are valued by customers. Customer satisfaction should be at the heart of everything an organization does. For this purpose, it is necessary to constantly monitor the needs and preferences of customers and adapt the offer to them. High quality customer service and understanding their expectations is the foundation for building long-term relationships and customer loyalty.

In order to effectively build and maintain a competitive advantage, modern organizations must focus on continuous market analysis, innovativeness of the offer, operational efficiency, organizational flexibility and customer orientation. Taken holistically and integrated into the company's strategy, these elements can collectively contribute to increasing organizational agility and strengthening the company's position in the market.

The study had some limitations. They are varied and result from both the nature of the research itself and external factors. One of the main limitations is the reliance on respondents' subjective assessments, which can affect the reliability and objectivity of the results. In surveys and individual assessments, there is a risk that the answers may be inaccurate or not reflect actual behaviors and practices in organizations.

Another limitation is the geographical and industry coverage of the surveyed organizations, which may not be representative of all sectors and regions. This limits the possibility of generalizing the results on a broader scale. In addition, market dynamics and the speed of technological and socio-economic change mean that research results can quickly become obsolete, highlighting the need for continuous data updates and long-term trend research.

Future lines of research may focus on expanding geographic and industry coverage to better understand how organizational agility functions in different contexts and how it can be adapted to specific market conditions. It is also possible to use blended methods, combining quantitative surveys with qualitative case studies, which would allow for a deeper understanding of the mechanisms and strategies of agility in practice.

It may also be important to examine the impact of technology and digital innovation on organisational agility. In the age of digitalization and the growing role of AI and automation, understanding how these technologies contribute to increasing organizational agility and adoption becomes crucial.

Agility research can also take into account the impact of external factors, such as changes in regulations or the impact of global crises, on an organization's ability to maintain a competitive advantage. This would allow for a better understanding of how companies can effectively navigate an uncertain and rapidly changing environment.

Future research could also show how organizational culture and human resource management practices affect organizational agility. Understanding the role people play in creating and maintaining agile organizations can provide valuable guidance on building effective talent management strategies and an organizational culture that supports innovation and adaptation.

It is also worth comparing the results of the research obtained by the authors of this article with the research of other authors. Rahimi & Mansouri (2019) points to similar benefits of organizational agility, elements of which such as continuous adaptation and learning are crucial for success in a fast-paced environment. These results support the relationship between agility and competitive advantage, which is also highlighted in the study in this article. Kocot & Kwasek (2022) discusses the wide application of agile practices outside the IT sector, which

corresponds to the results presented in the study, pointing to the universality and effectiveness of agile methods in various sectors.

Adamik (2019) emphasizes the importance of responding quickly to change and being flexible in action as key to maintaining an advantage in the market. The research presented in this article illustrates that organizations implementing agile practices achieve these goals, which is consistent with Adamik's observations. Bukowska (2023) and Sulimowska-Formowicz & Chrupała-Pniak (2010) point to quality and uniqueness as important factors of competitiveness, which is reflected in the study, where agile practices lead to a better understanding of customer needs and the delivery of unique solutions.

To sum up, the results of the study presented in this article are consistent with the literature on the subject and indicate a significant role of organizational agility in building and maintaining a competitive advantage, which is confirmed by research by other authors. The integration of these results into the article may strengthen the argument about the key role of agility in modern business management.

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THE USE OF SOCIAL MEDIA IN A RELIGIOUS COMMUNICATION STRATEGY: A CASE STUDY ON THE EXAMPLE OF POLAND

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Purpose: This discussion focusses on the way in which the Catholic Church in Poland is finding its way, i.e. whether the Church is making its presence felt through the use of the Internet including social media as instruments for communicating with the faithful.

Design/methodology/approach: In the analysis, the research procedure of Robert K. Yin's case study was applied, and it was assumed that the mere fact of having an online presence (website) and maintaining a profile on a given social network has the potential to increase the scope of social influence. The article analyzed social media profiles of Catholic dioceses in Poland.

Findings: It would seem that as social media becomes more popular and widespread, interactivity will become natural (commenting, sharing, posting posts, photos, videos), as it is as natural for the youngest generation of users as television or radio for Generation X. Meanwhile, 12 out of 41 dioceses and archdioceses in Poland do not have social networks at all. In conducting research to answer the research questions posed in this study concerning the extent to which archdioceses and dioceses in Poland use the Internet, including social media, it was found that a relatively high percentage, 93%, have websites and 71% of dioceses maintain social media accounts. This percentage seems quite high, but in an era of social media dominance, the fact that 29% of archdioceses and dioceses do not use this communication channel greatly narrows the scope of social impact, especially for young people, for whom these media are the primary form of communication.

Research limitations/implications: The profiles on TikTok are decidedly missing from the Internet-related communication strategies that are being developed, and it is in the Top 10 used in Poland. In summary, the following conclusion can be drawn, the Catholic Church in Poland is making up for its lack of presence on the Internet, including social media, but as stated, the communication strategies built do not fully reflect the social trends existing at the time.

Originality/value: These issues are relatively poorly researched and seem important from the point of view of shaping social influence, including reaching groups for whom digital media are the only medium they use.

Keywords: social media, religious communication strategy, media technologies, agenda-setting.

Category of the paper: research paper.

1. Introduction

Today's civilisation is based on the circulation of information, in which modern communication technologies, especially social media, play an essential role. The development of Web 2.0 platforms has revolutionised the online functioning of individual users, companies, and institutions, including the NGO sector. The main advantage, but also the goal of Web 2.0 is that the Internet offers users the greatest possible opportunity for interaction and integration.

The development of media technologies and the new communication possibilities associated with them is not only a change at the technical level, but technology has had and continues to have an impact on the shaping of society. The most important changes in media technologies are related to: a new way of representing the world through immersion in a virtual environment; new relationships between user subjects and media technologies; a change in the way time and space are experienced; a move away from traditional distinctions between artificial and the natural, human and technical, real and virtual; the globalisation of media production and culture, new definitions of ownership, the media broadcaster (Lister et al., 2009; Koszembar-Wiklik, 2017; Osika, 2016).

Social media grew out of the technological foundations of Web 2.0, enabling the creation and exchange of content generated by the users themselves, and has become the main communication channel across generations (Kaplan, Haenlein, 2010, p. 61; Guzek, 2015). Social media is currently the fastest growing medium in the world. They were initially created to satisfy the need for interpersonal communication and entertainment, but over time they have taken on many more roles, e.g. in the marketing of companies and organisations. The development of social media has caused significant changes in marketing communication (Buczyńska, 2018, pp. 1-2). Social media communication is the cornerstone of marketing, its strategic nature is emphasised, and it is an important prerequisite for creating the image of any organisation and for interacting with the audience, which is so crucial nowadays (Pluta-Olearnik, 2018).

Therefore, it is important from the point of view of the communication of entities such as Catholic dioceses, to use these communication channels for pastoral action and to transform communication practises from one-way contact to the interactivity typical of social media. As media theorists point out, interactivity, as the essence of social media, means the ability of the user to directly influence and change the images and texts viewed. The audience of new media is thus becoming more of a user than a viewer or reader (Lister et al., 2009, p. 34). What follows is that Internet users are not passive viewers, but show engagement and activity in content creation. These new communication practises and conditions need to be taken into account by all social actors wishing to integrate their agenda into the opinion-making mainstream, it seems that this is particularly important in the case of religious institutions. From this perspective, it is essential to recognise to what extent the Catholic Church in Poland has this communication potential. The first step to establish this potential is to examine what social media communication channels are available to the administrative units of the Catholic

Church in Poland, i.e., archdioceses and dioceses, which is the main research objective of this study. More specifically, the aim is to answer the following research questions:

- Do Catholic dioceses and archdioceses in Poland have a website?
- Do Catholic dioceses and archdioceses in Poland have accounts on social media sites?
- Which social media channels of communication with the faithful are dominant?

In line with the assumptions made earlier, these findings will provide a preliminary indication of the degree to which the Catholic Church in Poland is adapting to communication trends affecting the building of social outreach. It should be emphasised that the initiation of research on the use of social media in the communication practises of the church seems particularly important given the recognised research gap in this regard. For example, the ScienceDirect research database shows only five publications in the last 4 years (2019-2023) when searching for the keywords 'social media', 'religious communication', and 'social media', 'religious communication' 'Catholic Church' is only one.

2. Method and Results of the Study

The extent of an organisation's impact depends on the communication it establishes with the public (Koszembar-Wiklik, 2016). From this point of view, the existence of information about an organisation in the public consciousness and the methods and techniques of communication that make it possible to design its content are crucial (Sulkowski et al., 2022; Osika, 2008). The communication process itself, in turn, is influenced by technology, which determines the way communication occurs. Consequently, when we want to ask about the meaning and influence of the Catholic Church on society, we must take into account the dominant media and their information potential.

In this sense, a year-on-year increase in the role of social media is discernible, according to Digital 2023: Global Overview Report, currently 64.4% of the world's population uses the Internet (Digital 2023..., 2023), while 60% of the total population uses social media, i.e., 4.76 billion people (Digital 2023..., 2023). Many studies show that, for example, in the age group between 13 and 25, social media are the main media they use, in Poland, between 18 and 34, 100% of the population uses the Internet (Research Communication..., 2022).

Among the top 10 most used social media sites in February 2023 were:

- YouTube – 21 855 906 users.
- Facebook – 21 841 650 users.
- Messenger – 20 493 810 users.
- Instagram – 11 245 554 users.
- TikTok – 10 801 674 users (Polskie Badania Internetu, 2023).

The data cited seem to clearly indicate the need to consider the role of social media in all social influence processes, including the church. From this point of view, to what extent does the Catholic Church use these media to reach the public with its content, thus building its agenda.

Within the scope of one article it is difficult to make a broad study on this topic, therefore, it will be in accordance with the title, limited to one country, and it is proposed to make a study based on the case of Poland. The study will include 41 archdioceses and dioceses according to the administrative division of the church in Poland. The data was collected in April 2023, and the deviations are a result of the dynamic nature of the research subject, so the study is not concerned with measurement precision, rather with the diagnosing a trend regarding the communication strategy used. The following categories were used as criteria for the case study: the fact that the archdioceses/dioceses have a website and social media platform run by the archdioceses/diocese including the most popular ones: such as: Facebook, Twitter; YouTube, and others, which will include the remaining social media accounts. The study assumes that the mere fact of having an online presence (website) and maintaining a profile on a particular social network has the potential to increase the scope of social impact, according to the assumptions made earlier. The analysis followed the case study research procedure of Robert K. Yin (Yin, 2003; Stake, 2005; Lisiecka, Kostak-Bochenek, 2009), i.e.:

- the research problem was defined (introduction); a case (Poland) was selected; a data collection protocol was designed (a categorisation table was developed);
- data were collected;
- analysis was performed and conclusions were drawn.

The main research questions are as follows:

- Do Catholic dioceses and archdioceses in Poland have a website?
- Do Catholic dioceses and archdioceses in Poland have accounts on social networking sites?
- Which social networks as channels of communication with the faithful are dominant?

New media are often intuitively understood as media that apply communication via the Internet in opposition to old media such as radio, television, and the press. More precise seems to be the proposal of G. Weiman and H.B. Brosious, who distinguish three formats of division: traditional offline media, traditional online media, and social media (Weiman, Brosius, 2016, p. 28) or the proposal of Paul Levinson, who defines social media as "new new media" (Levinson, 2010). Many researchers of the social media phenomenon attempt to classify it. A classification distinguishes:

- social media for sharing resources, e.g., YouTube, Slidshare,
- social media for presenting opinions and views, e.g. blogs,
- social media aimed at building and maintaining relationships, for example, Facebook,

- social media geared towards communication and discussion, e.g., online forums, chat rooms,
- co-creation- or collaboration-orientated social media, e.g., Google Docs, Massive Multiplayer Online Game (MMO),
- current affairs Oriented social media, for example, microblogs (Kaznowski, 2016, p. 89).

Due to the constant development of technology, the boundaries between different types of media are blurred. The various media are evolving, expanding the available functions and media (Osika 2018). Regardless of the type of media, it is difficult to question their importance in communication when generations of young people cannot longer imagine life without them. The characteristics of generation Z or generation Y (*Millenials*), but also of generation X, indicate that social media have become an indispensable tool for communication, entertainment, information seeking and self-expression. The development of mobile devices means that people are constantly connected to the Web.

Social media in the Church's communication with the faithful are also essential in terms of information selection and prioritisation (Campbell, 2005). Based on the premise of the media agenda (Agenda Setting), McCombs and Shaw show that the media create reality by focussing public attention on issues of their own choosing and provide audiences with common reference points (McCombs, Shaw, 1972, pp. 176-187; McCombs, 2008; Wiecezorek, 2012; Nowak, 2016; Przybysz, 2018). They exert a significant influence on the directions (scope and hierarchy) of thought. This theory can be applied to the Church's communication with the faithful (community members) and the wider environment. It indicates that the absence of the Church's teaching in the media is its absence from people's thinking. The positioning of information is based on subjectivity and is individual to each medium.

In traditional media (TV, press, including online newspapers and radio), there is a visible hierarchy of content. Due to information overload, the media select the information that 'sells' well in the first place. It is also the editors or owners of the media who decide what it will appear at, in what place, and in what order. That is, there is a filtering of information, since the media are subject to the laws of the market, and the economic factor, which determines the profitability of a given medium, is important in the selection of information for publication. It is not only the media that selects information; the increasing number of means of communication also forces the audience to make a selection, which it calls 'hyper-selection' (Goban-Klas, 2011). The multitude of information flowing from the web forces users to select not only the sources, but also the information itself. In the information society, time becomes an economic good that cannot be produced.

In the context of Agenda Setting theory, communication through social media enables organisations to get their information out to audiences without the intermediation of media such as radio, television, or press. It is true that the Church in Poland has its own traditional media - radio, TV, or press, but these reach a relatively narrow audience. Social media allow institutions

(including dioceses) to freely shape content without the risk of it being distorted by the media, to position the content according to the importance of the information, and to allow dialogue with the audience. Furthermore, access to information by the faithful is possible at any time and from any place on Earth. The multimedia nature of social media increases the reach and provides an opportunity to reach those groups that already consume little of traditional media and traditional media formats.

The Internet, social media, and the two-way nature of communication are forcing the Church to change its methods of evangelisation. The new media have not only become a link between the Church and societies around the world, but also influence the image of the Church. Creating the image of the Church (also at the diocesan level) and communicating using social media is of particular importance today, when in Poland the image of the Church and the image of the priest in the media are often presented in an extremely critical way. "Scandals, scandals, and constant crisis situations – this is how the Church is most often portrayed in the electronic media, in the news services watched in the evening by several million viewers in Poland, but also on the Internet portals" (Przybylska, 2018). Often newsrooms about priests and their abuses become generalised reports about the Church as a whole. The media, or at least most journalists, are not interested in reporting positive information about the Church's activities. It is rare to come across positive or neutral information about the Church; the information selected by gatekeepers is usually already filtered, with ready-made negative commentary. In this situation, social media allows the Church's position to be shown from its point of view (see: Guzek, 2015, 2022; Wiesenberg, 2019, Nabożny, 2022).

The need for the diocese to participate in social media also comes from the fact that it has become an essential place for social relationships. A place of virtual meeting of people where one can realise oneself socially, emotionally, and artistically. They can constitute the third place according to the theory of R. Oldenburg's theory. The author points out that there are three basic places where people perform their activities. The first is home, the second is work or school, and the third is the place where people seek entertainment, take a break from work and everyday household activities, and pursue their passions and interests. In traditional society, these places were religious communities, theatres, cafés, interest circles, hairdressing salons, or sports clubs. In the consumer society, discos, nightclubs, cinemas, or shopping centres have become a Third Place (Oldenburg, 1999). In the era of 'liquid modernity', such a Third Place can be social media, which allows people with similar interests to 'meet'. And in this sense, the Church, as traditionally understood, is being replaced by social media.

The ease of access to social media and at the same time the pressure to be online, the 'imperative to be connected' (Zacher, 2015), also have its negative effects. The rapid pace of change means that even web generation is showing fatigue from technology (Osika, 2018). It is becoming increasingly difficult for young people to switch from active to rest mode. This peculiar speed culture can be particularly destructive for the older generations, but also in the online generation there is a problem with defining one's own identity or separating virtual

and real life. The dangers of participating in social media can also be looked at from the point of view of the organisations that run their profiles; they are mainly related to the possibility of negative comments. However, an institution like the Church (represented by dioceses, among others) should be based on trust and on receiving feedback from the faithful, which the church understands as a community form. It is the openness, the handling of criticism, and the skilful management of the relationship with the faithful that is a prerequisite for creating the bond of the Church as an institution with the faithful.

Data analysis research conclusions – Catholic Church presence on social media using the example of Poland

According to the research assumptions and indications of the 'Theoretical framework', answering the research questions required the collection of data according to an agreed categorisation key. The first reconnaissance was relatively straightforward; it was a matter of investigating whether archdioceses and dioceses had websites that allowed them to contact their faithful through this communication channel. The results of the data from the website are shown in Figure 1 below.

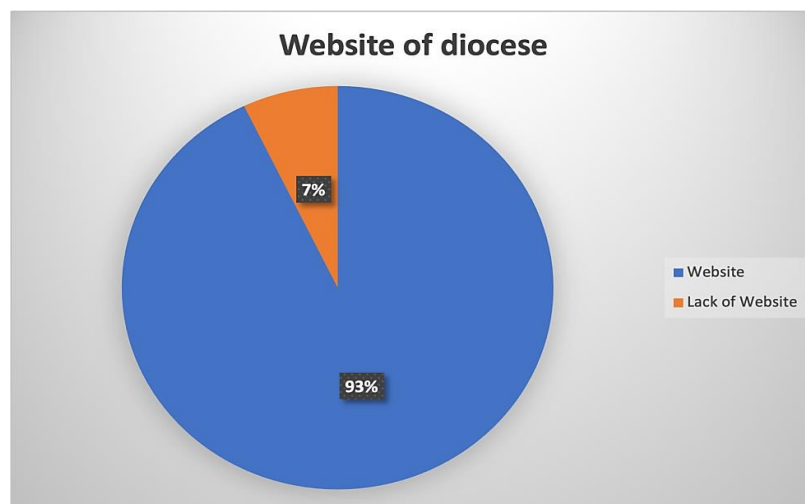


Figure 1. Website of the diocese.

Source: Own elaboration based on data downloaded from the Internet.

Such a high percentage of archdioceses and dioceses running their own websites demonstrates a high awareness on the part of church authorities of the need to use the Internet as a communications channel today. This takes into account both the worldwide media trend and the importance of broadening the possibility of reaching out to their message, especially to age groups for whom the Internet is the primary medium they use.

Having a website opens up the possibility of attaching social media accounts to it, but the use of this communication potential appears to be quite limited; the results obtained are presented below (Figure 2).

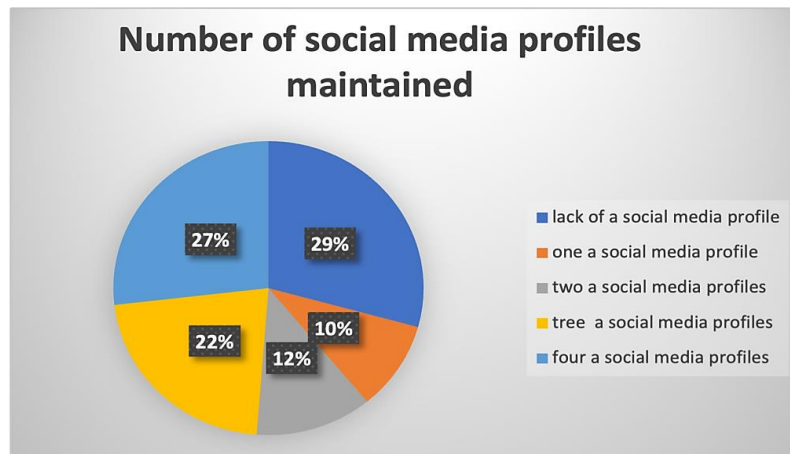


Figure 2. Number of social media profiles maintained.

Source: Own elaboration based on data downloaded from the Internet.

According to the analysis, up to 29% of archdioceses and dioceses do not have accounts on social media and 10% have only one, which means that around 40% of them make very little or no use of this communication channel. Taking into account the data on media preferences, it is apparent that a large proportion of potential faithful are excluded from the communication circuit; this is particularly true of young people. At the same time, it should be noted that more than half of the archdioceses and dioceses have several social media accounts, which are mainly Facebook (Meta), Twitter, and YouTube. Thus, those dioceses where there is a high awareness of the role of social media in building social outreach are not limited to one channel. It can also be inferred that in these dioceses, care has been taken to develop the media competence of those responsible for communication strategies.

Based on the information collected during the investigation, the distribution of the use of the different social networks by archdioceses and dioceses was also established, and therefore the Facebook (Meta) profiles are the most popular in this regard, the graph below (Figure 3) shows the data obtained.

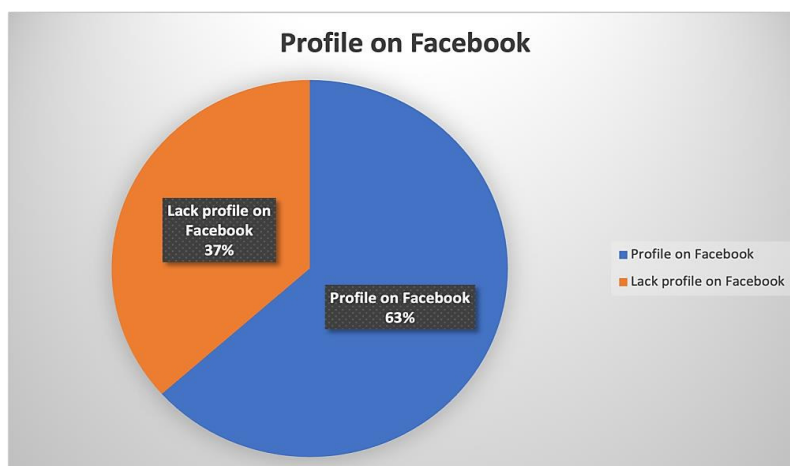


Figure 3. Profile on Facebook.

Source: Own elaboration based on data downloaded from the Internet.

According to the research, 63% of archdioceses and dioceses have a profile on Facebook (Meta), which indicates a relatively high participation in contemporary communication trends. The use of this profile, which has the highest percentage of users in Poland, is also important, i.e., it provides opportunities to build relationships with the faithful. At the same time, in this context, 37% of dioceses who do not have an account on the most popular social network should also give thought in terms of untapped communication potential.

On the websites hosted by archdioceses and dioceses, the second frequently appearing social media profile is Twitter; the results obtained are included below; see Figure 4.

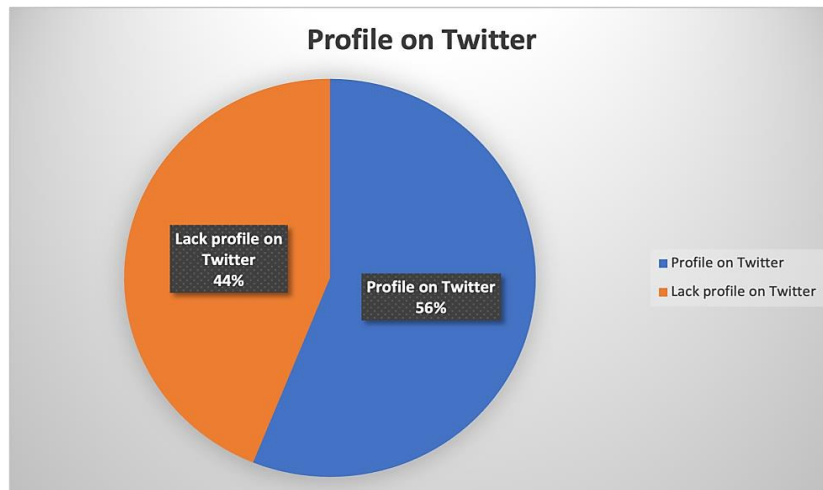


Figure 4. Profile on Twitter.

Source: Own elaboration based on data downloaded from the Internet.

As established, 56% of archdioceses and dioceses having Twitter accounts seems to be a quite a good result; however, in this case, the fact of the rather low popularity of this service in Poland is significant. As the results obtained in the Polish Internet Research, February 2023 show, Twitter is not among the 10 most popular social networks in Poland. Therefore, having a Twitter profile does not contribute to reaching the faithful more widely, as it does not build a social impact. From this point of view, it is important not only to have an account but also to be aware of the general communication trends we face in the community. At the same time, it was found that those archdioceses and dioceses that have Twitter profiles also have accounts on other social networks, so this may be a conscious decision to build a communication strategy aimed at reaching a diverse audience/believers to build a wider social network reach.

The third most frequent appearance on archdiocesan and diocesan websites is the YouTube profile, the graph below (Figure 5) shows the data received.

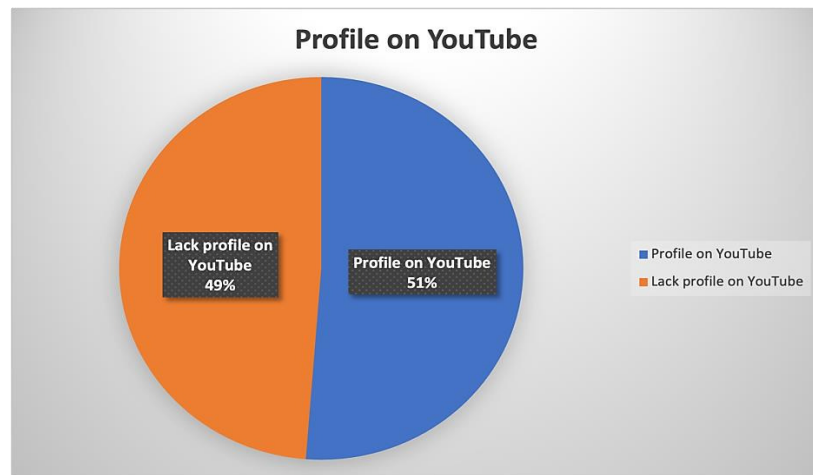


Figure 5. Profile on YouTube.

Source: Own elaboration based on data downloaded from the Internet.

Taking into account data from the Polish Internet Research, February 2023, stating that the most popular social network in Poland is YouTube, and the fact that 51% of archdioceses and dioceses have accounts on this portal, one can conclude that there is a relatively high awareness of the channels with which to communicate with the faithful. But at the same time, 49% of archdioceses and dioceses without established YouTube profiles must raise questions about ideas for reaching worshippers, especially the younger generation. It is probably not possible to conclusively link the neglect of this channel for building relationships with the faithful to the decline in the number of young-age believers, but according to the tenets of agenda-setting theory, the absence of the church in 'media' is an absence in their minds. And from the point of view of the church as an organisation, the potential for social impact in communicating with its stakeholders is neglected.

In line with the categorisation assumptions, it was also investigated whether archdioceses and dioceses have profiles on other social media than those listed above. The results obtained are presented in the following (Figure 6).

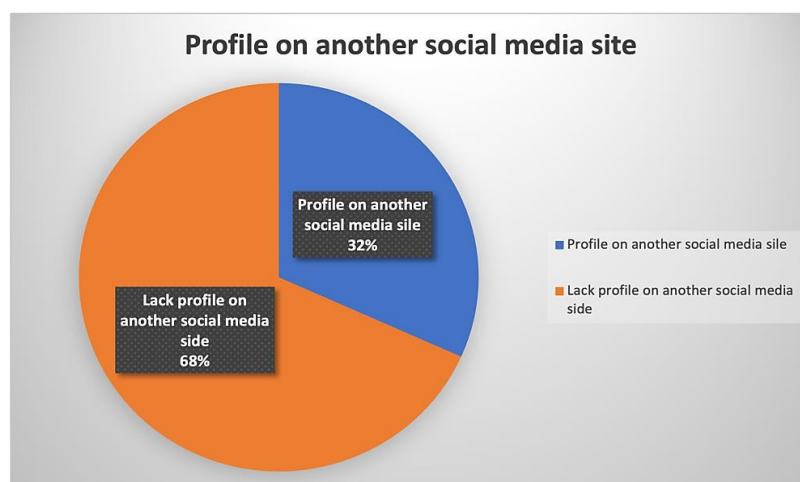


Figure 6. Profile on other social media sites.

Source: Own elaboration based on data downloaded from the Internet.

As found, only 32% of archdioceses and dioceses have accounts on social media other than those listed above. In most cases, these are those dioceses that have 4 social media profiles, only the Diocese of Gliwice was an exception to this rule. From this, it can be concluded that the fact of building relationships with the faithful through social media encourages further development of social networks. Among the most popular social media other than Facebook, Twitter, or YouTube is Instagram (9), which is among the five most popular sites in Poland according to data from Polish Internet Research, February 2023, followed by Flickr (3) and Spotify (1), see Figure 7 below.

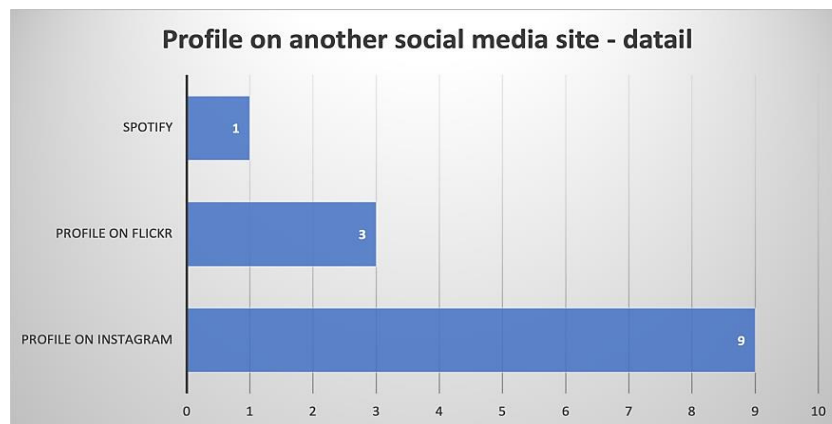


Figure 7. Profile on other social media sites – detail.

Source: Own elaboration based on data downloaded from the Internet.

Both Flickr and Spotify can only be seen as an insignificant attempt to diversify ways of building relationships with the faithful. And while the expansion of social media channels with Instagram can be seen as an apt idea to expand social impact, the strategy employed shows a lack of a methodical approach based on network trends. For example, *Polish Internet Surveys*, February 2023, show that a very thriving portal in Poland is TikTok, while none of the archdioceses and dioceses have taken this into account.

3. Conclusions

Media based on the platforms of Web 1.0, Web 2.0, and subsequent web technologies (Benioto-Osario et al., 2010; Król, 2020; Bajdak, Spyra, 2021) have changed the way people communicate with each other, as well as between organisations and their stakeholders. The features of digital media highlighted by many authors (Lister, 2009; Adamski, 2010; McQuail, 2012; Zacher, 2015; Koszembar-Wiklik, 2016; Osika, 2016) are digitalization, i.e. the ability to record all input data by means of digits, resulting in and dematerialisation of media texts (Lister, 2009, p. 42); convergence, which consists of putting all media into one, digital (McQuail, 2012); hypertextuality referring to the nonlinear nature of the cultural text;

interactivity allowing users to actively use new media, especially social media, and networking create a new media ecosystem (Adamski, 2010) forcing all actors of social life, including religious institutions such as the Catholic Church, to adapt to it.

From this point of view, it is important to recognise to what extent the church is open to the implementation of these new communication trends. This is important insofar as the general assumptions of agenda-setting suggest that failure to use new media solutions results in exclusion, which in turn contributes to the exclusion of one's message from the social space (McCombs, Shaw, 1972, pp. 176-187; McCombs, 2008; Goban-Klas, 2011; Wieczorek, 2012; Nowak, 2016; Przybysz, 2018). And in such a context, adaptation measures, i.e., the expansion of communication channels with new solutions, are necessary. Such measures are being taken (Guzek, 2015, 2022; Przybylska, 2018; Wiesenberga, 2019; Nabożny, 2022) but it is worth investigating what scale they are and whether they are sufficient to ensure contact with the faithful.

In this study, the case of the Polish Catholic Church was analysed in this respect. The degree to which it is present on the Internet, with a particular focus on social networks, was to identify the social potential of the archdioceses and dioceses that form the administrative basis of the Catholic Church in Poland. The presented results show a partial awareness of the importance of adaptation activities, as only 29% of archdioceses and dioceses do not have social media accounts, but only half of them create broader strategies to reach their faithful by marking their presence in several services. Of course, the mere fact of having a profile is not sufficient, as suggestions for further research work would be to undertake in-depth content analyses to determine whether the content posted is able to attract new faithful, i.e., children and young people, and whether it is attractive enough to maintain a relationship with their faithful.

Many market players choose to use social media in their stakeholder communication strategies because the cost of entering and conducting communication on these platforms is relatively small. A prerequisite for good management of social media communication in the strategy of Catholic dioceses is understanding the peculiarities of these media, which are different from the existing one-way media. It is important to treat social media profiles not as a formal communication tool characteristic of an official profile, but to encourage co-creation by the faithful. The challenge facing those responsible for managing this type of communication is not only to encourage people to look at these profiles more often, but also to amplify interactivity and participation. It would seem that as social media becomes more popular and widespread, interactivity will become natural (commenting, sharing, posting posts, photos, videos), as it is as natural for the youngest generation of users as television or radio for Generation X. Meanwhile, 12 out of 41 dioceses and archdioceses in Poland do not have social networks at all.

In conducting research to answer the research questions posed in this study concerning the extent to which archdioceses and dioceses in Poland use the Internet, including social media, it was found that a relatively high percentage, 93%, have websites and 71% of dioceses maintain

social media accounts. This percentage seems quite high, but in an era of social media dominance, the fact that 29% of archdioceses and dioceses do not use this communication channel greatly narrows the scope of social impact, especially for young people, for whom these media are the primary form of communication.

The most popular site is Facebook, which is also in line with national trends in media use, followed by Twitter, which in this case is more a form of differentiation of reach, as Twitter's popularity in Poland is limited. The third portal is YouTube, used by more than half of the archdioceses and dioceses, and this fits in with general media trends in Poland. Among the remaining social media, Instagram dominates, although only nine dioceses have an account on this portal. On the other hand, the profiles on TikTok are decidedly missing from the Internet-related communication strategies that are being developed, and it is in the Top 10 used in Poland. In summary, the following conclusion can be drawn, the Catholic Church in Poland is making up for its lack of presence on the Internet, including social media, but as stated, the communication strategies built do not fully reflect the social trends existing at the time.

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UTILIZATION OF LEAN PURCHASING TOOLS IN THE SUPPLY CHAIN IMPROVEMENT PROCESS

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Purpose: The rationale for writing this article is pragmatic. With the numerous challenges facing manufacturing companies and their purchasing departments, "tools" are needed to help them meet these challenges. Although Lean Management tools are very widely described in the scientific literature, the number of such publications on Lean Purchasing tools is insignificant.

Design/methodology/approach: The paper poses two research questions: 1) What management instruments can be used within the Lean Purchasing concept? and 2) What management instruments, recommended by Lean Purchasing, are most often used in procurement purchasing activities? It was decided to conduct a survey of a purposively selected research group. This group consisted of senior executives managing procurement purchasing in manufacturing companies (directors of the purchasing department) and owners, or presidents, of manufacturing companies. Such a choice of respondents involved conducting the survey on a smaller non-random sample, but made it possible to obtain representative results, thanks to the broad knowledge and professional experience, as well as knowledge of the specifics of the operation of manufacturing enterprises, of the survey participants. The survey covered a total of 120 enterprises.

Findings: An analysis of the results of the frequency of use of Lean Purchasing tools, as determined by all respondents, distinguishes the following tools, which are used by the majority (>50%) of the surveyed manufacturing companies: process and/or purchasing standardization, teamwork, team partnerships, learning by doing, supplier development, brainstorming, 5x why? and within the key process performance indicators: on-time delivery, or on-time and full-quantity delivery, material price index, number of defective parts per million units.

Research limitations/implications: The use of Lean Purchasing tools is still little known among micro, small and medium-sized enterprises. These companies took part in the survey conducted, however, due to the fact that the main research group in the study is large enterprises (63.3%), it was considered an insufficient research sample to be able to refer to this as a representative example to fill this research gap. The results included in the paper, however, can serve as a reference example for researchers wishing to address this issue in the future.

Originality/value: The article is an original proposal, based on the results of a survey on the use of management instruments recommended by Lean Purchasing.

Keywords: Lean manufacturing, Purchasing Strategies, Lean Purchasing.

Category of the paper: Research paper.

1. Introduction

Manufacturing companies, in order to remain profitable and continue to grow, must find new ways to deliver products on time and at the required quality, and at the same time face the ever-increasing costs of their operations. The amount of disruptions that have occurred and the increase in costs over the past few years have been particularly acute in the supply chain area of manufacturing companies. This has resulted in a number of challenges faced by the company in this area, such as the availability and increased cost of purchasing materials or semi-finished products necessary for order fulfillment, or the organization and cost of transportation. In their search for new sources of improvement, these companies can take advantage of proven management practices that are often even already in place in particular areas of their business. One such practice is Lean Management. This concept, in the form of Lean Manufacturing, is primarily used in production management, but can also be used in other areas of a company's operations, including the management of procurement purchases. These purchases, are responsible not only for ensuring that materials or semi-finished products are delivered on time, at a certain quality and price, but also for managing a significant area of the manufacturing company's supply chain. The use of Lean Management concepts in supply purchasing management is referred to as Lean Purchasing. Like Lean Management and Lean Manufacturing, Lean Purchasing is a concept focused on processes that add value for the customer, reducing activities that are necessary but do not add value, as well as systematically eliminating waste by getting rid of non-value-added activities. In effect, the aforementioned activities are aimed at improving supply chain performance.

The rationale for the article is pragmatic. In view of the numerous challenges faced by manufacturing companies and their purchasing departments, "tools" are needed to help them meet these challenges. Although Lean Management tools are very widely described in the scientific literature, the number of such publications on Lean Purchasing tools is insignificant. This situation prompted the authors of the article to attempt to answer the following research questions:

- 1) What management instruments can be used within the Lean Purchasing concept?
- 2) What management instruments, recommended by Lean Purchasing, are most commonly used in procurement purchasing activities?

In view of the research questions posed, the main purpose of the article is to present in cognitive terms the use of Lean Purchasing tools in the process of supply chain improvement. Such a broad purpose of the article required the preparation of the following specific objectives:

Cognitive Objectives:

- 1) Identify management instruments that can be used within the Lean Purchasing concept,
- 2) Categorization of Lean Purchasing tools and determination of the characteristics that a management instrument should meet if it is to be classified as a Lean Purchasing tool,

- 3) Identify the management instruments recommended by Lean Purchasing that are most commonly used in procurement purchasing activities.

The structure of the article is subordinated to the logical argument of the research proceedings. The research methodology section indicates the research methods used, such as the survey method and the documentary analysis method. For each research method, the following research techniques are specified:

- 1) For the survey method: a questionnaire survey in a purposively selected research group,
- 2) For the documentation analysis method: historical documentation analysis.

In doing so, it is also important to emphasize the function and value of the literature review and analysis, which allowed not only to identify research gaps, but also to find answers to cognitive research questions. A review of the literature relating to the theoretical basis of the lean purchasing concept was conducted. The purpose of the research sample was also indicated. The results of the survey were then presented. The conclusions focused on implications for further research in the area of using lean purchasing tools in the supply chain improvement process.

2. Literature review

2.1. The essence of Lean Purchasing

A lean manufacturing enterprise consists not only of lean production, but also of a lean supply chain. Collaboration between companies, within such a chain, is geared toward achieving three-factor goals: providing the best possible level of customer service, while delivering the highest level of quality, and creating new value at the minimum total cost of the product or service (Lamming, 1993). In the context of procurement management, the key features of such cooperation can be presented on the basis of Toyota and its cascading supplier management system:

- 1) A car manufacturer like Toyota is responsible for assembling parts supplied by first-tier suppliers.
- 2) First-tier suppliers (the first group of suppliers) are primarily responsible for the supply of whole components (partially assembled) or subassemblies, rather than component parts or materials for the production of components. These are trusted suppliers with a track record of cooperation confirmed by relevant results and length of cooperation. They have the largest order book and are characterized by advanced specialization.
- 3) Second-tier suppliers (the second group of suppliers) mainly supply first-tier suppliers. These are independent, specialized manufacturers whose implementation has been approved by Toyota.

- 4) Third-tier suppliers (the third group of suppliers), who cooperate, depending on the needs and complexity of the components, with suppliers of subsequent tiers. They are responsible, primarily, for supplying second-tier suppliers. They constitute the broadest group of suppliers.

This structure is pictorially shown in Figure 1. The number of suppliers in each group is approximate, hence it should be considered as an order of magnitude to show the illustrative structure of Toyota's supply network. A mid-range passenger car may consist of about 40,000 parts and components, hence it is worth noting the small number of first-tier suppliers Toyota directly works with. This structure of suppliers allows for a diversification of resources and competencies possessed by individual suppliers, allowing them, as they continue to work together, improve their processes and complete projects, to move into the group of higher-tier suppliers. Aspiring suppliers to join the first-tier supplier group, however, must prove that they have the right competencies, qualifications, knowledge, experience, while remaining competitive.

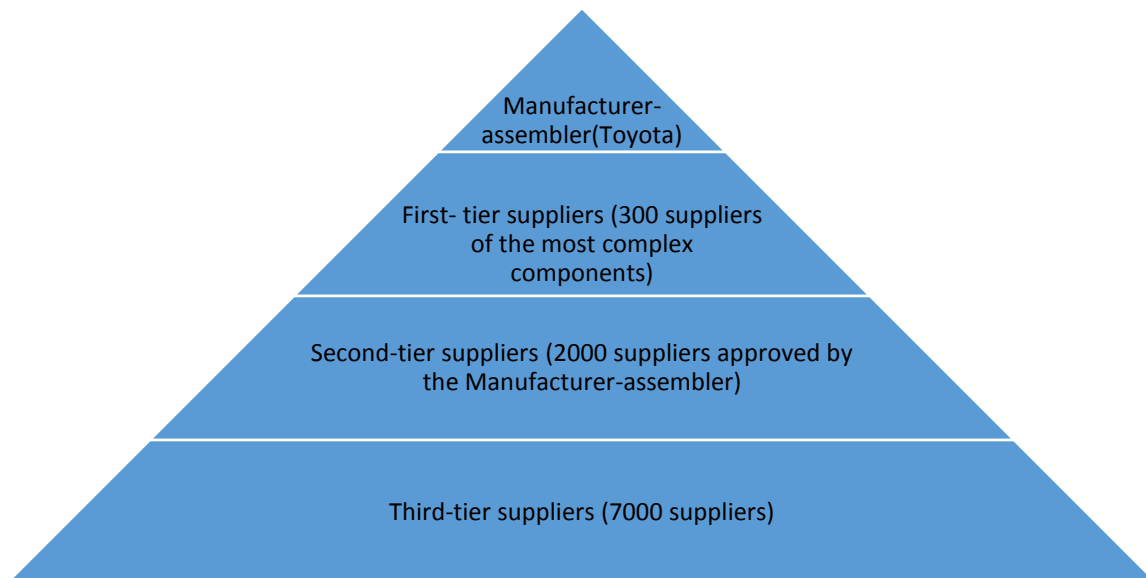


Figure 1. Toyota's hierarchical structure of suppliers.

Source: own compilation based on: (Liker, 2016; Lysons, 2004).

The essence of Toyota's supply chain is not only the flow of goods, services and information, but also the codification and sharing of knowledge among suppliers, and not only between suppliers and Toyota. This kind of knowledge sharing complements the collaborative partnership approach that is used at Toyota (not only towards employees, but also towards suppliers) (Witkowski, Baraniecka, 2018). Toyota understood that the essence of achieving a competitive advantage, is not only to implement the Toyota Production System in this company, but also to transfer these principles to its suppliers. Over many years of cooperation, Toyota has developed the following principles for effective partnerships with suppliers:

- 1) Collaborative process improvement, through sharing best practices with suppliers, supply chain integration, supplier associations, implementing a continuous improvement culture in supplier organizations, Kaizen employee referral programs, and more.
- 2) Communicate selectively to the supplier, through a precise and clearly defined information transfer procedure, regular meetings with suppliers or the use of databases and systems to facilitate and standardizing the exchange of data and information.
- 3) Technical-technological development of suppliers, by involving suppliers in challenging projects, fostering innovation and creativity, or supporting Toyota in solving problems.
- 4) Oversee the work of suppliers by involving senior managers in problem solving, meeting periodically with the supplier, providing feedback to suppliers, and reporting results periodically.
- 5) Maintain competitiveness and healthy rivalry between suppliers, through purchases of less complex components from different suppliers, compatibility of production between suppliers, and the establishment of joint ventures or Keiretsu with suppliers to ensure control and appropriate conditions for knowledge transfer.
- 6) Building business relationships and getting to know suppliers thoroughly by means of maintaining close, regular cooperation, periodic meetings, mutual respect or taking care of the continuous development of the company and suppliers.

Thanks to the principles adopted, it was then possible to develop such mechanisms as: joint pricing, use of learning curves to reduce prices or prevent price increases, joint design of new products, building inter-organizational teams of skilled workers, supplying parts free of defects (the no-defect principle) and, most importantly, delivery just in time (*Just in Time*) (Lysons, 2004). It should be noted once again that the presented approach to lean supply chain management, using Toyota as an example, refers strictly to the cooperation between a manufacturing company and its suppliers in procurement purchases.

The Toyota Production System was the first more widely described example of the application of the lean management concept. Initially, the application of this concept was presented mainly in the context of Lean Manufacturing, but later the proven solutions began to be copied to other areas of business. One of them is procurement purchasing, thus - Lean Purchasing.

The idea behind *Lean Purchasing* is to design purchasing processes that minimize waste while detecting it early and optimizing each process within the purchasing scope of work as best as possible. Like Lean Management and Lean Manufacturing, it is a concept focused on processes that add value to the customer, reducing activities that are necessary but do not add value, and systematically eliminating waste by getting rid of non-value-added activities. The definition of *lean* can be summarized by saying: "buy less, by buying better". The basic tenets of lean purchasing are delivery exactly on time, in the quantity needed (*Just in Time*) and free

of defects that disqualify its use (*Zero Defects*). Just in Time combined with Zero Defects affect both the quality and quantity of products purchased. In addition, a very important point consistent with the main purpose of purchasing activities is the elimination of waste in the cost aspect, primarily, by reducing the costs incurred. With regard to procurement purchasing, Just in Time (JiT) aims to provide the required materials and/or products at exactly the time they are actually needed and in the exact quantity required, so that added value is generated relative to the manufactured product, thus avoiding the generation of indirect costs.

Examples of JiT solutions include:

- Selection of preferred local suppliers.
- Focusing on total cost of ownership - the price of products is based on an open cost model.
- Long-term contracts that provide flexible delivery terms.
- The timing and specifics of delivery are predetermined. If necessary, order volumes are variable, and the size of the margins depends on the quantity of the delivered details.
- Control of samples at the stage of implementation, in the further stage of cooperation - abandonment of input control of delivered products.
- Invoices are sent and then billed on a monthly basis.

The higher frequency of deliveries and/or the smaller number of parts in deliveries creates the need to detect nonconformities as soon as possible (at the earliest possible stage of production). This need is the reason for conducting a Zero Defects Policy, i.e. shipping parts free of defects that make them unusable. As part of TPS and Lean Management, each employee is responsible for detecting and eliminating errors (which is also part of continuous improvement). This also applies to errors affecting the quality of manufactured parts or delivered services. If a Toyota production employee (or a Toyota supplier) notices that a part he received from a previous stage of production does not meet the requirements of the technical specification (e.g. in terms of assembly or surface quality), he will automatically notify the employee working in the previous production nest, so that the production of the erroneous parts can be quickly stopped and the problem can be solved. This approach contrasts with that adopted by many Western companies, where defective parts are set aside and the problem is handed over to the quality department, which must conduct an "investigation" and locate where the error originated (van Weele, Rozemeijer, 2022).

Both TPS and Lean Management, along with Lean Purchasing, place great emphasis on continuous employee development and training. Under these concepts, Teamwork, Employee partnerships, Learning by Doing, Job Enrichment, Mentoring, Yokoten, and Training are key elements for achieving expected performance. Therefore, in organizations that apply these management concepts, employee development values are usually firmly embedded in their corporate culture. The second element of the process is training and development of partners, which in Lean Purchasing are suppliers (supplier development). This takes place both between

the supplier and the customer, as well as between suppliers within the framework of so-called supplier associations (supplier associations). Supplier associations are usually made up of the company's most important suppliers, who cooperate with each other - to varying degrees, depending on the needs. The purpose of associations is to share and exchange best practices among suppliers (Hines, 1996). Another special type of cooperation is supplier integration, which goes beyond the traditional customer-supplier relationship and seeks mutual involvement, cooperation and information exchange. Supplier integration aims to build sustainable and strategic relationships with suppliers that benefit both parties. Supplier integration is based on a common business strategy and joint development of the customer and supplier, and is particularly applicable within Japanese supply chains.

The implementation of Lean Purchasing can be grouped into three main steps. The first step, and the most important element in the successful implementation of Lean Purchasing, concerns an organization's culture based on the pillars of the Toyota Way: continuous improvement, man at the center of the process, man as the best source of innovation, and respect for people. An organization that implements an organizational culture based on the Toyota Way will have a solid foundation to not only further implement Lean tools, but also to develop, engage and motivate suppliers to initiate the same actions on their side (and then also towards their sub-suppliers. The next step is to map purchasing processes and standardize them. It is important that the processes (and the procedures, instructions, and training created based on them) be as simple and transparent as possible - possible to implement sustainably and effectively. Only in the third stage of implementation does the organization focus on implementing the appropriate Lean Purchasing tools. Their selection should be the result of the previous steps and related work (Witkowski, Baraniecka, 2018; Hines, 1996).

By implementing Lean Management in the operation of procurement purchasing, companies can reap a number of benefits from doing so. These can be divided into three groups of benefits: in the area of management, use of technology and financial benefits. Benefits in the management area include:

- Standardization of purchasing processes, which makes communication and supply chain activities easier and faster.
- Elimination of unnecessary activities, within the framework of supplier-customer cooperation and directly at suppliers.
- Improve quality levels, reduce lead times and reduce inventory levels.
- A smaller supplier base that is easier to manage and involves fewer resources on the organization's side.
- There is less risk of losing a supplier (and, for the supplier, losing an important customer), thanks to more connections, and dependencies, between suppliers and the manufacturer.
- Less time required to acquire, change suppliers.

- Work more effectively with suppliers through joint planning, information sharing and resource sharing based on mutual trust, transparency and long-term cooperation.
- Supplier loyalty, which in addition to the high value of generated turnover, can translate into greater attentiveness of suppliers to the continuous improvement of supply chain operations, development of new products, ongoing cooperation, as well as prioritization of tasks especially in the event of crises or potential disruptions, which promotes the implementation of the company's strategy and building resilient and efficient supply chains.

Technological benefits, on the other hand, include:

- Greater willingness, openness of partners to share knowledge, experience and use of modern technology to achieve competitive advantage.
- Greater involvement of partners in the design of new products (under Early Supplier Involvement), from the conceptual phase, product design, to its commercialization and implementation in the market.
- Involving suppliers who are specialists in their field avoids many design errors or quality problems, and enables a new product to be launched more quickly.

On the other hand, financial benefits include:

- Cost optimization, by eliminating waste, reducing unnecessary processes and better inventory management, a company can significantly reduce purchasing costs.
- Sharing business risks, through various forms of cooperation with partners. In financial terms, this can translate into reducing risks associated with new investments, developing new technologies, conducting research, or adapting to changing trends and market conditions.
- Ability to better control price levels through close cooperation, transparency, and joint influence on emerging market changes (Benton, 2020; Taghipour, Phuong, Xue, 2020). In addition to the benefits that flow, as well as the opportunities that arise through it, the implementation of the Lean Purchasing concept, brings with it some challenges that companies must face. Among the most important of these are:
 - The need to change the organizational culture of companies in accordance with the Toyota Way - the implementation of Lean Purchasing requires a change in the organizational culture of the company as well as its suppliers.
 - Top management support for change - implementing change takes time (for example: it took Toyota about 15 years to fully implement the Kanban system) and commitment of resources. With this in mind, top management should initiate and support change within the organization, as well as change at suppliers.
 - Lack of knowledge and experience - as indicated above, the implementation of Lean Purchasing is a long process of continuous learning (also by making mistakes) and continuous improvement. It requires building awareness and a sense of responsibility

among employees or standardizing the solutions developed. In the absence of knowledge and experience in implementing Lean concepts, an organization may need more time and/or more resources necessary to develop best practices.

- Supply chain complexity - implementing Lean Purchasing can be difficult in the case of a complex supply chain in which many companies are involved in providing products or services.
- Lack of cooperation from the supplier's side - implementing Lean Purchasing requires cooperation, willingness and commitment from the supplier's side, which can be difficult if the supplier is not prepared to make changes.
- Dependence on suppliers can also be a risk - deeper cooperation can bring a number of benefits to both partners. On the other hand, too much dependence on the other party involves certain risks, such as the phenomenon of domination or supplier bankruptcy.
- Costs of change, implementation costs - the implementation of changes may involve implementation costs, such as training of employees, suppliers or implementation of management systems, or the involvement of consulting companies to support the implementation.
- Reducing costs in one part of the supply chain may stimulate their occurrence in another part of the chain, for example - reducing minimum order sizes may help reduce the size of a company's inventory, but at the same time may result in the need for more frequent deliveries, thus increasing transportation costs. In the same way, too much reduction in inventory levels throughout the supply chain can cause downtime or delays, resulting in the company facing financial penalties for delays or even lost orders, in addition to downtime costs.

Despite the challenges faced by companies in implementing Lean Purchasing, the benefits of implementing the concept significantly outweigh the potential risks. It is important, however, that companies, being aware of their occurrence, take proactive measures to minimize their appearance (as well as the resulting consequences) and have an action plan in place should they occur.

2.2. Lean Purchasing in the face of contemporary trends in the development of procurement purchasing

The development of Industry 5.0 is forcing changes within both supply chain management and procurement purchasing management. These changes, will at the same time cause Lean Purchasing, along with Lean Management, to also have to evolve. The form and possible areas of use of Lean Purchasing tools will certainly change. The range of available tools that can be used within the concept will also increase. Some of them may also cease to be widely used. In the authors' opinion, what will change are the underpinnings of this Lean concept, framed by the Toyota Way, such as continuous improvement, man at the center of the process or respect - for people and the environment. On the one hand, they are universal, simple, logical and

confirmed by many years of practice, validity and success of organizations that have adopted the Japanese culture of conduct. On the other hand, these principles are in line with industry development trends, which the author would describe as its level of maturity to provide products and services in a responsible and sustainable manner. Of course, this is a long-term process that, despite much faster technological advances, will take years, but from an ethical point of view, this is the right direction for development, and the Toyota Way can help in its consistent implementation.

What, in turn, will have to change, within the Lean concept, is the "focus" of the concept and the way it has been perceived, which up to now has been primarily placed on maximizing results using the minimum number of resources¹. Initially this was due to the post-war socio-economic conditions in which Japan found itself, then the described "anatomy" of Toyota's success was widely disseminated both in the world of science and business, which adapted it in a similar form to the original. If, on the other hand, as a result of the increasingly frequent disruptions to supply chains and the changes that are to take place as part of the progress of civilization, greater emphasis is to be placed on the flexibility and resilience of supply chains, then the aforementioned "focus" of the concept will have to shift toward achieving both goals. This may mean, a change in the interpretation of certain phenomena, within Lean Management. For example, maintaining an adequate level of inventory of materials or semi-finished goods, ensuring the required resilience, may no longer be treated as a waste, but as a necessity within "Lean Purchasing 5.0". With such adaptation, Lean Management and Lean Purchasing, particularly for the preferred conditions of their application, will be able to continue to be successfully used in business practice. Specifically, since some of the attributes of Supply Chain Management in Industry 5.0, such as transparency, standardization, strong network connections, fast delivery or quick response, innovation or even compliance with ESG assumptions, overlap with the attributes of Lean Purchasing, hence the concept will be able to have further practical application within Industry 5.0. The assumptions of the concept, as well as the tools used within it, can actively support ESG (Environmental, Social and Governance) assumptions, through: using sustainable materials, minimizing the use of materials, using recycled raw materials, selecting suppliers that provide decent working conditions for their employees, including following the model of Japanese supply chains - local suppliers, and much more. Despite the evolution of the industry, companies will have to continue to constantly compete with each other, hence the emphasis on eliminating waste and focusing on adding value for the customer will continue to be an important source of ensuring competitive advantage. Another guiding element of the next industrial revolution is the digitization, autonomization and automation of processes. As part of technological advances, a number of modern instruments can be applied to lean purchasing management. Among the most important of these are:

¹ Such a definition of Lean is consistent with the definition of optimization, but such a comparison is a gross oversimplification, since Lean Management, Lean Purchasing are primarily based on the process of continuous improvement, which is a broader concept than optimization.

- 1) Internet technologies and connected solutions:
 - Internet of Things (IoT). IoT solutions can include, among others, Vending Machines, Real-time tracking systems (Real-time device location system) and Chatbots.
- 2) Technologies and analytical tools:
 - Big Data (processing of digital datasets of very large size),
 - Artificial Intelligence (AI), including: Machine Learning (Machine Learning), Big Data Analytics (Big Data Analytics) and Chatbots,
 - Cloud computing (cloud computing, cloud computing), for example: cloud software (Dropbox, Office 365), cloud storage (Google Drive, iCloud), cloud analytics and business solutions (Power BI).
- 3) Purchasing Systems:
 - Supplier Relationship Management (SRM), E-Sourcing, E-Purchasing, E-Procurement, supported by Electronic Data Interchange (EDI).
- 4) Technologies related to identification and integration of processes and equipment:
 - Radio-Frequency Identification (RFID - remote identification of objects using radio waves),
 - Cyber-Physical Systems (CPS - the integration of physical devices, their software with a digital network).
- 5) Technologies related to automation and robotization of equipment and processes:
 - Autonomous Vehicles,
 - Robotic Process Automation (RPA).
- 6) Technologies related to security and information management:
 - Blockchain and Smart Contracts.
- 7) Technologies related to the creation of virtual reality:
 - Digital Twin (Digital Twin),
 - Virtual Reality (VR),
 - Augmented Reality (AR).
- 8) Enterprise resource planning (ERP) business systems (Jaouhari, Arif, Kumar, Jain, Agrawal, 2023).

Technological instruments may have the greatest impact in the future on the further development of procurement purchasing management, and at the same time - Lean Management and Lean Purchasing due to the fact that in modern industry, competitive advantages will be built by modern technologies. As part of the continuous improvement of the aforementioned instruments, both from the point of view of the user and their author (manufacturer), the already well-known Lean tools such as Standardization or Value Stream Mapping can be used.

3. Methodology

3.1. Lean Purchasing tools in theoretical terms

Lean Purchasing tools can be presented as management instruments supporting the implementation of the Lean Purchasing concept within the framework of procurement purchasing management and supply chain operations. The variety of Lean Purchasing tools means that, like Lean Management tools, they should be classified as management instruments used within the Lean Purchasing concept. The overriding goal of using Lean Purchasing tools should be to maximize the added value for the customer created by purchasing processes by eliminating or maximally reducing anything that does not bring this value. Given the unchanging priorities of purchasing operations, it is understood that there is a strong synergy between Lean Management (and Lean tools) and procurement purchasing management. This fact means that a significant number of Lean Management tools can be categorized as Lean Purchasing tools. In order to systematize them, the authors propose the following division, according to the area of their implementation:

- 1) Lean Purchasing tools used within the operation of the company's purchasing department (*internal tools*).
- 2) Lean Purchasing tools used within supply chain flows (*indirect tools*).
- 3) Lean Purchasing tools used in the implementation of Lean Management directly at the supplier (*external tools*).

Internal tools will be concerned with improving the operation of purchasing processes within the company, i.e., for example: Standardization, 5S, Kaizen Employee Referral System, Value Stream Mapping. Indirect tools, on the other hand, are concerned with activities at the "points of contact" between suppliers and the company, i.e. the links between them within the supply chain operation. These can include such tools as Kanban, Just in Time, Just in Sequence, Milk Run and others. On the other hand, external tools, implemented directly within the operation of the supplier's enterprise, qualify the same tools that are used within the internal tools of Lean Purchasing. In addition, also any other Lean Management tools that will be implemented in cooperation between the customer and the supplier, such as knowledge and/or technology transfer, also in the area of the supplier's production process, so One Piece Flow, Jidoka, Andon, SMED or TPM. As with Lean Management tools, the proposed division is not the only one by which Lean Purchasing tools can be categorized. Another division proposed by the authors differentiates Lean Purchasing tools due to the following five criteria:

- 1) Continuous improvement.
- 2) The man at the center of the process.
- 3) Cooperation with suppliers.
- 4) Problem solving and data analysis.
- 5) Process monitoring.

This proposal for the division of Lean Purchasing tools follows from the main principles of the Toyota Way and the criteria for their division in the context of their use in procurement management. This division was considered superior to further research work, due to the fact that it does not cause a dilemma to which group, the division criterion, a given tool should be assigned (for example: external tools can be the same instruments that the supplier's customer has implemented, in the form of internal tools). Based on a review of the literature, the authors identified thirty-eight key Lean Purchasing tools, which were categorized according to the above five criteria:

- *Continuous improvement of people and processes*, within which the most important tools are: **Value Stream Mapping (VSM)**, **Waste Analysis** (Waste Analysis), **Standardization** (Standardization of processes and/or purchases), **5S** (Selection, Systematics, Cleaning, Standardization, Self-Discipline), **Visual Management**, **Kaizen employee suggestion system**, **Kaizen process**, **Kaizen flow**, **Kaikaku** (Breakthrough Kaizen - implementation of innovations), **Hansei** (reflection) - Lessons Learnt, **PDCA** (Deming Cycle).
- *Man at the center of the process*, so tools relating to cooperation between employees of enterprises and their development: **Teamwork**, **Employee partnerships**, **Learning by Doing**, **Job Enrichment**, **Mentoring**, **Yokoten**, and **Sharing best practices**.
- *Supplier collaboration*, which includes: **Supplier development** (Rozwój dostawcy), **Supplier integration** (Integracja dostawców), **Supplier association** (Stowarzyszenia dostawców), **Heijunka** (Balansowanie pracy w ramach zamówień do dostawców, planowania produkcji i in.), **Kanban**, **Vendor Managed Inventory (VMI)**, **Consignment Stock** (Zapas Konsygnacyjny), **Just in Time** (Dokładnie na czas), **Just in Sequence** (Dokładnie w kolejności), **Milk Run** (Dostawy w ramach „kursu mleczarza”).
- *Problem solving and data analysis*, which include: **Genchi Genbutsu** (Go and See), **Ishikawa Diagram** (Fishbone Diagram), **5 Why?** (5x Why?), **Brain Storming**, **Poka Yoke** (Mistake proofing, Error proofing), **Pareto principle** (Pareto principle - 80/20), **ABC analysis**, **Failure mode and effect analysis (FMEA analysis)**, **A3 Report**, **Total Cost of Ownership analysis (TCO analysis)**.
- *Monitor processes* using **Key Performance Indicators (KPIs)**, in terms of monitoring costs, investments, deliveries, quality and ongoing procurement projects.

It should be noted that these are not all the tools (management instruments) that can be categorized as Lean Purchasing tools. This collection is a recommendation against the instruments that can be used within the Lean Purchasing concept. Due to the dynamic progress in the exchange of best practices, the widespread access to knowledge, whether through academic literature, as well as conferences, industry forums, training courses or based on visits to other companies or in the development of one's own enterprise, there may be more and more proposals to qualify the proposed management instruments as Lean Purchasing tools.

This can cause dilemmas as to whether the instrument can actually be qualified as a Lean Purchasing tool. Therefore, the authors have prepared a summary of the key eight characteristics that a management instrument should meet if it is to qualify as a Lean Purchasing tool:

- It focuses on added value for the customer.
- It enables the elimination of waste by removing non-value-added activities and reducing business value added.
- It is part of a continuous improvement process.
- It is intuitive and relatively easy to implement and use.
- It is integrable and scalable within the supply chain.
- It meets all necessary safety standards and social and environmental standards and environmental standards.
- It was implemented as part of the culture and values of the Toyota Way.
- The implementation area must include procurement purchases (Purchasing).

The above summary of characteristics can be helpful not only in categorizing Lean Purchasing tools, but also in "slimming down" already implemented, functioning tools in the organization. It is worth noting that this "slimming down" should be understood as a greater focus on customer value, by eliminating non-value-added activities and reducing business value added. This is a very important aspect of Lean Purchasing, so as to avoid a situation where "slimming down" one process, creates 3M (Muda, Mura, Muri) in another area of the supply chain. Equally important is the implementation of tools in "lean organizations" that function in accordance with the culture and values of the Toyota Way (hence, first the organization should implement the culture, values and principles on which the concept of Lean Management and Lean Purchasing are based, and only then focus on Lean Purchasing tools). An integral part of Lean Purchasing is the process of improvement and continuous improvement. This improvement should be interpreted as a unit improvement, an improvement of a solution (e.g., by solving a problem), which can be part of a continuous improvement process. At the same time, since the decisions made by the purchasing department of an enterprise, will have a direct impact on the functioning of the supply chain (which is due to the broader scope of their functions than the term "procurement purchasing" itself may suggest), the use of the Lean Purchasing tool in the process of improving the supply chain (and not just procurement purchasing) has been referred to.

The application of Lean Purchasing tools can bring a number of benefits to companies, which include: reducing/reducing purchasing costs while improving product and service quality, streamlining the procurement process and flow, reducing delivery times and elimination of waste, increased efficiency and responsiveness of suppliers, strengthening the strategic and partnership approach in the development of procurement purchasing and above all - greater focus on value-added activities for the customer and the company.

3.2. Survey methodology

It was decided to conduct a survey of a purposively selected research group. This group consisted of senior executives managing procurement purchasing in manufacturing companies (directors of the purchasing department) and owners, or presidents of manufacturing companies. This made it possible to target respondents who should have knowledge of Lean Purchasing and Lean Purchasing tools. Such a selection of respondents involved conducting the survey on a smaller non-random sample, but made it possible to obtain representative results, thanks to the broad knowledge and professional experience, as well as knowledge of the specific operation of manufacturing enterprises, of the survey participants. The survey covered a total of 120 enterprises. The larger survey sample exceeded the research capacity due to the fact that only senior executives were selected for the survey. Respondents represented a global supply chain company that manufactures medical equipment, their direct suppliers and second-tier suppliers (vendor suppliers), and equally micro, small, medium, or large enterprises. The inclusion of companies of varying sizes in the survey made it possible to capture different perspectives on their use of Lean Purchasing tools. The companies in the study were located in Europe, North America, or East Asia and had diverse manufacturing operations in the industrial sector. Due to the wide diversity of the companies' business profiles, the results cannot refer to any other type of business than manufacturing activities in the industrial sector. The survey was conducted in April 2023. The survey questionnaire was prepared in electronic form. It was sent out to the enterprises comprising the survey sample via Internet mail. The distribution of the questionnaire was preceded by a direct email or telephone contact to present the purpose and scope of the survey, how it was conducted and the relevance of the research area. At the same time, technical instruction was also provided. Respondents were assured of anonymity. The survey used the CAWI (Computer-Assisted Web Interview) method, in which the participant is asked to complete the survey electronically. The survey used Lean Purchasing tools, categorized according to 5 criteria based on the key tenets of the Toyota Way. The survey focused on the quantitative aspect of the use of Lean Purchasing tools in business practice (which tools and how often they are used by respondents), so it captures, first of all, the percentage of respondents using the tools (N) and the frequency distribution (%^K). The survey did not take into account the qualitative aspect of the use of these tools (for example, assessing the effectiveness of the use of Lean Purchasing tools), so it does not exhaust the issue of the use of Lean Purchasing tools in business practice and is a prerequisite for further analysis of this research area.

4. Survey results - analysis of respondents' answers

The survey verified the practical use of individual Lean Purchasing tools, according to their systematization, according to the following criteria: continuous improvement, people at the center of the process, cooperation with suppliers, problem solving and data analysis, and process monitoring. In addition, the survey took into account such factors as the size of the company, the location of the production facility and the declared desire to implement the tools in the near future. Managing an enterprise according to the Lean Management concept was a common practice in the sample, with the vast majority of respondents identifying with it. Only one in four respondents declared that their enterprise was not a "lean organization". 10% of the survey sample were respondents who could not clearly indicate whether their enterprise was managed in accordance with the Lean Management concept.

Respondents were asked about the use of Lean Purchasing concepts in purchasing management - two-thirds of them used Lean Purchasing in their company for this purpose. A quarter of respondents did not use Lean Purchasing in purchasing management. There was also a small group in the survey that was unable to clearly state whether they were using Lean Purchasing in their procurement management.

In the next stage, respondents answered questions about the use of selected Lean Purchasing tools in the enterprise they represented, systematized into 5 categories. For this purpose, multiple-choice questions were used, which allowed respondents to select more than one answer - in this case, respondents could select all the tools they used from a given category, or not select any of them, in case their enterprise did not use any of the listed tools. First, it was decided to look at Lean Purchasing tools from the *continuous improvement* category. A fairly wide range of tools related to continuous improvement are used in enterprises, but the popularity of each of them varies quite a bit. Based on the results, it can be concluded that certain continuous improvement tools are used more often than others. From the indications of respondents, it appears that standardization of processes and/or purchasing is most often used in companies. Of relatively high popularity can be said for 5S and the Deming Cycle, which are used in a third of enterprises. At the same time, it is also possible to distinguish such tools, which are used by enterprises far less frequently: visual management, reflection (hansei) and kaizen flow.

Table 1.*Use of Lean Purchasing tools from the continuous improvement category*

	N	%K
value stream mapping	36	8,7%
waste analysis	38	9,2%
Standardization of processes and/or purchasing	83	20,1%
5S	55	13,3%
visual management	32	7,8%
kaizen employee suggestion system	44	10,7%
process kaizen	33	8,0%
kaizen flow	15	3,6%
hansei (reflection)	27	6,6%
Deming cycle	49	11,9%

Source: own elaboration.

A slightly different perspective on the use of Lean Purchasing tools is presented by the set of *human-centered* tools. A narrower repertoire of instruments can be observed in this group of tools than in the continuous improvement category, but the popularity of their use is much more comparable to each other, as captured by the summary in Table 2.

Table 2.*Use of Lean Purchasing tools from the human-centered process category*

	N	%K
teamwork	94	23,6%
partnerships in teams	81	20,3%
learning by doing	83	20,8%
Employee development through challenging tasks	40	10,0%
mentoring	55	13,8%
yokoten (sharing of good practices)	46	11,5%

Source: own elaboration.

Based on the above information, it can be concluded that teamwork is widely used in the surveyed companies. No less important are team partnerships and learning by doing. It can be noted that the least surveyed companies rely on sharing best practices (yokoten) and developing employees by assigning challenging tasks.

The next Lean Purchasing category analyzed is *supplier-based* tools. It can be seen that a fairly diverse range of supplier-oriented instruments are used in the surveyed companies. Their summary is presented in Table 3.

Table 3.*Use of Lean Purchasing tools from the supplier collaboration category*

	N	%K
supplier development	79	22,0%
supplier integration	39	10,9%
supplier associations	21	5,8%
consignment stock	42	11,7%
heijunka (balancing work)	18	5,0%
kanban	47	13,1%
supplier-managed inventory	44	12,3%
just in time	40	11,1%
exactly in the (expected) order	12	3,3%
deliveries under the "milkman's course"	17	4,7%

Source: own elaboration.

For this category of tools, their popularity varies quite a bit - some tools are used more readily than others. A relatively large number of companies used kanban, supplier-managed inventory and consignment stock. The surveyed companies relatively rarely decided to implement just-in-time delivery, a surprising result relative to expectations. The fewest respondents marked deliveries exactly on (expected) time and deliveries as part of the "milkman's course".

The survey also included a group of tools oriented toward *conducting analysis and solving problems*, which can not only lead to an in-depth analysis of the root cause of problems, but also allow this problem to be solved. Included in this group of tools was a wide "array" of instruments, listed in Table 4, the popularity of which varies widely among the surveyed companies.

Table 4.

Use of Lean Purchasing tools from the problem solving category and conducting analysis

	N	%K
genchi genbutsu (go and see)	24	5,6%
fishbone diagram	38	8,8%
5x why?	67	15,6%
brainstorming	82	19,1%
poka yoke (error prevention)	33	7,7%
Pareto principle (80/20)	56	13,0%
ABC analysis	47	10,9%
Analysis of the causes and consequences of failure - FMEA analysis	34	7,9%
A3 report	7	1,6%
Total Cost of Ownership analysis	42	9,8%

Source: own elaboration.

Based on respondents' indications, it can be concluded that companies are most likely to use brainstorming. The second most commonly used tool is 5x why? which involves asking the question "why?" five times to provide a clear answer that solves the right problem. Also in common use is the Pareto principle (80/20), which states that 20% of causes cause 80% of effects. Relatively few companies use error prevention (poka yoke). Few managers also declare that, if necessary, they personally verify the necessary information (genchi genbutsu). Somewhat contrary to its simplicity and effectiveness, the A3 report is also not very popular in the surveyed organizations.

Lean Purchasing's "toolbox" (i.e., the surveyed toolbox) also had to include tools for monitoring processes using Key Performance Indicators, which are presented in Table 5. Within this category, differentiated indicators were identified that focus on key aspects of procurement purchasing activities, which include monitoring: costs, investments, deliveries, quality and ongoing procurement projects.

Table 5.*Use of Lean Purchasing tools from the process monitoring category*

	N	%K
return on investment	51	6,6%
material price index	69	9,0%
supplier price index	23	3,0%
life cycle cost	21	2,7%
coverage by supplier contracts	29	3,8%
deliveries on time and in full quantity	60	7,8%
on-time delivery	82	10,7%
average order processing time	40	5,2%
inventory turnover ratio	54	7,0%
stock size indicator	18	2,3%
open orders value index	24	3,1%
quality indicator of supplies / suppliers	42	5,5%
Number of defective parts per million units	63	8,2%
getting it right the first time	38	4,9%
cost of low quality	18	2,3%
8D report	55	7,2%
scrapping rate	36	4,7%
project implementation time	24	3,1%
Scheduled project hours vs. time spent on project implementation	8	1,0%
deviation of the project budget	14	1,8%

Source: own elaboration.

The popularity of the use of indicators in the surveyed companies is characterized by clear variation. The largest number of companies focus on monitoring just-in-time deliveries (while at the same time exactly one in two companies, instead of just-in-time deliveries, monitor just-in-time deliveries and in full quantity). For two out of three companies surveyed, the key performance indicator for the supply chain is also the material price index. Slightly more than half of the companies in the survey are aware of the value of monitoring the number of defective parts created per million units produced. A large percentage of respondents also marked the performance of 8D reports. Interestingly, both quality indicators were selected more often in the survey than the supplier/supplier quality indicator. At the same time, some tools are used far less often. For example, only one in ten companies monitors the deviation of the project's financial budget, which can signal budget overruns, but also the possibility of allocating free financial resources. Only single companies verify the difference between the planned number of hours allocated to a project and the time actually spent on it.

5. Conclusions

An analysis of the results of the frequency of use of Lean Purchasing tools, as determined by all survey respondents, makes it possible to distinguish the following tools, which are used by the majority (>50%) of the surveyed manufacturing companies: process and/or purchasing standardization, teamwork, team partnerships, learning by doing, supplier development,

brainstorming, 5x why? and within the key process performance indicators: on-time delivery, or delivery on time and in full quantity, material price index, number of defective parts per million units. These ratios relate to three basic aspects of procurement management: on-time and complete deliveries, prices of purchased products, and their quality. There were slight differences in the tools used between companies in different geographic regions of the world, which may be a result of globalization and universal access to knowledge and information. There was greater variation in the tools used by company size - large and medium-sized companies used a wider range of Lean Purchasing tools than small or micro companies. This may be due to factors such as the scale of the companies' operations, their resources and capabilities, organizational structures or market competition.

The above aspects mean that further work on Lean Purchasing, both in practical and theoretical terms, is still necessary, especially in the area of Lean Purchasing auditing, which could help companies identify directions for further development of this concept in the organization, as well as the tools implemented within its framework. The survey conducted within the framework of the study dealt with the use of Lean Purchasing tools in business practice, but did not include a qualitative aspect concerning the evaluation of the level of effectiveness of the implemented tools, which could also be the subject of further research on Lean Purchasing tools. The use of Lean Purchasing tools is still little known among micro, small and medium-sized enterprises. These enterprises took part in the survey conducted, however, due to the fact that the main research group in the study is large enterprises (63.3%), it was considered an insufficient research sample to be able to refer to this as a representative example to fill this research gap. The results included in the paper, however, can serve as a reference example for researchers wishing to address this issue in the future.

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THE LEGAL ENVIRONMENT OF THE ENTREPRENEUR AND THE MANAGEMENT OF CHANGE INDUCED BY LEGISLATION IN A THEORETICAL PERSPECTIVE – A LITERATURE REVIEW

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Purpose: The purpose of the publication is to organise and analyse the views presented so far in the literature on the impact of the legal environment on the entrepreneur's business activities. From a theoretical perspective, the publication presents: the issue of change and change management with particular emphasis on change enforced by law. The article discusses the theory of institutional change.

Design/methodology/approach: The research method used in the publication was desk research, including analysis and critique of the literature.

Findings: The publication makes visible and justifies the need to complement existing concepts of change and change management with an individual approach to legally enforced change.

Originality/value: The publication provides an overview and analysis of the views presented in the literature on change and change management, in particular the change induced by the legal environment of the entrepreneur.

Keywords: change management, law.

Category of the paper: general review.

1. Introduction

Today's entrepreneurs operate in an extremely difficult and therefore demanding external environment. The external environment has come to be understood as anything that lies outside the enterprise - as an organisation - and can have any influence on it (Griffin, 1997; Korzeniowski, 2019). It is also defined as an entity that lies outside the boundaries of the organisation, influencing the performance of the organisation, imposing constraints and forcing adaptation as the price for survival (Hatch, 2002). Nowadays, it is characterised by high dynamics of change caused by a wide variety of factors, often impossible to predict. It is emphasised that contemporary business management is a continuous adaptation of the

enterprise to the external environment - in other words, it is oriented at change management (Kisielnicki, 2004; Nogalski, Falencikowski, 2014). These are activities aimed at preserving the competitiveness, profitability, ergonomics of the enterprise, which are a response to the present. They also give the enterprise a chance to prosper in the hardly foreseeable future (Brzezinski, 2005). According to the concept of the organisational life cycle, an organisation persists and develops as long as it is able to adapt to changes in operating conditions (Karbowski, Wyrzykowska, 2019). One of the elements that significantly shape the external environment of an entrepreneur is legislation. It falls within the scope of the entrepreneur's macro-environment (further environment), which is, unlike the micro-environment (closer environment), uncontrollable, meaning that the entrepreneur has no direct influence on this environment. In addition to legislation, the entrepreneur's macro-environment is also formed by economics, politics, technology and social culture (Hatch, 2002) (Figure 1).

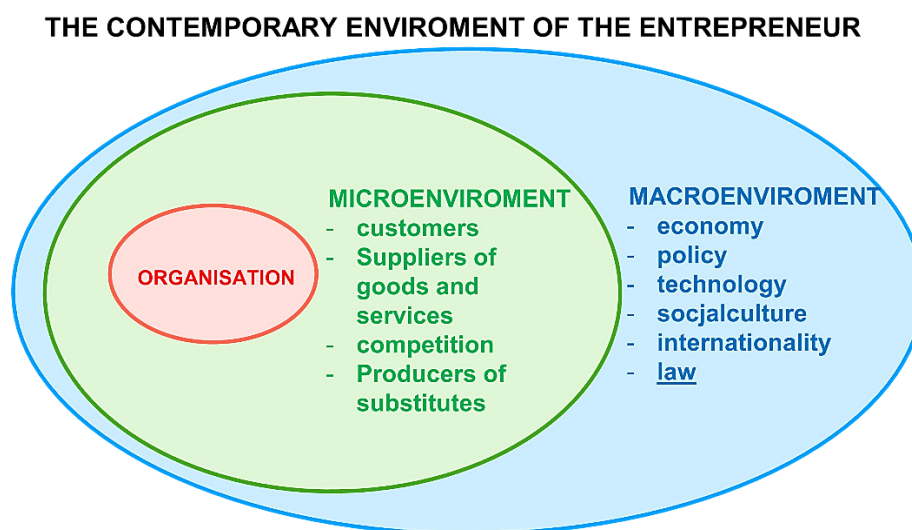


Figure 1. The contemporary environment of the entrepreneur.

Source: Magdziarczyk, 2023, p. 25.

The law defines such concepts as business activity, entrepreneur, enterprise, describes the permissible forms of business activity and, above all, outlines the framework of the freedom to conduct this activity. It is a source of both rights and obligations for the entrepreneur. From the point of view of business management, it is crucial that the functioning of the enterprise is adapted to the requirements of the law, that it remains in compliance with the legal environment. The consequences of a company's non-compliance with the applicable legislation may not only have a negative civil, criminal, administrative and legal dimension for the entrepreneur (e.g. lawsuits for damages, fines, prohibition of business activity, loss of a licence, administrative fine), but also an image dimension, especially in its micro-environment. The current high level of legislation in life, makes it imperative for the entrepreneur, not to underestimate the importance of adjusting the company to the legal environment. According to the available statistics, another record for the 'production' of legislation was set in 2023. More than 3 thousand new pieces of legislation came into force, totalling some 37-38 thousand

typed pages. For comparison, it is worth pointing out that in 2022 it was 15-20 thousand typed pages (Rzeczpospolita, 2 January 2024). The changes to the law concerned, among other things, the tax and social insurance system, areas of environmental protection, labour law, civil law and commercial company law.

In addition to economic conditions, legal regulations have become a fundamental element in the shaping of the entrepreneur's external environment. They are an important determinant of changes in the activities of entrepreneurs in their businesses. Legal change management has been promoted to the catalogue of basic skills entrepreneurs should have in order to develop and strengthen their businesses. It should be noted that legislation can force changes that will affect many areas of an enterprise such as strategic, operational, financial, marketing, or project and human resource management. It is therefore advisable to carry out a literature analysis of the subject, in order to organise and summarise the existing theories of change management induced by legislation. The research method that has been used to achieve the stated objectives is an analysis and critique of the literature. In selecting the literature, an important consideration was that the views presented should relate to contemporary reality. The analysis in question is undoubtedly a new and original take on and presentation of the views present in the literature.

For the sake of conceptual consistency, it should be indicated here that the term "entrepreneur" is understood in this publication in accordance with Article 4(1) of the Act of 6 March 2018, Entrepreneurs' Law (i.e. of 9 February 2024, Journal of Law of 2024, item 236), and the term "enterprise" is defined on the basis of Article 55¹ of the Act of 23 April 1964, Civil Code (i.e. of 2 August 2023, Journal of Laws of 2023, item 1610), taking into account that, in addition to tangible and intangible components, it also includes human resources (as such an understanding of an enterprise is consistent with the views of management and quality sciences).

2. Methods and Results

The research method adopted to achieve the objectives of this study is the analysis and critique of the literature (Apanowicz, 2005). Based on the analysis of the literature, in particular in the field of strategic management and change management, it can be stated there are significant deficiencies in terms of theoretical considerations, as well as methodological studies relating directly to the issue of entrepreneurs' management of change forced by the legal environment in which these entrepreneurs operate. On the other hand, a number of definitions of the concept of change can be found in the literature. Often quoted is the theory of L. Clarke, who believes that change is a transition from the known to the unknown (Clarke, 1997). No less popular is the view of M. Amstrong, who sees change as a process of analysing the past in order to carry out such actions in the present that will produce favourable results towards the

desired goal, while accepting the transitional state (Amstrong, 2000). E. Masłyk-Musiał, in turn, notes that in order for a phenomenon to be called a change it must be: 1) perceived (changes must be perceived); 2) empirical (changes can be studied to prove that something has actually changed in the organisation); 3) planned (changes must be controllable to some extent) (Masłyk-Musiał, 2003).

In relation to organisations, an organisational change can be distinguished. R.W. Griffin defined it as any significant modification of some part of the organisation. He emphasised that it may concern every area of the enterprise or only a selected area, a functional scope - however, if made in one area, it will often force changes in other areas. It should therefore be seen in a comprehensive and long-term view (Griffin, 2014). Similarly, this change is viewed by M. Bartnicki, pointing out that it refers to any real process in which the final state of the enterprise as an organisation differs from its initial state (Bartnicki, 1998). Z. Czerska adds that organisational change is a deliberate and conscious transition of an organisation from its previous state to a different, unambiguously different state. Such a definition of organisational change emphasises that the change is a source of permanent correction or modification in the relations between goals, tasks, people and apparatus in the dimension of time and space, regardless of the nature of its effects. Change means the introduction of a new solution and includes its development, the creation of conditions for implementation and start-up (Czerska, 1996, 2002a). In a similar vein, organisational change is defined by A. Zarębska, considering it to be any significant modification of some part of the organisation, i.e. the transformation of an existing system (enterprise) according to established procedures, with the simultaneous anticipation of the results of this transformation directed by the purposefulness of the organisation's activities (Zarębska, 2002). On the other hand, W. Walczak sees in organisational change an integrated and well-thought-out process of implementing new organisational, technological and cultural solutions aimed at better use of tangible assets and valuable intangible stocks, leading to improved management efficiency, asset management efficiency and increased market competitiveness (Walczak, 2009).

Many approaches to the classification of change have been presented in the literature. These classifications differ in terms of the criteria adopted, in particular: causes of change, duration of change, rate of change and size of change, direction of change, style of change. The most common ways of classifying change are presented in Table 1.

Table 1.

Types of change and criteria for identifying them

Criteria	Type of change
Source (reason for change)	<ul style="list-style-type: none"> spontaneous (voluntary) change - the organisation itself sees the need to change imposed (forced) change - its necessity and direction are determined by the environment
Size of change (purpose of change)	<ul style="list-style-type: none"> conservative change - aims at maintaining the current degree of adaptation of the organisation to its environment developmental change - aims to improve the degree of organisation and performance and ensure the development of the organisation

Cont. table 1.

Strategy for change	<ul style="list-style-type: none"> • structure-oriented changes (organisation) - e.g. decentralisation • change in the degree of formalisation • changes in technology - e.g. work operations, procedures • changing people - their qualifications, attitudes, motivation, relationships
Scope of change	<ul style="list-style-type: none"> • holistic changes - covering the entire organisation • fragmented changes - concerning specific parts of the organisation
Interdependence of the timing of organisational change and environmental change	<ul style="list-style-type: none"> • reactive changes - in response to changes in the environment, made only when the need arises • anticipatory change - anticipates future changes in conditions and prepares the organisation for them before the need arises
Assessment of the impact (effects) of the changes	<ul style="list-style-type: none"> • positive changes - when, as a result of measuring the effects of changes, the real useful result exceeds the expenses incurred • negative changes - when the useful results obtained are less than the costs associated with the change • neutral changes - when useful results and costs incurred are equal or close to each other
Strength, shape and extent of change	<ul style="list-style-type: none"> • incremental (normal) change - is a permanent feature of the organisation's operation • radical changes - are revolutionary in nature, e.g. the organisation's strategy is changed
Method of change	<ul style="list-style-type: none"> • adaptive change - is the organisation's response to emerging forces • planned change - is carefully planned and implemented in an orderly and timely manner
Scope of novelty	<ul style="list-style-type: none"> • innovative (creative) changes - bring about new solutions • adaptive (restorative) change - uses existing solutions, adapting them to the organisation's conditions

Source: Magdziarczyk, 2023, pp. 30-31.

Taking the source (cause) of change as a criterion for the classification of change, change underpinned by legislation is referred to as imposed or forced. This is because the necessity and manner of its introduction is dictated by the environment. On the other hand, taking into account the purpose of changes, a change induced by legislation has a conservative character, consisting in maintaining the current degree of adaptation of the organisation to the environment. In the context of the interdependence of the timing of organisational changes and changes in the environment, it has, in turn, the characteristics of a reactive change, i.e. constituting a reaction to the occurring changes in the environment. Regulatory change can also be referred to as adaptive change, considering the criterion of how change is introduced. Adaptive change is the organisation's response to external forces affecting the organisation. From the point of view of the novelty criterion, on the other hand, it is an adaptive (restorative) change, which involves the implementation in the organisation of already existing solutions adapted to the needs and conditions of the organisation.

The impact of legislation on the entrepreneur's efforts to adapt the enterprise to its environment is the basis of the theory of institutionalism and institutional change, based on a sociological approach. Its founder is P. Selznick. He noted that organisations are subject to environmental pressures in terms of technical and economic requirements as well as social values and regulations. The environment may even force organisations to play specific roles in society, and reward those that demonstrate the ability and willingness to conform to society's

values, norms, rules and beliefs (Selznick, 1996; Tolbert, David, Sine, 2011; David, Tolbert, Boghossian, 2019). P. Selznick's theory was further developed by W. Powell and P. DiMaggio (Powell, DiMaggio, 1984, 1991a; Dacin, Goodstein, Scot, 2002), particularly emphasising the influence of the state and the state-created legal environment on the organisation. Institutional theory has taken institutions to mean formal and informal rules and procedures, operational practices, as well as systems of symbols, cognitive scripts and moral patterns that provide a cognitive and interpretive framework for members of society (social actors). Institutions are rules and structures legitimised by social norms and values. They are also pointed out as sets of related rules and routines that define relevant actions in the sense of the relationship between role and situation, the essence of which is to structure the context in which the interpretation and meaning of individuals' actions takes place (Mazur, 2013). According to institutionalists, institutions shape the values, attitudes and behaviours of social actors by equipping them with cognitive schemas - and it is not that institutions are supposed to indicate how to act, but to determine what kind of actions are socially legitimised in a given context. They are also a source of control mechanisms, facilitate cooperation and reduce uncertainty, serving the persistence of the social order. The persistence of institutions, in the institutionalist view, stems from the belief that they introduce a state of equilibrium, which manifests itself in individuals adapting to the requirements of the institution, for this is more beneficial than not adapting, even though the situation they find themselves in may be suboptimal for them. Institutions change when they no longer serve the interests of rational social actors seeking to maximise utility. A break with the continuity of institutions provides the opportunity to configure new rules for the distribution of benefits. Institutional change occurs when consensus cannot be reached and coalitions for the continuance of an institution cannot be formed or maintained. The cause of institutional change is therefore a crisis resulting from a contradiction between the logic of institutions and the logic of social actors. Institutional change can be projective or evolutionary. In the first case, social actors are assumed to have an idea of the ideal social order, the ability to define precise goals and the resources to create this order. In the second case, it is a process of smooth and gradual transformations of institutions, not affecting the essence of the institution, but limited to the modification of its specific components (Mazur, 2013).

At the same time, it should be noted that P. DiMaggio and W. Powell are considered to be representatives of the concept of institutional isomorphism, which is one of the most important concepts of the 'new' institutionalism (neo-institutionalism) trend that began to develop in Western sociological and organisational thought in the 1950s (Wróbel, 2011; DiMaggio, Powell, 1991). Representatives of neo-institutionalism included G.H. Mead, Ch.H. Cooley, J.G. March or R.W. Scott and J.P. Olsen. This current was formed on the critique of legalism, structuralism, holism, historicism and normativism of previous tendencies in the study of the life of institutions (Jasinska-Kania, 2006). It should be noted that at its origins, the theory of institutionalism took as determinants of human action: law, social structures, or historical conditions, thus drawing on the thought of K. Marx, M. Weber and E. Durkheim. Describing

the phenomenon of similarity between organisations that co-exist in a similar environment, P. DiMaggio and W. Powell pointed to institutional isomorphism, the essence of which they considered to be the presence of other organisations. They took coercive isomorphism, consisting of formal and informal pressure from other organisations on which the organisation is dependent, as well as pressure to conform to social expectations, as one of the three basic premises of institutional isomorphism. Among the causes of coercive pressure, P. DiMaggio and W. Powell strongly emphasised the presence of the state and the existence of a common legal environment. The theory of institutional isomorphism was also close to J. Meyer and B. Rowan, who presented the view that, as the state and other large organisations extend their dominance over more and more dimensions of social life, organisational structures will increasingly reflect rules and arrangements legitimised by the state (Meyer, Rowan, 1977). It should be noted at this point that the very notion of isomorphism has previously been defined by A. Hawel as a coercive process inducing an individual to resemble others who face the same environmental conditions (Wróbel, 2011).

The specificity of change imposed by legislation, in turn, has a bearing on the process of managing that change. The literature is rich in definitions of change management, but they are of a general nature and do not take into account the differences presented by change induced by legislation. Thus, change management is described by M. Brzozowski and T. Kopczyński as a set of activities aimed at achieving an expected state in an organisation (Brzozowski, Kopczyński, 2009). In turn, L. Clarke believes that it consists of creating a vision for the organisation and a programme for its realisation (Clarke, 2012). According to him, change management should aim to maintain the competitiveness, profitability and ergonomics of the enterprise, focusing on maintaining a balance between the enterprise as an organisation and its environment and between all subsystems. A similar position to L. Clarke is presented by M. Bielski (Bielski, 2012). L.H. Haber, on the other hand, points out that change management is a process of decision-making aimed at enabling the best possible use of owned physical, capital and human resources in order to achieve the set tasks (Haber, 2011). K. Wybrańczyk, G. Polok, M. Naramski i R.A. Szromek, as well as M. Rousseau write about change management as the creation of flexible management capabilities and rapid response to the present, i.e. building such an organisation that will prosper in the hardly foreseeable future (Wybrańczyk, Polok, Naramski, Szromek, 2018; Rousseau, ten Have, 2022). According to G.P. Wojcik, change management should be defined as a conscious and organised activity aimed at planning and implementing change in an organisation. The essence of the change management process according to her is: 1) adapting reality to new needs and conditions; 2) improving the efficiency of the organisation's functioning; 3) formulating variants of solutions to improve reality; 4) implementing the selected solution into practice; 5) making decisions on the choice of the solution considered the best, meeting the adopted criteria; 6) a recurrent process, due to the obsolescence of solutions (Wójcik, 2011). For A. Stańda, change management, on the other hand, are activities that involved in the management of people

in the process of organisational change, he also points out that the basic task of change management is to ensure that the objectives of organisational change are achieved (Stańda, 2008). A slightly different definition of change management is provided by M. Narkiewicz, emphasising that it is the process of using the organisation's strategy to maintain harmony with the changing market environment (Narkiewicz, 2015).

At least three currents of change management approaches can be distinguished in the literature. The first is the systemic approach (object-oriented approach), which assumes that the organisation is made up of interacting and interdependent elements that are affected by the same forces, and that the effects of change in any area should not be considered in isolation. It is assumed that change in one area of the organisation triggers change or the need for change in another area. The precursors of this trend are J.J. Leavitt, R.H. Waterman, T.J. Philips and J.R. Philips (Stoner, Wankel, 1997). However, J. Skalik considers the omission of the interpersonal aspect of organisational life as its main shortcoming (Skalij, 2018). The second, is the behavioural approach (subject approach). This current was developed by W.L. French and C.H. Bell Jr. It focuses on organisational improvement by arguing that change management and organisational improvement are interrelated (Woodman, 1986; Pasmore, 1996). In contrast to the systemic approach, the behavioural approach places emphasis on the interpersonal aspects of the functioning of a changing organisation and the need to associate people's needs with the developmental intentions of the organisation (Skalij, 2010). Related to this current is the concept of OD (Organisation Development), which is based on the view that organisational development becomes a necessity for a company that wants to survive in an environment of constant change. However, this development should be linked to the development of managers (Bednarski, Szlendak, 1997; Trocki, 1989). The integrated approach is the third current (comprehensive approach) that stands out in the literature. Its proponents are L. Clarke, D.K. Carr, and K.J. Hard. It combines strategic orientation with simultaneous full utilisation of managerial and employee potential (Zarębska, 2002). This comprehensive approach to change management offers the most opportunities to respond effectively to the increasing dynamics of the turbulent environment of a changing organisation.

3. Discussion

A number of concepts relating to the concept of change and the issue of change management in the context of entrepreneurial activities have been presented in the literature. In both areas, the concepts described differ only slightly from each other. In their assumptions, they turn out to be based on almost identical foundations. At the same time, it should be noted that these concepts focus in particular on changes originating in economic processes and technological developments, while at present, it is legislation that is a significant stimulus for the

implementation of organisational change in enterprises. Legislation is capable of forcing change at every level of a company's operation, and often becomes a premise for actions aimed at evolving the mentality of the people involved in the operation of the company (especially employees). Examples include legislation relating to employment relationships (non-discrimination, gender equality), or legislation introducing data protection for individuals. When comparing a legally enforced change with other types of change, it is important to first of all consider the source of the change, which is legislation or, in other words, coercion by an authority. This coercion makes such change more difficult to manage than change induced by other factors. When faced with a change forced by legislation, the entrepreneur is essentially deprived of the opportunity to plan for it. Moreover, regardless of his or her conviction that it is necessary to implement it in the enterprise, he or she must take appropriate implementation actions, very often acting under pressure of time as well as possible civil or fiscal criminal liability. In the process of implementing a change enforced by the law, the conflicting nature of the law and its lack of precision (vagueness) is often a problem for the entrepreneur. A legal provision that is imprecise becomes a source of interpretation discrepancies. An entrepreneur who is obliged to implement a change resulting from such a provision in his enterprise, in order for his action to be consistent with the will of the legislator, should be guided by the interpretation made by the authorities.

The classic perception of change as a process of deliberate and conscious transition of an organisation from its previous state to a different, unequivocally different state, in relation to change enforced by law, should therefore be modified by emphasising that it is a deliberate process, but fully enforced by the activity of authorities. The characteristic feature of a change forced by law is that the entrepreneur is not able to foresee or plan it, he is forced to implement it even if he perceives the change as unnecessary or even unfavourable (or even harmful) from the point of view of his business activity. Current definitions of change in the literature therefore do not fully address the change that is dictated by an authority through the law enacted by that authority. Each of these definitions can be considered correct in general terms, not taking into account the uniqueness of the change imposed by the law.

By definition, the change management process should be 'tailored' to a specific enterprise, taking into account its needs and requirements arising from the specifics of its business, but above all it should be adapted to the type of change being implemented. It is a process that requires a combination of organisational, psychological and sociological aspects. Properly planned, it should, in particular, take into account the objectives of the enterprise, an analysis of the interaction network of mutual influences and an analysis of the strengths and weaknesses of the enterprise taking into account their specificities (van der Voet, 2014). The issue of managing regulatory-enforced change applies equally to all entrepreneurs, regardless of their size, type of business, etc. The ability to manage such change enforced in times of a highly dynamic legal environment should therefore be treated as an essential element of any entrepreneur's business (Walczak, 2012). Effective management of change enforced by

legislation is a prerequisite for the survival of businesses and for keeping them viable and growing. The change management concepts described in the literature do not directly address change induced by legislation, and are not dedicated to the most numerous group of entrepreneurs, which are micro-, small and medium-sized entrepreneurs. Most of these concepts are similar and do not call for discussion. What requires discussion, however, is the lack of a concept dedicated to the management of change imposed by legislation, which in recent years has begun to significantly determine the actions of entrepreneurs.

4. Summary

The conduct of business in the modern world has been subject to numerous legal regulations. These laws change, and new regulations are enacted to cover further areas of entrepreneurial activity. This state of affairs means that entrepreneurs are constantly faced with the challenge of adapting their businesses to the current state of the law. In other words, they are confronted with the problem of implementing changes that are driven by legislation (coercion from the authorities). Often, such changes are not foreseeable for the entrepreneur and their implementation is most often carried out under time pressure and various sanctions, which may even result in termination of the entrepreneur's business activity. The entrepreneur is obliged to adapt the functioning of the enterprise to the current legislation, regardless of whether it is approved by the entrepreneur. This means that entrepreneurs may find themselves in the situation of having to implement a change which he assesses negatively. Such a change may result in a reorganisation of the enterprise's work, placing new obligations on the entrepreneur and his employees. It may also force the entrepreneur to make financial outlays that the entrepreneur had not planned for and therefore had not secured the necessary funds. Managing change imposed by legislation is particularly challenging for micro, small and medium-sized entrepreneurs, who have limited human and financial resources and organisational capacity.

The review of the literature entitles one to the claim that general concepts of change and change management do not fully capture the nature of change induced by legislation creating the legal environment for the entrepreneur. These concepts do not take into account the individual nature of this change - its compulsory nature. In their assumption, they focus on voluntary change, indicating the choice to implement the change. By contrast, a change enforced by law is a change with which one may disagree, but one cannot choose not to implement it.

It is worth mentioning that the lack of a case-by-case approach to the issue of legally enforced change in the literature is linked to the lack of descriptions of methods for implementing such change.

In conclusion, it is important to recognise that the need of modern times is to take a more careful look at the changes faced by entrepreneurs, which are dictated by authority, through legislation. A theoretical grounding in management and quality sciences is required to manage the change enforced by legislation. Indeed, the general approach to change and change management to date is proving to be inadequate. The research findings presented are based on an analysis of relevant yet selected examples of the literature, which may be a complaint that they are limited. However, it seems that they can nevertheless provide a basis for reasonable conclusions. A basic conclusion is that there is a need for new insights into the issue of regulatory-induced change and entrepreneurs' coping with this change. Managing regulatory-induced change is an essential skill for modern entrepreneurs and a challenge before management and quality sciences to develop effective methods and tools to implement such change.

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THE USE OF INTERNET AND SOCIAL MEDIA AS MARKETING TOOLS IN COMMERCIALIZATION OF RESEARCH RESULTS

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Purpose: The article presents the survey results, concerning commercialization processes conducted in scientific and research organizations in the scope of research and development projects' results of innovative character, with the use of Internet and social media as marketing tools.

Design/methodology/approach: The questionnaires were distributed among universities, research institutes and institutes of the Polish Academy of Sciences. Special attention was paid to the most commonly used commercialization methods such as sales of the R&D results, granting a license for R&D results and making a contribution in a form of R&D results. The Authors were particularly interested in the type of collaboration oriented onto a commercialization of research results such as a development of a new product, a modification of an existing product, an elaboration of a new process, a modification of an existing process, entering a new market, a participation in a creation of economic programmes as well as opinions, expert opinions and reports.

Findings: The research results, presented in the article, also reflect different forms of disseminating the R&D offer with use of the Internet and the social media such as the website of the institute, branch website portals, social media e.g. Facebook, X portal (former Twitter), multi-media website pages e.g. YouTube, Flickr, Picasa, SlideShare.

Originality/value: The article assesses the factors that play a decisive role in the processes of successful commercialization of R&D research results in a research institute.

Keywords: research results, commercialization, Internet, social media, marketing tool.

Category of the paper: Research paper.

1. Introduction

The article aims at a presentation of a research problem, identified by the Authors, consisting in an investigation of using the Internet and social media as marketing tools in commercialization processes of R&D projects results. The scientific problem, under consideration, fits in the scope of “Engineering of Innovations”, understood as a technical dimension of implementing innovative solutions in the economy (Malec, Stanczak, 2020).

The Authors’ scientific contribution concerns an identification of a research problem, a preparation of the questionnaires concerning determinants of collaboration between an industrial enterprise with research organizations such as universities, research institutes and institutes of the Polish Academy of Sciences and a preparation of the questionnaire related to a commercialization level diagnosis in research institutes. It also includes a detailed analysis of the survey results and an elaboration of guidelines and recommendations for stakeholders of commercialization processes. The research work, described in the article, is oriented onto phenomena, events and processes between creators of research results, i.e. a research institutes and their users representing industrial enterprises.

Currently social media become one of the most important tools of the Internet marketing. The websites of social media such as Facebook and X platform (former Twitter) are an element of everyday life. The crucial role of social media consists in building relationships. It should be borne in mind that marketing activities include a process in which organizations create customers’ interest in product or services. It is an integrated process enabling organizations to build relationships with their customers, generating profits for themselves and for their customers. These relationships are based on mutual trust and understanding. Marketing in the social media is based on a creation of real relationships online with the final recipient or in the other words with the user enabling him/her to get to know the research institute, to like it and to trust the partner to the extent encouraging an interest in a collaboration. There is a big difference between traditional marketing activities, which transfer the information to indefinite recipients. It is concentrated on the company/institute and not on a customer/recipient and it should be highlighted that in this case the communication is unidirectional. On the contrary the marketing activities in the social media include interactions, they concentrate on the recipient and it is important to realize that two-directional dialogue is moderated by the recipients (Bullock, Agbaimoni, 2014).

2. Literature review

“Social media marketing” is based on using social platforms, blogs, VR and other spaces for a realization of not only promotional, image and sales targets, but also related to the customer’s support and servicing. It should be highlighted that an approach to the social media changed in recent years and the present stage of their development is a serious managerial challenge. There are some indicators enabling an efficiency measurement of marketing activities in the social media (Mazurek, 2016).

The potential of social media as regards marketing activities is extensively described in the literature. In particular it concerns the changes in relationships between the organization and the customer (Kitzman et al., 2011), levelling of information asymmetry between the players active on the market (Kaplan, 2012), a change of the customer’s role in the contemporary world (Barker et al., 2013), a creation of the brand success in the Internet (Mazurek, 2012). A phase of the popularity, of the potential identification of the activity possibilities is displaced by a phase of maturity. The social media marketing interferes dynamically in current processes, activities and the way of thinking about marketing, organization and customer. An identification of the social media potential in marketing activities determines a necessity of separating at least three perspectives:

- an operational perspective - a promotion of the brand, a creation of image, current customer’s service, maintaining contacts with recipients,
- a tactical perspective - a transformation of the social media user into a customer,
- a strategic perspective - an innovative perception of the market relationships between an organization and a customer.

The problem of developing an approach to increase the motivation of employees of the company’s marketing department to promote products to partners and consumers in the virtual space by using marketing tools of information interaction is presented in (Raiko et al., 2023). It is important to realize that marketing of the R&D projects’ results differs from other business-to-business (B2B) marketing processes due to its uniqueness and complexity of offers. Toukola et al. (2023) presented interesting information about the use of digital tools. They conducted a two-phase qualitative study analyzing digital tools applied in the project results marketing process, offering insights into the tools that suppliers can use in each step of the R&D results marketing process.

It is worth comparing modern tools used in marketing communication and to determine their position in relation to the traditional tools (Tarapata, 2022). The results of the research prove that an important future of marketing communication includes an integration of promotional instruments and activities. It should be mentioned that tools based on new technologies are gaining popularity, but they are not eliminating the traditional ones. Some barriers in commercialization processes of R&D projects’ results are presented in

(Stanczak, 2020) and in (Malec, Stanczak, Ricketts, 2023). In the result of the literature review and analyses, conducted by the Authors, key features of the Internet and social media marketing are presented.

3. Key features of Internet and social media marketing and advantages of using it

3.1. Key features of Internet and social media marketing

Key features of Internet and social media marketing include:

- a creation of contents which stimulate their further popularizing,
- a credibility of the message due to a transfer of the announcement promotion of third parties,
- a transfer of control over the message,
- a discussion and a dialogue as the basis resulting from an engagement of other users and participants,
- an efficiency of activities is not based on a simple function of time and expenses,
- a basis of relationships does not result from transactions but from mutual trust.

Successful implementation of innovative solutions, developed at scientific and research institute, among others due to an application of the social media, determine overall changes in the system of conducting marketing activities, in the way of thinking about customers and methods of reaching marketing targets. It should be borne in mind that the social media marketing is one of the fastest growing fields of marketing, determining many important changes in contemporary views on marketing activities, customers and market relationships. Social media are a very efficient and important promotional support which will be confirmed by the survey results described in a further part of this article. They contribute to a co-creation of innovative solutions, a positive brand image creation and efficient as well as reliable after-sales services. It is worth highlighting that they foster communication and coordination skills in a very efficient way. The social media marketing is also an example of a deterministic influence of information technologies on potential changes in marketing activities - their concept and realization. The dynamic perspective of social media marketing enables to conclude that the early stage of its usage, focused on supporting promotional activities, changes from tactical to strategic usage. Social media marketing is perceived as an important source of a competitive advantage and value creation (Mazurek, 2016). Some advantages of viral marketing should be mentioned (Szewczyk, 2015). It is a kind of activities oriented onto a generation of an advertisement which will disseminate spontaneously. This phenomenon develops quickly in the YouTube service. As the real time market is based on an immediate

reaction to the occurring events, it is forecast that in future this kind of marketing will become more and more popular and it will become the key communication channel among organizations.

According to surveys conducted by the Mzinga and Babson Executive Education, it can be seen that in the USA 86% enterprises actively uses social media marketing (Kowalski, 2011). It is also important to bear in mind that enterprises which are not active in the social media can be perceived as conservative ones, not taking advantage of modern tools and even not very professional (Podlaski, 2011). A non-invasiveness of the way to reach a customer or consumer plays a significant role. In the case of Facebook a contact with an Internet user takes place through the website, from which the information is sent after a clear confirmation of the interest in its obtaining, i.e. after its subscribing. Many Internet users express an opinion that social media services give marketing activities the second youth.

3.2. Advantages of using Internet and social media marketing

The Harvard Business Analytics Services conducted a survey of 2100 organizations, discovering that 79% of them use channels in the social media (Bullock et al., 2014). In their opinion advantages of using social media are as follows:

- a bigger awareness of the organization existence,
- bigger traffic on the website,
- more positive opinions about the brand,
- a possibility of monitoring opinions and discussions concerning the organization,
- a possibility of developing focused marketing activities,
- a better understanding of the brand perception by customers,
- a bigger knowledge about target markets,
- an identification of positive and negative comments,
- a development of a new activity,
- an identification of new chances for products or services,
- a possibility of measuring a frequency of discussions about the brand,
- an early warning against potential problems with products or services.

An implementation of the 5 W strategy facilitates commercialization processes. The 5 W strategy requires answers to five questions: WHY? WHO? WHERE? WHAT? WHEN?

WHY? – The answer to this question enables to raise the status of the organization, get a better knowledge about customers' needs, identify new markets.

WHO? – The answer to this question gives precise information about the target recipient, with whom it is possible to enter into interactions. It also informs about the recipients' characteristics, it reflects their way of thinking and preferences.

WHERE? – The answer to this question helps to understand which social media suit the marketing targets best.

WHAT? – The answer to this question specifies the message of the organization and transfers information in a clear way.

WHEN? – The answer to this questions gives information about online reactions and it is recommended to use the calendar software for up-dating information when it cannot be done personally.

The presented advantages are mainly of cognitive value, but they highlight the significance and importance of social media in the marketing activities of organizations. It should be borne in mind that an implementation of the 5W strategy contributes to a successful realization of marketing activities.

4. Contents of questionnaires used in the process of survey research

4.1. Questionnaire concerning collaboration determinants of enterprise with scientific and research organizations (universities, research institutes, institutes of the Polish Academy of Sciences).

Enterprises were divided into four categories in relation to their size: a microenterprise, a small enterprise, a medium-size enterprise and a single person enterprise. The surveyed legal persons were asked about the period of their market activity: no longer than two years, more than two years, but not longer than 10 years, more than 10 years but not longer than 20 years, more than 20 years. Then the surveyed persons were to mark their scope of activity: metal and machine industry; services, trade and transport; fuels; power engineering; extraction of raw materials; industrial production, agriculture and fishing; safety; construction; engineering and technical services; IT services, development of software; installation and maintenance of IT systems; customer support services; warehousing and storage. The area of the market activity was also identified: regional, domestic, European Union countries, world.

The Authors also asked about a collaboration with scientific and research institutions, trying to investigate the reasons which caused no interest in such a collaboration. They included lack of a collaboration need, lack of an enterprise interest in innovative activities, a use of ready-made technological solutions, lack of financial means for a collaboration with research organizations, lack of experience in collaboration with research organizations, no information about offers of research organizations, lack of contacts with research organizations, maladjustment of offers of research organizations to needs of enterprises, lack of or inefficient marketing activity of research organizations, long-lasting administrative procedures in research organizations, complexity of administrative procedures in research organizations, difficulties in communication with representatives of research organizations, tendency to theorize

excessively by representatives of research organizations, downplaying of implementation problems by representatives of research organizations, patronization of the business party, use of research results as the basis of their own scientific career by representatives of research organizations. One of the questions concerned a type of collaboration, i.e. an implementation of a new product, an introduction of a change in an existing product, an elaboration of a new process, a modification of an existing process, a new market entry. It was important to find out which legal form of collaboration was chosen by an enterprise: a contract for sales of research and development project results, a license for using the results of research and development work, a spin-off company, a spin-out company. Apart from other items such as financing of collaboration, intellectual property rights or general level of satisfaction, the Authors intended to investigate the importance of the following factors, having a crucial impact on the decision about collaboration with a research organization: knowledge and competences, innovativeness, experience, market recognition, an adaptation of the offer to the enterprise needs, price, quality, advertisements, reaction speed, accordance in the scope of intellectual rights, complexity of administrative procedures, and operation of a department taking care of a customer, an interest in customer's needs, an ease in making contacts, a trouble-free communication, a flexibility in negotiations. The questionnaire was ended with the question about a frequency of using Internet and social media such as the website, Internet branch portals, social media (Facebook, former Twitter), multimedia websites (e.g. Youtube, Flickr, Picasa, SlideShare).

4.2 Questionnaire concerning the condition diagnosis in research institutes

The questionnaire started with the information about the revenue volume (up PLN 10 million, PLN 10 to 25 million, PLN 25 to 50 million, over PLN 50 million), the revenue volume from the commercialization R&D project results in the institute (up to PLN 5 million, PLN 5 to 15 million, PLN 15 to 25 million, over PLN 25 million), the most common commercialization method (sales of R&D project results, license, making a contribution in a form of R&D results to the company), the percentage of R&D project results subject to commercialization (up to 25%, 26-50%, 51-75%, 76-100%). Then it was important to find out which collaborative options were realized with industrial partners: a development of a new product, a modification of an existing product, a modification of an existing process, a new market entry, a participation in a creation of economic programmes, opinions, expert opinions and reports as well as diagnoses, accredited laboratory tests, a certification of products or management systems. It was important to investigate financing of commercialization processes such as financial means of an industrial partner exclusively, financial means of the industrial partner and the institute, domestic research projects, European research projects, international research projects.

As far as success factors are concerned, the following aspects were taken into consideration: knowledge and competences, innovativeness, experience, market recognition, reliability, an adaptation of the offer to the enterprise needs, price, quality, advertisements, reaction speed,

accordance in the scope of intellectual rights, complexity of administrative procedures, an operation of a department taking care of a customer, an interest in customer's needs, and ease in making contacts, a trouble-free communication, a flexibility in negotiations.

As in the case of industrial partners, representatives of scientific and research organization were asked for an efficiency assessment of the Internet and social media (e.g. Facebook, former Twitter), multimedia websites (e.g. Youtube, Flickr, Picasa, SlideShare). Three final questions concerned a collection and analysis of information about customers, a basis of key customers enabling a quick identification of their needs as well as barriers which impede marketing activities in a research institute such as lack of financial means, lack of qualified personnel, lack of the state-of-the-art marketing tools, blindness of the management and employees to marketing activities as well as a mismatch of actions to the needs of industrial partners. The obtained survey results enabled to compare opinions of industrial partners and research institutes as regards the use of the Internet and social media as marketing tools in commercialization of R&D results.

5. Contents of questionnaires used in the process of survey research

As it has already been mentioned 100 questionnaires were distributed among all research institutes and 390 questionnaires were sent to industrial partners. Unfortunately only 23 questionnaire were returned from the institutes and 65 questionnaires - from industrial partners. However, considering the circumstances, it was possible to draw conclusions of general character, reflecting specific trends and specific barriers to commercialization processes. Fig. 1 shows the percentage of R&D project results which were commercialized.

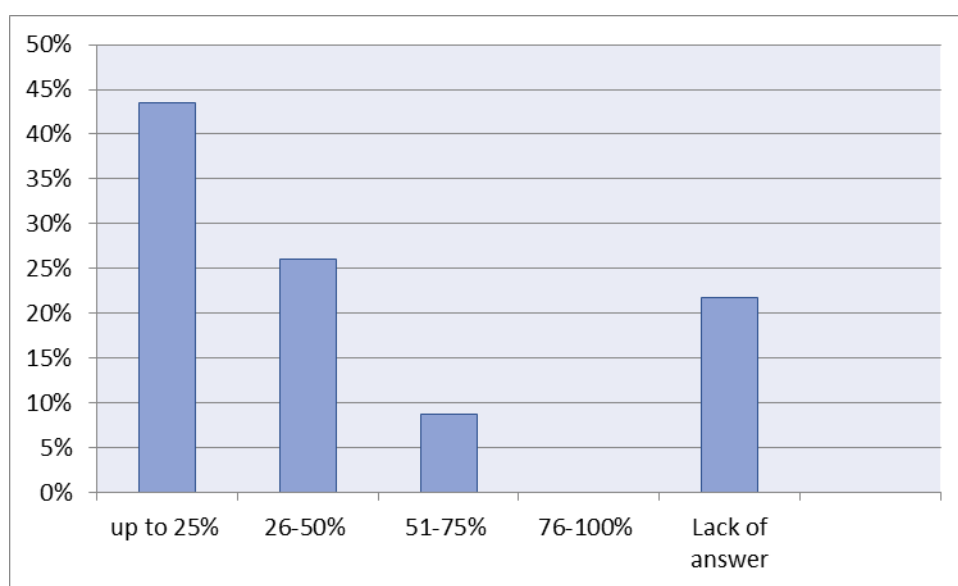


Figure 1. The percentage of R&D project results subject to commercialization.

It can be seen that 44% of the institutes commercialize up to 25% of R&D results, 26% of them from 26 to 50% and only 9% of them commercialize from 51 to 75%. No institutes commercialize more than 76% of their research results. It may be interesting to investigate an impact of different stakeholders on the subject matter of R&D projects planned to be commercialized – Fig. 2.

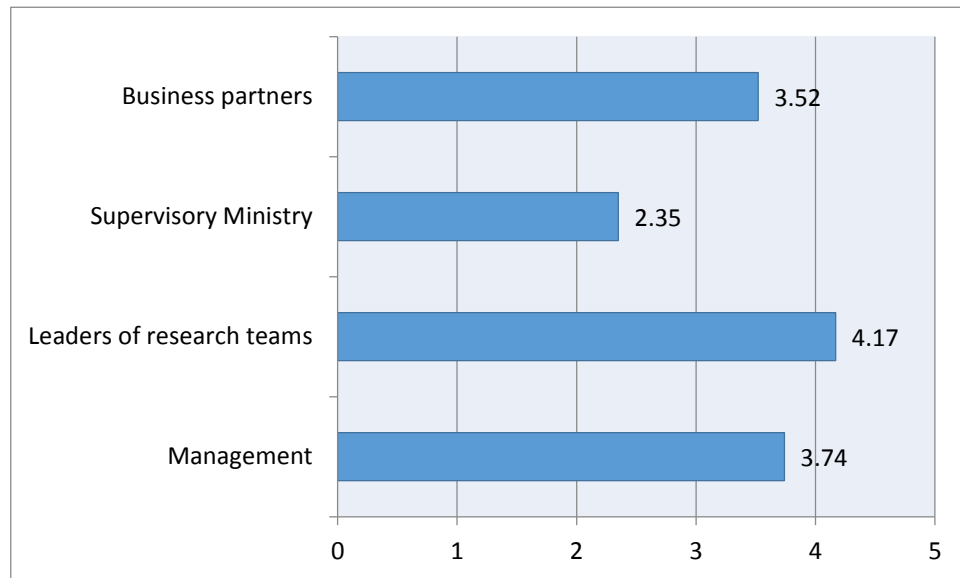


Figure 2. An impact of stakeholders on the subject-matter of R&D projects.

It should be highlighted that leaders of research teams had the biggest impact on the subject-matter of R&D projects – median 4.17, whereas the institute management – 3.74 and business partners – 3.52. The role of business partners is extremely important in this case.

From the scientific point of view it was worth investigating the frequency of using different sources by enterprises while searching information about offers of scientific organizations (Fig. 3).

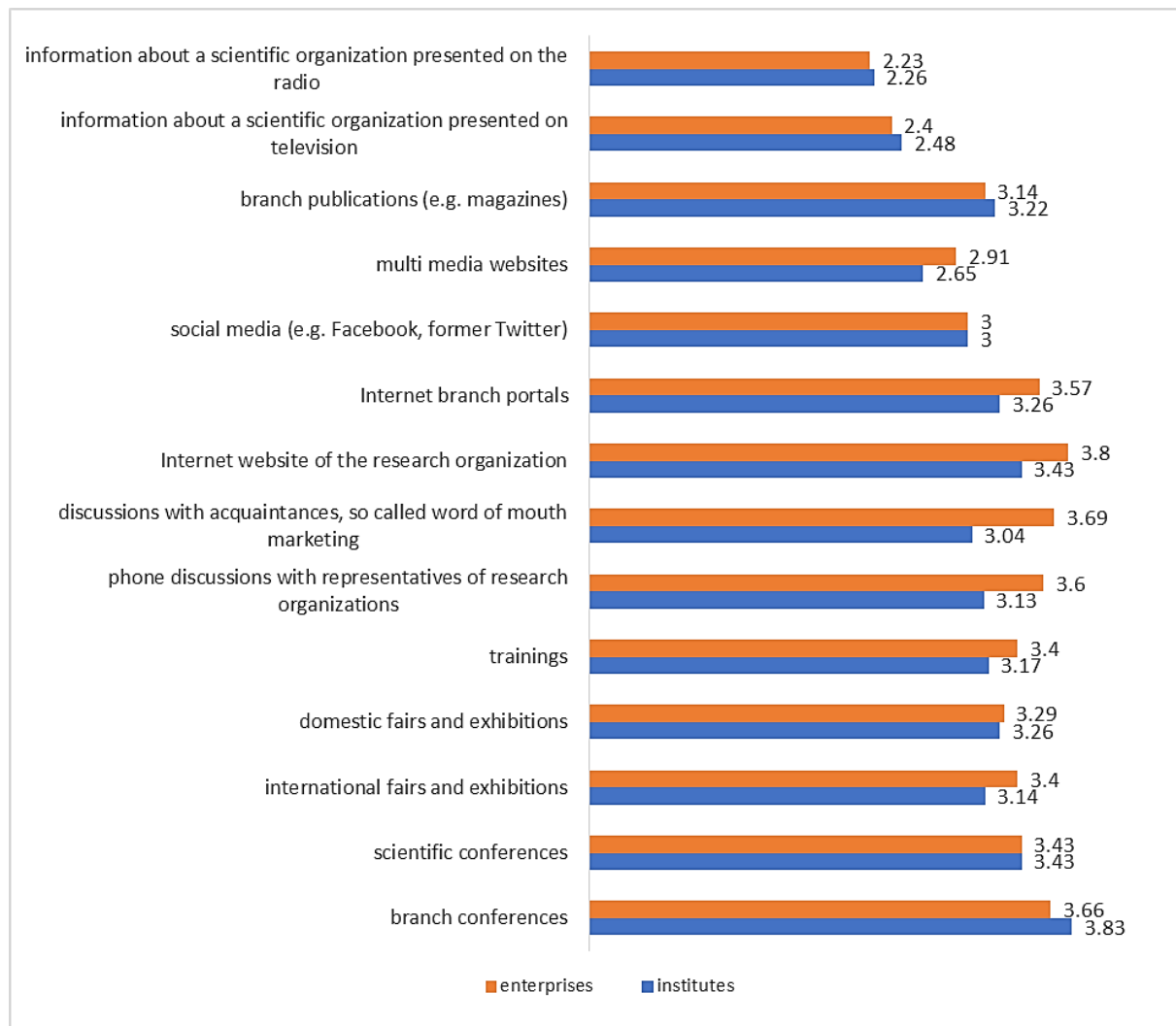


Figure 3. Frequency of using the following sources by enterprises while searching information about offers of scientific organizations.

It is worth highlighting that the enterprises used the Internet website of the research organizations as the source of information, then they indicated a use of a so called word of mouth marketing and branch conferences.

The analysis and comparison of survey results also included two time intervals, i.e. the year 2022 and the year 2023. In the year 2022 there were 69 indications and in the year 2023 – 99 indications which reflect 43% increase in efficiency of using different marketing tools. Fig. 4. presents 69 indications in the year 2022 and Fig. 5 – 99 indications in the year 2023.

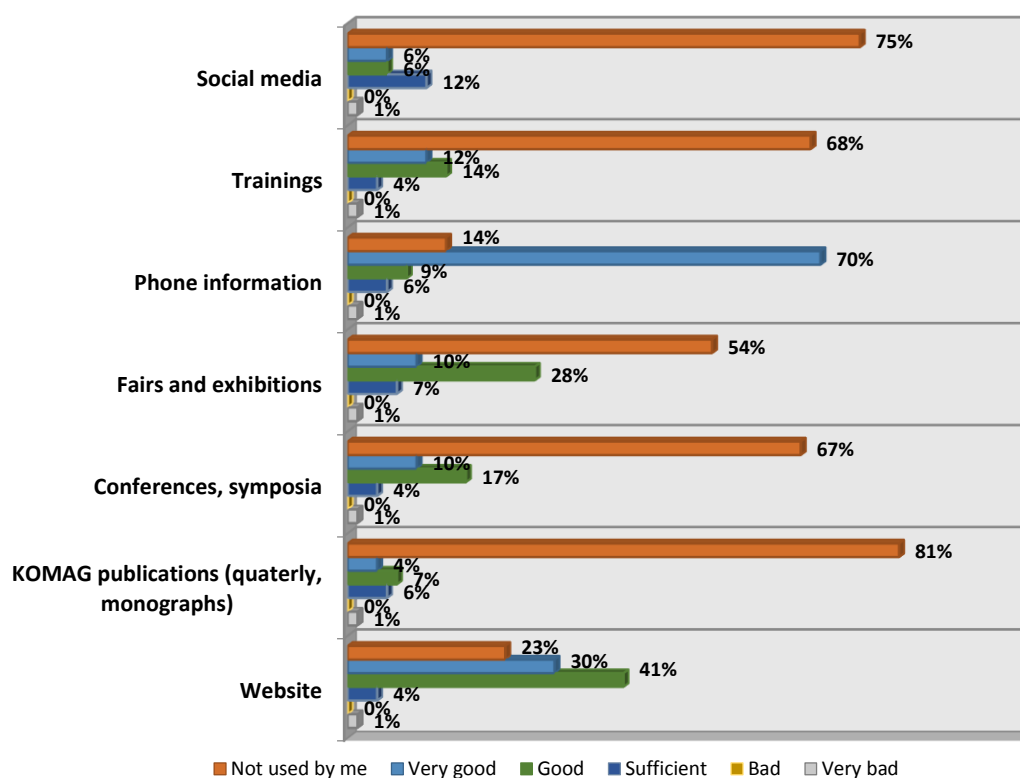


Figure 4. Use of different marketing tools in the year 2022 (69 indications).

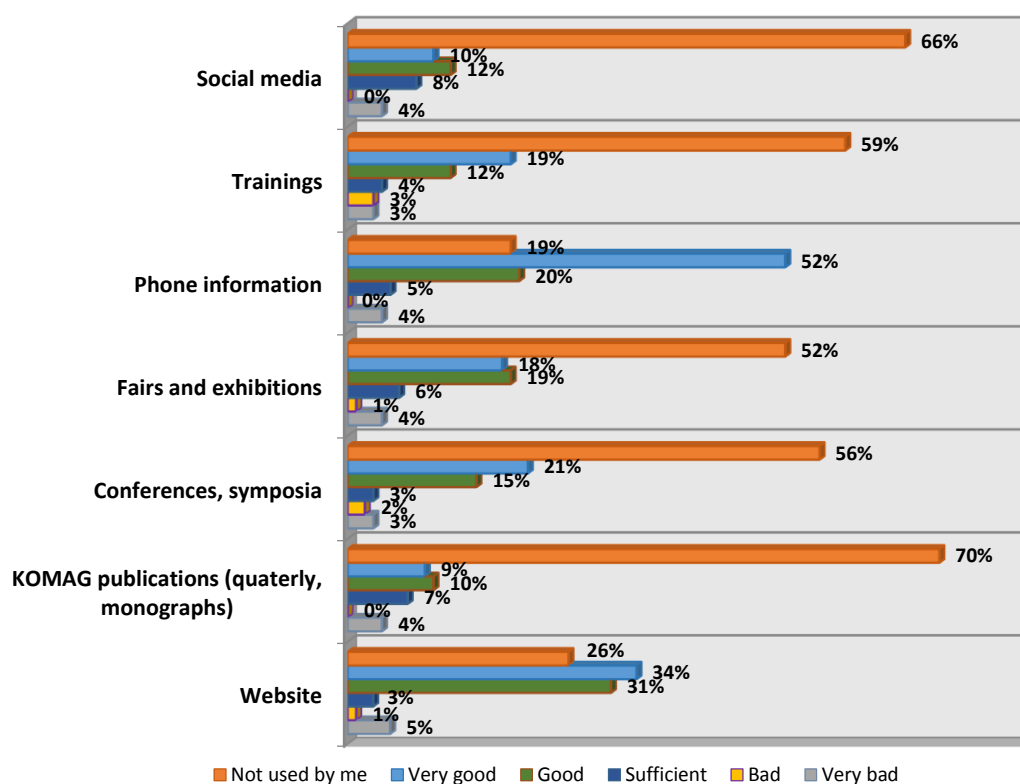


Figure 5. Use of different marketing tools in the year 2023 (99 indications).

It should be noticed that in the year 2022 1% of respondents assessed all the marketing tools, subject to the analysis, as very bad, whereas in the year 2023 the opinion “very bad” varied from 3 to 5%. The number 3% concerned trainings as well as conferences and symposia, but the number 5% concerned websites which needs taking corrective measures as soon as possible.

6. Conclusions

The Authors presented a research problem consisting in an investigation of using the Internet and social media as marketing tools in commercialization processes of R&D projects' results. They were oriented onto phenomena, events and processes between creators of research results, i.e. research institutes and their users representing industrial enterprises.

- The article is primarily of cognitive values, emphasizing the importance of modern technologies in the marketing activities of research organizations, but it also gives some guidelines which can be used in successful commercialization processes of R&D project results.
- Internet and social media are important marketing tools that stimulate the management of modern research institutions which intend to apply the latest solutions enabling to reach specific groups of stakeholders.
- The dynamic perspective of social media marketing enables to conclude that the early stage of its usage, focused on supporting promotional activities, changes from tactical to strategic usage.
- Social media marketing is perceived as an important source of competitive advantage and a value creation.
- The obtained survey results enabled to compare opinions of industrial partners versus scientific and research institutes.

The crucial role of Internet and social media as marketing tools in commercialization processes is reflected in the survey results obtained during the presented project. They are important for building relationships between research organizations and industrial enterprises which use different forms of research results. These relationships are based on mutual interest, trust and understanding. Traditional marketing activities transfer the information to indefinite recipients whereas the marketing activities in the social media concentrate on recipients, realizing a two-directional dialogue moderated by recipients.

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STUDY OF ACCIDENT RATES AND EVALUATION OF ACCIDENT EVENT CORRELATION IN THE PERIOD 2022-2023 FOR SELECTED LOGISTICS COMPANIES

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Purpose: The main purpose of the article is to analyze accident rates and the ocean of correlation of accident events in the period 2022-2023, as well as to identify relationships affecting changes in the number of accident events.

Design/methodology/approach: The research methods used in the article were quantitative methods, which included empirical surveys and qualitative methods including conducting interviews/questionnaires with representatives of the surveyed companies. An additional approach to the research referred to the statistical data.

Findings: The considerations presented in the publication made it possible to analyze the accident rates for the surveyed 25 companies in the logistics industry, statistical data in correlation with both the level of employment and the measures taken that are aimed at the complete elimination of accidents at work. The article seeks to analyze in detail the correlations that occur in the surveyed enterprises in relation to the decreases in accident rates, which were evident in the whole set at 52.98%, with a slight decrease in employment determined for the total at 2.443%. Thus, new courses of action were verified and established, through which companies will eliminate accidental events, affecting the provision of very safe working conditions.

Originality/value: The carried out assessment of accident rates in the surveyed companies as well as on the basis of statistical research indicates minimization and strives for complete elimination of accident events in the logistics sector. The main influence on this is the raising of awareness by employees as well as the continuous spreading of safety culture through the implementation of new technical, organizational, analytical or management solutions. The focus on the development, implementation and maintenance of safety management at the highest level, as well as its continuous improvement, significantly affects the decrease in accident rates, which should continue to be maintained and introduced in the logistics industry, but also in other branches of the economy.

Keywords: safety management, accidents at work, accident rate, safety management system, occupational safety and health, reduction of accidents.

Category of the paper: research paper.

1. Introduction

The continuous development of enterprises and the pursuit of the highest position in the market both domestically and expansion into international markets, forces entrepreneurs to continuously improve, in every aspect of the functioning of the organization. A variety of factors, including modern economic conditions, which now include the volatility of the business environment, the focus on meeting customer requirements, time compression prompts organizations to the so-called integration of the above elements, which directed entrepreneurs to seek areas of improvement in productivity, efficiency. These activities have influenced the desire of organizations to expand modern and unconventional business models. Important issues in the construction and creation of new directions for the logistics industry sector is, first of all, the mutual correlation between service providers and service recipients, who together take care of many aspects that are an indispensable element that is a link of symbiotic fulfillment of common expectations occurring in the process.

These correlations and actions taken include, first and foremost, the building of common ties between stakeholders (internal/external customers) in the integration of supply chains to ensure the proper exchange of goods, from production through the marketing of the product to the direct transfer of the order to the customer. Companies go to great lengths to streamline the supply system to improve customer satisfaction. It is by taking such measures, that the competitiveness of a given enterprise in the markets increases (Staniewska, 2021). An important aspect that is placed as a priority in many industries, including logistics, is the approach to health and safety management. It is the guarantee of a certain, currently high level of safety that makes it possible to establish mutual business correlations between organizations. It has been found that the trend of striving for the highest safety standards is increasingly evident. Ensuring safety at an appropriate level for the processes carried out provides the opportunity to feel that a certain kind of mission has been fulfilled, which is a guarantee of the real creation of supply chain relationships, which is also pointed out by M. Hugos, who argues the following, that it is the companies that mutually learn to build and maintain sustainable supply chains, including effectively as well as productively operate within them, that will achieve a significant competitive advantage in the markets (Hugos, 2011). There is a lot of information in the literature, indicating that the theoretical basis for a kind of integrated supply chain concept, is the value chain of M.P. Porter (Porter, 2001), who states that in conditions of significant market competition it is necessary to seek growth and increase the value for stakeholders, as well as to adapt to their needs. Stakeholders according to the understanding of customers, local government units, the social side, or employees, without whom organizations would not function. In all this juxtaposition and chain of successive important issues, values, the term safety, in relation to working conditions, the environment in which it is carried out, productivity and process efficiency, increasingly appears, ending with the most important - employee awareness. It is the employees' awareness of an appropriate

safety culture that is the backbone of companies' operations and, consequently, their high position in the market. Conscious management gives confidence in the direction of safe processing by employees, ending with external customers in the area of safety (Woźny, Pacana, Dobosz, Saja, 2015). It is the full responsibility of business that influences the constantly improved and enhanced safety management systems. Through proper safety management, companies regularly influence the reduction of accidental incidents, which are reduced through the implementation of a series of measures ranging from technological, organizational to behavioral that are the essence of spreading safety culture.

2. Health and safety management system in the logistics sector

The modern logistics system is an important function in the management of the enterprise, as well as the entire market for the exchange of goods and products. It is the logistics enterprises that are necessary for the proper flow of materials. It all starts with production processes, which in turn, after the production of a given item, trigger the product flow system. After the production processes, the given product goes through the technological system (more, or less complicated) to warehouses, where the processes of delivering it to the customer are underway. It is the logistics processes that consist of various handling activities, which include moving, storing, receiving or issuing materials, products or finished shipments. Everything along the supply chain in terms of warehousing consists of a series of activities that are carried out during the flow of the aforementioned elements through the warehouse. A detailed diagram of the flow of products, products and goods is shown in Figure 1 (Rut, Wolczanski, 2015).

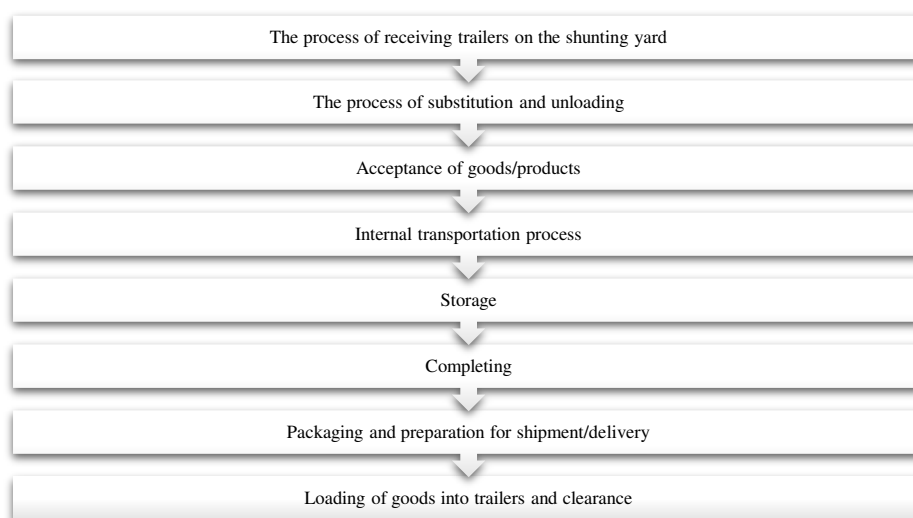


Figure 1. Flow diagram of products in the supply chain.

Source: own work based on (Rut, Kulinska, 2006).

In order to ensure the continuity of the logistics (warehouse) process, appropriate technical and organizational conditions should be met. Space along with technical place should be provided in a way that allows the execution of warehouse activities, equipment, machinery and devices should meet appropriate conditions, and employees carrying out the work should have the knowledge and experience to perform the work, which will give a high probability of processing in a safe manner (Dudzinski, Kizym, 2000). Analyzing the modern market, at each stage of the activities of enterprises we are in contact with logistics. Therefore, the effective implementation of processes from production to distribution is closely related to ensuring their continuity and consistency. Many components and factors have a significant impact on the continuity of processing, and one of the most important elements is occupational health and safety (Wojciechowski, 2009).

When analyzing the way logistics processes are approached, one notices a trend indicating continuous improvement and an attempt to raise employee awareness toward promoting a culture of safety. An important element is to influence the way processes are carried out by taking measures to minimize accident events and then eliminate them altogether. In connection with the processes carried out in the supply chain, one notices many risks in warehouse operations that can negatively affect employees, which can ultimately result in occupational accidents, including severe ones. With the continuous improvement, implementation, certification and maintenance of safety management systems, including on the basis of standards such as ISO 45001, SCC, SCP etc. in the area of safety, it can be concluded, that companies are focused on meeting the highest safety standards (Zywiołek, Staniszevska, Jarosz, 2012). The most important and main factor shaping the safety culture, whether the organization has a safety system in place or not, is first and foremost the awareness, knowledge, experience and willingness of managers to pass on the rules for the safe execution of work. In line with the statement that the example should always "come from the top", in this situation good practice, acting in accordance with the guidelines by managers provides the opportunity for analogous processing by all employees. The combination in employees of their knowledge, experience, aptitude for the job combined with commitment and adherence to the safety standards of the facility, can influence the maintenance of safety ranges at the highest possible level. Thus, combining additionally the above with proper maintenance of infrastructure, machinery, equipment or installations, together can affect the on the elimination of accident events, which can potentially be completely eliminated (Dworecki, Berny, 2005).

3. Evaluate accident rates in 2022-2023 for selected logistics industry enterprises and statistical data

The evaluation of accident rates was made on the basis of an analysis of data obtained from 25 enterprises providing services in the area of broadly understood logistics, supply chain and selected scopes of production. By subjecting the received data to analysis, a compilation was made, and a comparison was made of the results obtained from the surveyed enterprises in relation to indicators made available by the Central Statistical Office for the period 2022-2023. While conducting an evaluation of the number of accidents, comparing them for the period 2022-2023, consultations were held with representatives of the management of companies in the logistics industry, and the possibilities and causes affecting the difference between the number of accidents in the period 2022 compared to 2023 were discussed.

Analyzing the rate of fatal accidents in relation to the total number of deaths in Poland in the period 2020-2023

By analyzing the sources of literature data, which indicate that the third classification of causes of death includes accidents at work, the actual state of affairs in Poland was verified on the basis of statistical data. In order to verify the above, the number of deaths over 4 years in the period 2020-2023 was evaluated and determined the proportion of deaths resulting from accidents at work, to the total number of deaths, as shown in table 1.

Table 1.

Number of deaths with occupational fatality rate for the period 2020-2023

Year	Number of deaths in Poland	Number of fatal accidents in Poland	Information on percentage data covering deaths due to occupational accidents in relation to the total number of deaths [%]
2020	477355	99	0,021
2021	519517	180	0,035
2022	448448	219	0,049
2023	397968	99	0,025

Source: own work based on data from the Central Statistical Office (access: 25.01.2024).

Based on Table 1, it is concluded that fatal occupational accidents account for no more than 0.05% of the total number of deaths recorded in Poland. This trend does not confirm global trends, which indicate that accidents at work affect a significant reduction in the human population.

Analyze accident rates on the example of the surveyed logistics industry companies for the period 2022-2023

In order to verify the level of the number of accidents and the indicators that have been achieved by individual companies, the level and degree of the number of accidents were analyzed and evaluated with reference to the period 2022-2023. Companies from selected areas of the Poland were selected for the study, which was a total for:

- a) Silesia Province – 32% of the surveyed companies;
- b) Lodzkie Province – 16% of the surveyed enterprises;
- c) Greater Poland – 12 % of the surveyed companies;
- d) West Pomeranian province – 12% of the surveyed companies;
- e) Lower Silesia province – 12% of the surveyed companies;
- f) Masovia province – 4% of the surveyed enterprises.

Table 2.

Characteristics of companies in the logistics industry included in the assessment of accident rates

Company		Year of establishment	The economic area in which the surveyed enterprise is classified	Number of employment 2022	Number of employment 2023
1	2	3	4	5	6
1	Company 1	2014	Transportation/storage	3100	2905
2	Company 2	2020	Transportation/storage	1908	1988
3	Company 3	2014	Transportation/storage/production	350	433
4	Company 4	2021	Transportation/storage	11	24
5	Company 5	2018	Transportation/storage	3225	3124
6	Company 6	2015	Transportation/storage	1280	1210
7	Company 7	2020	Transportation/storage	2135	2566
8	Company 8	2021	Transportation/storage	1255	1032
9	Company 9	2019	Transportation/storage	550	451
10	Company 10	2017	Transportation/storage	135	260
11	Company 11	2018	Transportation/storage/production	768	774
12	Company 12	2020	Transportation/storage	1856	1862
13	Company 13	2014	Transportation/storage	3220	3022
14	Company 14	2017	Transportation/storage	2330	2411
15	Company 15	2021	Transportation/storage	2390	1992
16	Company 16	2019	Transportation/storage	2480	2352
17	Company 17	2015	Transportation/storage	1244	1218
18	Company 18	2019	Transportation/storage	455	470
19	Company 19	2014	Transportation/storage	1658	1722
20	Company 20	2014	Transportation/storage	2599	2254
21	Company 21	2016	Transportation/storage/production	233	260
22	Company 22	2018	Transportation/storage/production	1789	1644
23	Company 23	2019	Transportation/storage	542	551
24	Company 24	2015	Transportation/storage	1754	1840
25	Company 25	2020	Transportation/storage	2122	2062

Source: own work based on consultations with representatives of enterprises.

On the basis of the data obtained from companies in the logistics sector, which are presented in Table 2, an analysis of employment for selected companies was carried out, verifying what percentage constitutes employment for the surveyed companies from each province, to the total level of employment in all analyzed companies in 2022-2023, as indicated in Table 3.

Table 3.

Summary of the number of employees in each province of the surveyed enterprises in the period 2022-2023

Province	Number of employment 2022	Number of employment 2022	Number of employment 2023	Number of employment 2023	Dependency of employment in relation YoY [%]
Silesia	13264	33,67	13282	34,56	0,14 ↑
Lodzkie	3309	8,40	3347	8,71	1,14 ↑
Great Poland	7940	20,16	7425	19,32	6,49 ↓
West Pomerania	4179	10,61	4040	10,51	3,33 ↓
Lower Silesia	8575	21,77	8271	21,52	3,55 ↓
Masovia	2122	5,39	2062	5,37	2,83 ↓
Sum	39389		38427		2,44 ↓

Source: own work based on collected data from the analyzed enterprises.

Based on Table 3, it is concluded that the most employment for the analyzed enterprises in the logistics industry is for organizations located in Silesia Province, which indicates a 33.67% level in 2022 and 34.56% for the 2023r period in terms of total employment. Next in the top three provinces is the predominance of the Lower Silesia province indicating 21.77% of employment in the 2022 period and 21.52% for 2023 in relation to the total sum of the surveyed enterprises. The third voivodeship with the most employment in the surveyed organizations is Greater Poland, whose rate for the 2022 period is 20.16% and for 2023 it is 19.32%. In order to verify the number of accidents for the periods 2022-2023 for the surveyed enterprises, taking into account the indicators of the organizations in terms of occurrence in the particular province in which the enterprises are located, the summary and comparison shown in Table 4 was obtained.

Table 4.

Summary of the rate of occupational accidents in each province of the surveyed enterprises for the period 2022-2023

Province	Number of accidents 2022	Number of accidents 2022	Number of accidents 2023	Number of accidents 2023	Dependency of employment in relation YoY [%]
Silesia	153	33,77	59	27,70	61,44 ↓
Lodzkie	26	5,74	20	9,39	23,08 ↓
Great Poland	102	22,52	33	15,49	67,65 ↓
West Pomerania	37	8,17	16	7,51	56,76 ↓
Lower Silesia	93	20,53	73	34,27	21,51 ↓
Masovia	42	9,27	12	5,63	71,43 ↓
Sum	453		213		52,98 ↓

Source: own work on the basis of collected data from the analyzed enterprises.

On the basis of Table 4 it is noted that in the case of the averaged values of accident rates for the surveyed companies in the logistics industry, decreases in accidents at work are indicated in sum for all provinces. The largest decrease was recorded in the Masovia province, which is a decrease at 71.43% in 2023 compared to 2022, followed by Greater Poland province with a decrease of 67.65%, and Silesia with a decrease of 61.44%.

The next step is to verify and evaluate the number of accidents in the surveyed logistics companies with an indication of accident rates for the period 2022-2023, and to verify how the number of accidents is shaping up, in order to determine whether it is characterized by a decrease or increase in the area of accidents, and then to determine the directions to achieve the intended goals by the surveyed companies, which is to be presented in Table 5.

Table 5.

Summary of the number of accidents for the period 2022-2023 at the surveyed companies in the logistics industry

Company		Number of employment		Difference in Employment Decrease ↓ Increase ↑ [%]	Number of accidents		Difference in accidents rates Decrease ↓ Increase ↑ [%]
		2022	2023	YoY	2022	2023	YoY
1	Company 1	3100	2905	6,29 0 ↓	30	14	53,33 ↓
2	Company 2	1908	1988	4,020 ↑	13	3	76,92 ↓
3	Company 3	350	433	19,17 ↑	4	6	33,33 ↑
4	Company 4	11	24	54,17 ↑	0	0	0,000 -
5	Company 5	3225	3124	3,130 ↓	8	2	75,00 ↓
6	Company 6	1280	1210	5,470 ↓	22	8	63,64 ↓
7	Company 7	2135	2566	16,80 ↓	38	15	60,53 ↓
8	Company 8	1255	1032	17,77 ↑	38	11	71,05 ↓
9	Company 9	550	451	18,00 ↑	4	2	50,00 ↓
10	Company 10	135	260	48,08 ↓	2	2	0,000 -
11	Company 11	768	774	0,780 ↓	6	11	45,45 ↑
12	Company 12	1856	1862	0,320 ↓	14	5	64,29 ↓
13	Company 13	3220	3022	6,150 ↑	45	11	75,56 ↓
14	Company 14	2330	2411	3,360 ↓	15	10	33,33 ↓
15	Company 15	2390	1992	16,65 ↑	42	12	71,43 ↓
16	Company 16	2480	2352	5,160 ↑	5	4	20,00 ↓
17	Company 17	1244	1218	2,090 ↑	21	8	61,90 ↓
18	Company 18	455	470	3,190 ↓	11	4	63,64 ↓
19	Company 19	1658	1722	3,720 ↓	14	14	0,000 ↓
20	Company 20	2599	2254	13,27 ↑	27	12	55,56 ↓
21	Company 21	233	260	10,38 ↓	5	5	0,000 -
22	Company 22	1789	1644	8,110 ↑	24	26	7,690 ↑
23	Company 23	542	551	1,630 ↓	12	7	41,67 ↓
24	Company 24	1754	1840	4,670 ↓	11	9	18,18 ↓
25	Company 25	2122	2062	2,830 ↑	42	12	71,43 ↓
Sum		39 389	38427	2,443 ↓	453	213	52,98 ↓

Source: own work based on collected data from companies in the logistics industry.

Based on Table 5, the relationship between employment rates and accident rates for the period 2022-2023 in the surveyed companies, as shown in Table 6.

Table 6.

Relationship of the employment rate to the number of occupational accidents in the surveyed companies

Lp.	Relationship indicated in evaluation of indicators	Number of companies
1	Decrease in employment rate vs decrease in accidents	10
2	Decrease in employment rate vs increase in number of accidents	2
3	Decrease in employment rate vs number of accidents unchanged	2
4	Increase in employment rate vs number of accidents unchanged	1
5	Increase in employment rate vs decrease in number of accidents	9
6	Increase in employment rate vs increase in number of accidents	1

Source: own work based on collected data from companies in the logistics industry.

Analyzing the rates of all surveyed companies, it was indicated that the number of employment fell from 39,389 (2022) to 38427 (2023), which is 2.443%. Analyzing the accident rate, an analogous trend was presented, showing a decrease from 453 (2022) accidents to 213 (2023), a total of 52.98%.

4. Discussion of the results obtained and conclusions from the analysis of accident rates in the surveyed logistics industry companies and on the basis of statistical data

The analysis of accident rates for companies in the logistics industry was aimed at verifying how the number of accidents develops, whether it presents an upward or downward trend, and what factors affect the change in the above-mentioned rates. The first part of the data analysis consisted of verifying the statistical data that the Central Statistical Office presents in its reports in terms of accident rates and the indicator relating to the total number of deaths in the periods 2020-2023. When analyzing the data in terms of fatal accidents that occurred in the period 2020-2023, they represent between 0.02% and 0.049% of all deaths in Poland, which does not confirm global trends in the area of mortality due to occupational accidents. Thus, it is also concluded that the percentage of fatal accidents is small compared to the figures presented by the Central Statistical Office.

The next steps included analyzing the data collected from the 25 selected logistics industry enterprises, mainly focusing attention on the number of employment and accident rates that were determined for 2022-2023, and then verifying, based on the information collected from company representatives, what measures were taken to affect the rates and their potential decreases/increases.

The companies that were selected for the assessment of accident rates for the period 2022-2023 in the logistics industry are located in 6 provinces, including the most employment, were as follows for the provinces:

- a) Silesia - employment in 2022 amounted to 13264, while in 2023 it was shaped at the level of 13282, which represents 0.14% annual growth;
- b) Lower Silesia - employment in 2022 amounted to 8575, while in 2023 it was at the level of 8271, which represents a decrease of 3.55% per year;
- c) Greater Poland - employment in 2022 amounted to 7940, while in 2023 it was at the level of 7425, a decrease of 6.49% per year.

Analogous to the above, analyzing the accident rate for the surveyed enterprises in the period 2022-2023 by 6 provinces indicated that all metrics experienced decreases in the area of the number of accidents at work. The largest reductions in accidents occurred in enterprises located in the following provinces:

- a) Masovia - in 2022 the number of accidents was 42, while in 2023 it was at the level of 12 incidents, a decrease of 71.43%;
- b) Greater Poland - in 2022 the number of accidents was 102, while in 2023 it was at the level of 33 incidents, a decrease of 67.65%;
- c) Silesia - in 2022 the number of accidents was 153, while in 2023 it was at the level of 59 incidents, a decrease of 61.44%.

Moving smoothly to the discussion of detailed data on the surveyed companies, analyzing the information in Table 5 and Table 6, it was found that for the 10 organizations, the number of occupational accidents decreased with the decrease in employment, accounting for a total of 10 companies. No less, however, 9 companies indicated a significant increase in employment, with a decrease in occupational accidents. Overall, looking at the total number of employment in 2022 was 39 389 which represents a decrease of 2.443% to 2023. The number of accident is on a similar downward trend. In 2022, the number of accidents amounted to 453 which represents a decrease of 52.98% to 2023 in which a total of 213 accidents occurred.

When comparing the year-over-year (YoY) decrease in employment of 2.443%, it is significantly lower than the accident incident rate, which is 52.98%, clearly indicating the unobserved correlation between the decrease in employment in the decrease in accidents. After verification the above data and additional consultation with representatives of the companies included in the study for the period 2022-2023, it was determined what caused such large differences in the minimization of accident events. Namely:

1. After the occurrence of accident events, measures were taken to determine all possible causes of accidents on the basis of extensive analysis, including brainstorming, 5Why analysis and other tools used to obtain the necessary information on causes;
2. A number of corrective actions have been implemented to eliminate similar accidents to those that occurred in 2022;
3. A number of training sessions were conducted with employees, from management to entry level employees. The increase in training was around 25-55% at the surveyed companies;

4. Special internal trainings have been implemented to successively remind employees of rules as well as safety standards. They are held at enterprises on a monthly/quarterly basis. The trainings are conducted by internal instructors, trainers or mentors;
5. There have been a number of campaigns in the area of safety, to which employees have been involved at a level of 15-45% for the surveyed companies;
6. During post-accident processing, companies use external technical experts, as well as support themselves with additional opinions from experts, representatives of medical units to analyze the circumstances very thoroughly and causes of occupational accidents;
7. enterprises place greater emphasis on reporting hazardous and potentially accidental events, which affect the ability to take prompt action and determine the cause of the event. Such actions affect the ability to take action to eliminate the occurrence of an accident at work. The increase in reported hazardous or near miss incidents was between 36-52% among the surveyed enterprises.

5. Summary

Analyzing in detail the data that are collected, processed and then made available by the Central Statistical Office, as well as on the basis of the collected data obtained directly from the surveyed companies in the logistics sector for the specified time frame, the accident rates and the dependencies affecting their occurrence were verified. It is found, based on the data obtained, that the number of accidents at work each year shows a downward trend, which is a good trend if confirmed, that entrepreneurs are striving to achieve their complete elimination. Such measures are aimed at providing a sense of safety, thus giving convenient conditions for the execution of work.

Based on the results, it is noted that there is a minimal trend of decline in employment in the logistics industry of the surveyed enterprises, which decreased by more than 2.4% compared to 2023. On the other hand, the number of accidents decreased significantly, i.e. by 52.98%, and this is not a clear correlation with the decrease in employment. The decrease in the number of accidents is evident in 19 companies out of a total of 25 surveyed, which is influenced by a number of factors that are an indispensable part of the goal of achieving zero accidents at work. The correlation occurs primarily with the increase in reporting and reporting of near-misses (an increase between 36 and 52%), which in turn indicates that it is the actions taken after reporting potential hazards that influence the elimination of the actual occurrence of an accident at work. Thus, it is confirmed that companies in the logistics industry are taking a number of measures and initiatives to influence the pursuit of to achieve the best results, i.e. 0 accidents at work. Thus, there is an opportunity to create the most optimal and safe

conditions for employees for the provision of work, and the spread of a safety culture will influence the continuous improvement of their awareness.

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LOGISTICS CONCEPT REVISITED. THE LOGISTICS PERSPECTIVE OF THE DISTRIBUTION

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Purpose: The aim of the article is to identify the most important characteristics related to the logistics perspective of distribution and the concept of distribution logistics.

Design/methodology/approach: The article presents the nature and the most significant characteristics concerning the distribution and distribution logistics. A literature review and an identification approach were used.

Findings: Within the logistics concept the particular importance is assigned both to the nature and the most important features of distribution as well as to the nature of the distribution logistics and its basic characteristics.

Practical implications: Both distribution and distribution logistics are the important tools for building firm success and its competitive advantage. Distribution and distribution logistics also play a crucial role in firms' and supply chains strategies development, as well as in building and implementing modern business models.

Originality/value: The most important features related to the logistics perspective of distribution and distribution logistics were presented. The article is addressed both to researchers as well as managers and other business practitioners.

Keywords: logistics, logistics concept, distribution, distribution logistics.

Category of the paper: Conceptual paper.

1. Introduction

The role of logistics in widely perceived business as well as business management is constantly growing. Logistics is a significant tool for building the firm success as well as the competitive advantage of a firm. Particular importance is assigned to the concept of logistics, the effective and efficient development and implementation of which is the path to the above-mentioned success and competitive advantage.

In general terms, the logistics concept means a decision-making model that includes: (1) strategic analysis of logistics situations, (2) logistics goals, (3) logistics strategies and (4) logistics tools (Matwiejczuk, 2021a, 2022).

The concept of logistics has had many studies in its classic approach, including such logistics processes as transport, storage, reloading, packaging, marking, labeling and order fulfillment. These processes relate to a very large extent to distribution logistics.

At the same time, in recent years one may notice an increasing importance of the managerial and strategic aspects of the logistics concept (Blaik et al., 2013), related to its perception as a determinant of the business management performance (Blaik, 2015) as well as the formation and development of business models (Matwiejczuk, 2021b) related to distribution and logistics in the area of distribution. It is distribution and distribution logistics that are an important tool in building the firm success and its long-term, sustainable competitive advantage.

The aim of the article is to identify the most important characteristics related to the logistics perspective of distribution and the concept of distribution logistics. The article presents in particular: (1) the nature and the most important characteristics of distribution as well as its place and role in the concept of logistics (2) the nature of the concept of distribution logistics and its basic characteristics.

2. Distribution and its place and role in the concept of logistics

Logistics within the distribution area is the third main sphere (phase) of flows in a manufacturing firm, next to the logistics in the sphere (phase) of procurement and logistics in the sphere (phase) of production. Like the two previous spheres (phases), i.e. procurement logistics as well as production logistics, logistics in the sphere (phase) of distribution is often abbreviated as distribution logistics.

The basis for the development of distribution logistics is primarily distribution, which is – next to the product, price and promotion – one of the basic marketing tools co-creating the so-called marketing-mix composition, abbreviated as “4P” (product, price, place /distribution/, promotion) (Kotler, 1994; Altkorn, 2003).

However, the “4P” composition presents only the perspective (point of view) of the firm, related to the marketing tools developed by a firm, thanks to which the firm is able to actively influence the market and the customers.

From the customer’s perspective (point of view) each of the marketing tools should be developed in a way that ensures specific benefits for the customer. R. Lauterborn proposed the so-called “4C” composition, developed from the customer’s perspective, corresponding to the “4P” composition, developed from the firm perspective. R. Lauterborn’s “4C” composition comprises (Kotler, 1994, pp. 89-91):

- 1) Customer needs and wants.
- 2) Cost to the consumer.
- 3) Convenience.

4) Communication.

Taking into account the place and role of distribution within the logistics concept, it should be noted that distribution is related to the sphere (phase) of goods and information flows in the firm, which is called distribution logistics. Distribution is characterized by both marketing-related characteristics and logistics-related characteristics. A very special (distinctive) feature of distribution is its close relationship with the customer and his needs, wants, preferences and expectations.

In general, distribution includes all decisions and activities related to making manufactured products available to their final buyers (ultimate customers) (Altkorn, 2003; Czubała, Niestrój, Pabian, 2020). According to M. Frankowska and M. Jedliński, the semantic meaning of the term “distribution” comes from two other terms: (1) *distributio*, meaning the division and (2) *distribuere*, meaning the separation or handing out (Frankowska, Jedliński, 2011, p. 11).

B. Piasecki emphasizes that distribution is a set of activities and decisions related to making the product available at a place and time corresponding to the customers needs (Piasecki, 1999, p. 295). In turn, T. Kramer believes that distribution includes all activities related to overcoming the spatial and temporal differences between the production and the consumption (Kramer, 2004, p. 111).

The most important and significant aim of distribution is to provide (create) customers with the opportunity to purchase the products they want in accordance with the “7R” logistics principle which comprises: (Blaik, 2017, p. 281) (1) right product, (2) right information, (3) right quantity, (4) right quality, (5) right time, (6) right place, and (7) right cost.

The above components concern broadly and comprehensively understood logistics as a concept of the flow management of materials, goods and information within the firm as well as the entire supply chain. They are particularly related to the area of distribution due to its proximity to the customer and his needs, wants, preferences and expectations.

Taking into account the firms efforts to meet the needs and wants of customers by offering and delivering products that meet their expectations, A. Czubała points out the following among the most important functions of distribution (Altkorn, 2003; Przybyłowski et al., 1998; Rutkowski, 2000; Stern, El-Ansary, Coughlan, 2002):

- 1) Pre-transaction functions, including in particular: collecting and transmitting the market information needed to plan and organize the sale of products as well as the promotional information about the offer and the benefits it provides to potential customers, searching for and submitting purchase and sale offers, establishing business contacts, negotiating transaction terms, etc.;

- 2) Transactional functions, including in particular concluding purchase and sale agreements creating legal basis for the transfer of the ownership rights to moved products; the aim of these functions is to coordinate the supply of the products with the demand for these products by securing the necessary capacity of distribution channels;
- 3) Logistics functions, including in particular: order processing, transport, warehousing and inventory management, commercial processing, transformation of the production assortment into commercial assortment, as well as the transfer of the products to intermediaries and ultimate customers, enabling the physical flow of products from the manufacturer to the ultimate customers, referred to as the physical distribution; the aim of these functions is to ensure the level of service expected by the customer with minimizing the costs of this service;
- 4) Post-transaction functions, including in particular: the implementation of customers' rights related to the warranty and guarantee granted for purchased products, providing customers with differential additional services (e.g. installation, repair, delivery, etc.), examining the level of customer satisfaction with purchases made and products used, expected service forms and standards, causes of customer loss, etc.; the purpose of these functions is to form and sustain the relationships with customers, as well as to build and strengthen their loyalty to the firm and its offer.

In defining the place and role of distribution in logistics, logistics functions are of the key importance, thanks to which it is possible to effectively and efficiently implement logistics processes and activities, allowing both to offer the level of service required by customers and to rationalize (minimize) incurred costs. These processes and activities are related to the "material side" of distribution, i.e. the physical distribution.

At the same time the processes and activities related to the flow of goods, i.e. the above-mentioned physical distribution, require the appropriate structures allowing for their planning and implementation. Distribution channels are the such structures.

Taking the above into consideration, one may say that distribution is a marketing tool playing a very important role in the process of forming and developing the logistics concept in the area of distribution. Distribution perceived in such a way covers two main areas of decisions and actions regarding:

- 1) Distribution channels related to the concept of marketing and its tools (marketing-mix).
- 2) Physical distribution of goods, related to the concept of logistics and its tools (logistics-mix), in particular to the distribution logistics and its tools comprising customer service, merchandising, and demand forecasting.

The distribution channel, also referred to as the market channel or marketing channel, is created by a group (chain) of firms participating in the process of providing and making available a product or service to customers. Business practice proves that there are a number of types of distribution channels performing many, often very diverse, functions. The classification of distribution channels presents table 1.

Table 1.*Classification of distribution channels*

Criteria of classification	Types of channels
1. Type of participants	1. Direct 2. Indirect
2. Number of intermediate levels	1. Short 2. Long
3. Number of intermediaries at the same level	1. Narrow 2. Wide
4. Type of flowing streams	1. Transactional 2. Material
5. Scope of cooperation between channel participants	1. Conventional 2. Vertically integrated 2.1. Integrated along the entire length 2.2. Partially integrated in some sections
6. Method of coordination of the channel participants activities	1. Administered 2. Contractual 3. Corporate
7. Title of property to intermediaries participating in the channel	1. Own 2. Partially own 3. Alien

Source: Altkorn, 2003, p. 200.

The subject of flows within the distribution channels are specific market streams. These streams include primarily (Altkorn, 2003, pp. 198-199): (1) market information, (2) promotional information, (3) purchase and sale transactions negotiations, (4) fulfilling the customers orders, (5) logistics processes concerning the storage and delivery of products, (6) payment processing, (7) acquiring and transferring the ownership of products and (8) risks related to products, inventories and sales (table 2).

Table 2.*Basic market streams flowing in the distribution channel*

Market streams	Examples of flows in the distribution channel
1. Market information	Collecting, processing and transmitting information regarding potential customers, competitors, as well as the price elasticity of demand for the offered products and services
2. Promotional information	Providing information about the offered products, encouraging customers to make a purchase
3. Negotiations	Identification of potential customers, agreeing on the terms of purchase and sale transactions regarding concluded contracts and transfers of titles to products
4. Orders fulfillment	Providing information about customers' intentions to purchase specific products
5. Products	Shipping, transport, physical distribution, warehousing, sorting, picking
6. Payments	Payment of receivables by banks on behalf of customers, financing of inventories
7. Ownership	Transfer of ownership or the right to use a product between channel participants
8. Risk	Taking over the risk related to the financing of inventories, the sale of products moved through the distribution channel and the collection of receivables

Source: Based on: Altkorn, 2003, pp. 198-199; Pisz, Sęk, Zielecki, 2013, pp. 146-148; Stern, El-Ansary, Coughlan, 2002, pp. 24-28.

In flow management within the distribution area the division into direct and indirect distribution channels is of key importance. It is primarily related to decision-making (managerial) processes that determine the place and role of intermediaries in distribution channels. These decisions significantly influence the form and shape of the logistics concept in the area of distribution, in particular the number of market intermediaries and tasks performed by them.

Distribution channels play a crucial role both in the process of moving goods from production to customers as well as in transmitting appropriate information accompanying the flow of goods. The goods and information flows between the area of production and the area of consumption create a distribution system. This system occupies an important place in the overall concept of logistics within business management and the entire supply chain management. Apart from distribution channels, an important part of the distribution system is distribution logistics.

3. The concept of distribution logistics and its basic characteristics

Distribution logistics, which should be more precisely called “logistics within the area of distribution”, is the third phase of flows, located in a manufacturing firm after procurement logistics (logistics within the area of procurement/supply) and production logistics (logistics within the area of production).

The concept of distribution logistics comprises decisions as well as processes and activities related to the flow management of goods moved from the area of production (manufacturing) to the area of consumption, i.e. to the ultimate customers (end buyers/users).

The set of distribution channels for products offered by the manufacturer and the relations between the participants of these channels, carrying out specific logistic activities, create the manufacturer's distribution system (Altkorn, 2003). Thus, the structure of the distribution system consists of: (1) distribution channels, and (2) logistics processes and activities related to distribution logistics (Figure 1).

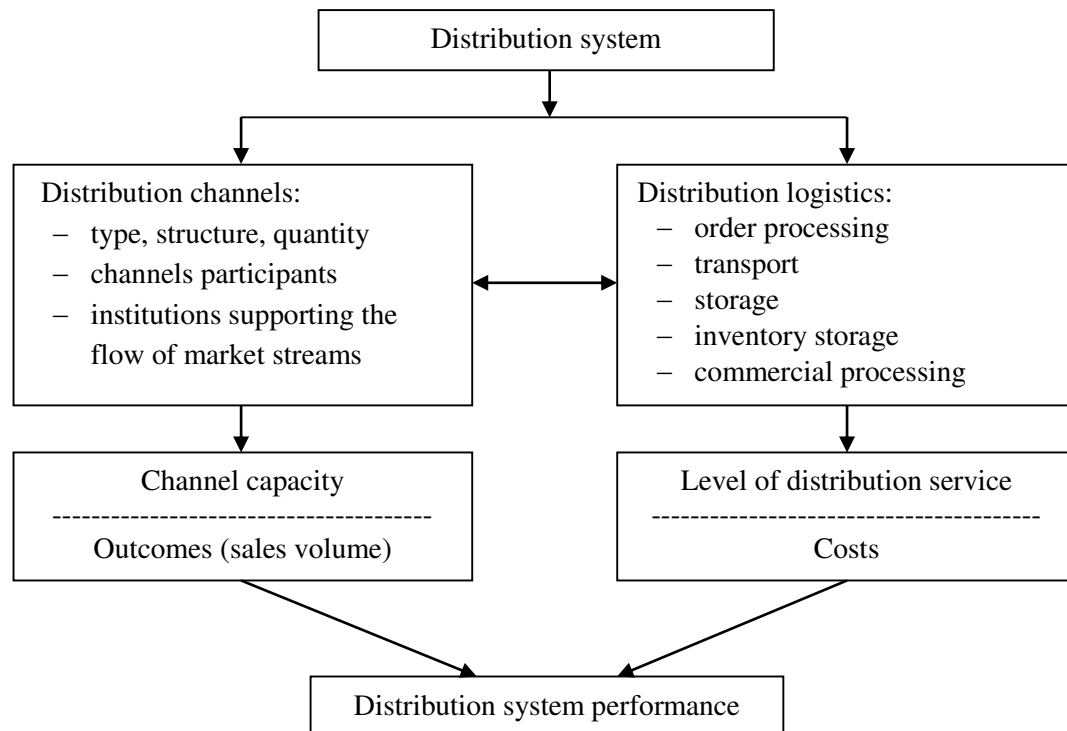


Figure 1. The structure of the distribution system.

Source: Altkorn, 2003, p. 196.

As A. Czubała points out, the institutional structure of the distribution system is created by entities participating in the sale of specific products, their type (e.g. manufacturer, wholesalers, retailers), quantity, order of occurrence, and relationships between them. In turn, the functional structure of the distribution system is determined by the type and scope of logistics activities necessary for the physical flow of products to the places of purchase by the ultimate customers (end/final buyers) and their division among the channel participants (Altkorn, 2003).

In the process of the distribution system forming and development one may identify a number of factors that influence the choice of the distribution system. As M. Frankowska and M. Jedliński point out, in general terms the above-mentioned factors can be divided into two groups (Frankowska, Jedliński, 2011, p. 27):

- 1) Endogenous (internal) factors related to the firm capabilities, including its human, material and financial resources, as well as the firm capabilities to build the relationships with customers and the features of the product itself,
- 2) Exogenous (external) factors influencing the distribution system by forming and shaping customers' possibilities and expectations, competitors' behavior, or elements (characteristics) of the macroeconomic environment.

More detailed factors influencing the choice of distribution system comprise the following (Frankowska, Jedliński, 2011):

- 1) Features of the target market where the firm intends to place its products,
- 2) Features of the product that the firm intends to sell,

- 3) Features of the firm influencing its situation within the market,
- 4) Factors concerning the competition,
- 5) Factors resulting from the current distribution structure and expected trends in its development.

The key process in offering products to customers is the physical distribution. It is related to the real, i.e. physical movement of products from the production area to the final buyer (ultimate customer) area. Physical distribution requires the implementation of a number of real logistics processes and activities related to the material side of distribution, including: (1) transport, (2) warehousing, (3) storage and inventory management, (4) packaging and labeling (5) commercial processing, and (6) order processing.

As A. Czubala points out, the following solutions can be distinguished within the organization of physical distribution (Altkorn, 2003):

- 1) The manufacturer himself is responsible for placing manufactured products on the market and organizing his own sales network,
- 2) Logistics activities are performed by commercial intermediaries (wholesalers, retailers) creating a given distribution channel,
- 3) The manufacturer or trade intermediaries outsource all or part of the logistics activities (transport, forwarding, warehousing) to specialized logistics firms.

Taking into account the varying degrees of distribution intensity, three basic distribution strategies, also known as distribution methods, can be distinguished (Altkorn, 2003; Frankowska, Jedliński, 2011; Rutkowski, 2000):

- 1) Intensive distribution,
- 2) Selective distribution,
- 3) Exclusive distribution.

The first distribution strategy, i.e. intensive distribution, consists in offering products at all possible and available sales points (places) to customers at a specific level of the distribution channel, as well as within the boundaries of a spatially separated market. This type of distribution requires the development of long and wide distribution channels that enable advanced penetration of the serviced market. Intensive distribution is used primarily in the market of frequently purchased consumer products and services, whose buyers require wide availability of products, as well as the shortest possible time necessary to make a purchase.

In turn, the second distribution strategy, i.e. selective distribution, involves offering products on a specific territorial market area by a limited number of commercial intermediaries who are selected according to pre-defined criteria and obliged to carry out specific commercial and promotional activities. As a consequence, the distribution channels typical for this strategy are often significantly narrower than in the case of intensive distribution.

Selective distribution is used primarily within the markets concerning the so-called “electable” products and services. Customers purchasing such products and services base their purchasing decisions on detailed information about the purchased goods and services, while at

the same time devoting themselves to thorough assessments of the offered product assortment. Selective distribution allows producers to focus their activities on cooperation with selected intermediaries, and also ensures fuller market control as well as helps in distribution costs reduction.

Finally, the third distribution strategy, i.e. exclusive distribution, assumes offering products through one or – at most – several intermediaries operating at a specific level of the distribution channel and within the boundaries of a spatially separated market. The “extreme” form of exclusive distribution, associated with the use of the narrowest distribution channels, is “sole” distribution. It consists in the exclusivity of a selected commercial intermediary in the sale of products of a given manufacturer, with a simultaneous ban on the sale of products of other competitive manufacturers.

Exclusive distribution is used primarily in the markets for luxury, unique, episodic purchase and specialized goods and services. The above-mentioned types of products often have no substitutes in the minds of customers. At the same time, the customers themselves are willing to devote significant amounts of time for purchasing these products. As a consequence, exclusive distribution provides producers with extensive control over the sales processes of the offered products, their prices and the level of services offered. This distribution strategy can also support effective brand creation and promotion, and contribute to achieving a number of benefits for intermediaries, including relative certainty of supply sources, restrictions of competition, or support for the sale of products and services by producers.

4. Conclusion

The significance of logistics in business management has been growing for many years. Logistics as a strategic tool for building the firm success as well as its competitive advantage plays an increasingly important role in firms. In building firm success and creating firm competitive advantage, the concept of logistics as well as the concepts of distribution and distribution logistics are of particular importance.

The article presents the most important features related to the logistics perspective of distribution and to the distribution logistics. The particular significance was assigned both to the nature and the most important features of distribution as well as its place and role in the concept of logistics, and also to the nature of the concept of distribution logistics and its basic characteristics. Distribution and distribution logistics are not only the important tools for building firm success and its competitive advantage, but also play a crucial role in the development of firms' and supply chains strategies, as well as in building and implementing modern business models.

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THE IMPACT OF FINANCIAL CONDITIONS ON THE SUSTAINABLE DEVELOPMENT OF TRANSPORT ENTERPRISES IN POLAND – FROM THE FINANCIAL CRISIS TO THE COVID-19 PANDEMIC

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Purpose: The paper primarily aims to assess financial conditions' impact on the sustainable development of transport enterprises in Poland from 2008 to 2020.

Design/methodology/approach: The research's novelty is to create the sustainable development indicators and its three pillars, economic, social and environmental and assess the impact of the chosen financial areas on its levels. I use the Ordinary Least Square, and the Seemingly Unrelated Regression methods to verify the central research hypothesis.

Findings: The analysis results indicate that in Poland, there is a positive trend in the sustainable development of transport enterprises. What is more, its high rates also remain at the time of the outbreak of the Covid-19 pandemic. Moreover, financial situation indicators significantly impact sustainable development (profitability on sales and debt level) and its pillars (here, the level of impact of individual areas on the pillars of sustainable development varies); therefore, managers of enterprises must make rational decisions in this respect.

Research limitations/implications: The availability of data, the choice of normalization method and the choice of research sample.

Practical implications: The empirical implications include that the results of the analyses can support the managers of enterprises in making operational and strategic decisions.

Social implications: The social development of the logistics sector is visible, and it is necessary to take further actions to improve working conditions and quality.

Originality/value: The study's novelty is to show how the sustainable development of transport companies and their pillars behaved in Poland from the financial crisis to the Covid-19 pandemic.

Keywords: sustainable development, transport enterprises, financial conditions.

Category of the paper: Research paper.

1. Introduction

The sustainable development of enterprises is crucial for building sustainable economic growth, considering social issues and environmental protection (Pieloch-Babiarz et al., 2021; Comporek et al., 2022). It means running a business that cares for the present and future generations. In economic practice, implementing sustainable development goals refers to taking active measures in three pillars: economic, social and environmental (Gryga, 2016; Oželienė, 2017). Thus, in addition to maximizing profit, entrepreneurs should actively support the development of the company's human capital, care for the development of local communities and reduce the negative impact on the natural environment (Costa, 2022; Marrucci, 2022).

Sustainable development of enterprises supports the country's stable development; its level, dynamics and conditions depend on the sector of the economy in which they occur. One of the key sectors for creating favourable conditions for the country's economic growth is transport (Buonocore et al., 2019). Its role results from the fact that these enterprises generate national income and play a subordinate role towards other sectors of the economy. Moreover, the transport sector is one of the biggest polluters of the environment due to high harmful emissions (Omahne et al., 2021; Taghvaei et al., 2022).

Sustainability is the subject of several scientific studies. Researchers emphasize that this development is important for the country's development, but there is no consensus on how to measure the level of its sustainable development (Giles-Corti et al., 2020), and there is no agreement as to which factors, external or internal, are the most important for socially and ecologically responsible investments (Penfield, 2007; Zuzek, Mickiewicz, 2014; Matinaro et al., 2019; Sun et al., 2023).

The study's novelty is to show how the sustainable development of transport companies and their pillars behaved in Poland from the financial crisis to the Covid-19 pandemic. In addition, the impact of selected areas of the financial and property situation assessment on its level was assessed. For this purpose, the following research hypothesis was formulated, "Profitability and debt level are of key importance for the sustainable development of transport companies in Poland from 2008 to 2020", and the Pearson's correlation coefficient, the Ordinary Least Square Method (OLS) estimation and Seemingly Unrelated Regression (SUR) were used to verify it.

Despite the research limitations related to the selection of diagnostic variables, the normalization method or econometric methods, the study is important and can support the managers of economic entities in making operational and strategic decisions.

The manuscript includes an introduction, theoretical background, research methodology, results, discussion and conclusions. The paper uses Polish and foreign literature on the subject, collected based on the Web of Science and Scopus databases and statistical data from the Eurostat database.

2. Sustainable development of enterprises and its financial conditions – theoreticall background

Socio-economic changes and increased awareness among society meant that companies wanting to meet the increase in competitiveness and maintain or strengthen their competitive position on the market must take socially and ecologically responsible actions (Koźmiński et al., 2020; Pieloch-Babiarz et al., 2021). The concept of sustainable development must be implemented by states, international organizations, communities and enterprises to bring measurable effects. Especially the role of the latter is fundamental because the rapid development of industry and globalization have led to the degradation of the natural environment (Amin et al., 2021; Nodehi, Taghvaei, 2022).

Sustainable development of enterprises is often identified with ecological development, corporate social responsibility (CSR), or the environment, social responsibility and corporate governance (ESG) (Yun, Lee, 2022; Park et al., 2023). This term is variously defined in the literature on the subject (Poskrobko, 1997; Mazur-Wierzbicka, 2005; Marrucci et al., 2022).

Researchers who equate sustainable development with ecological development emphasize the importance of eco-innovations, activities to protect the natural environment, saving electricity, and introducing environmentally friendly technologies or electric vehicles (Bonzanini Bossle et al., 2016; Pichlak, Szromek, 2021). Other scientists emphasize the issues of responsibility towards society, including towards employees, and point to the role of training and education for sustainable development (Padilla-Rivera et al., 2020; Sagan, 2021). Many researchers emphasize that the sustainable development of enterprises is related to responsibility towards stakeholders, in other words, activities supporting the development of local communities or nature conservation, raising the competitive position, strengthening stakeholders, and favoring the interest of new shareholders (Bower, Paine, 2017; Bose, 2020; Krasodomska et al., 2022).

An overview of selected definitions of sustainable development of enterprises is presented in Table 1.

Table 1.
Selected definitions of sustainable development of enterprise

Author	Definitions of sustainable development of enterprises
B. Poskrobko (1997)	New ways of organizing and managing business units, manifested by replacing technology that is burdensome for the environment with technological devices that are environmentally friendly and ensure safety and people's comfort. Implementing sustainable development at the level enterprise is done through greening management.
T. Dyllick, K. Hockerts (2002)	Meeting the needs of a firm's direct and indirect stakeholders (...) without compromising its ability to meet the needs of future stakeholders as well
E. Mazur-Wierzbicka (2005)	Sustainable development is expressed by three key areas: "ecological (preserving the environment and its natural resources), economic (economic development stimulated by technological progress and increasing the efficiency of the use of raw materials, and human work) and social (improvement of living conditions and safety for all people)"

Cont. table 1.

B. Colbert, E. Kurucz (2007)	Keep the business going
P. Penfield (2007)	Sustainable development is now about thinking in terms of life cycle costs, parts of equipment or a single process, as well as activities
M. Drljača (2012)	A process in which less and fewer resources are being spent to meet the needs of consumers and in which the environment is less polluted
D.K. Zuzek, B. Mickiewicz (2014)	All activities undertaken by the company and minimizing the negative impact on the natural environment can be considered as a manifestation of implementation sustainable development concept. In this way, companies contribute to maintaining the right amount and quality of natural capital, which is the basis for meeting the needs of current and future generations and adapting the scale of the economy to the ecosystems on which it operates
A. Panasiewicz (2015)	A sustainable company, in accordance with the concept of sustainable development, can maximize its profit and at the same time reduce its negative impact on the environment.
E. Lorek (2015)	Sustainable development requires the introduction of an organization management system that allows monitoring and adapting to the conditions external
K. Gryga (2016)	The basis for building a sustainable and sustainable enterprise is sustainable production and consumption. Attention is paid to the modernization of production, leading to the optimization of processes, reduction of energy and materials, as well as for an effective dialogue between entrepreneurs and state authorities
D. Oželiene (2017)	A holistic approach of thinking of business which seeks to integrate consideration of the three aspects of sustainability—social, environmental and economic
A.A.A. Sharabati (2018)	The continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as the local community and society at large
P. Centobelli (2020)	Sustainable development that encompasses different types of focus, ranging from resource efficiency to the circularity of product usage and disposal
A.J. Costa (2022)	The concept of sustainable development should apply to the external environment of the organization, in other words to a certain region [country, state] in a certain period of time.
L. Marrucci et al. (2022)	Sustainable development considers three dimensions: economic, environmental, and social. Therefore, most of the operations in manufacturing companies in the sustainable area face challenges with the mentioned three
H. Sun et al. (2023)	Sustainable development capability is also a part of enterprise values and business methods.

Source: own elaboration based on literature on the subject.

Sustainable development of the enterprise means quantitative and qualitative changes taking place in three dimensions: economic, social and environmental. It means a process of changes related to the production system, thinking about running a business, and implementing technologies and environmentally friendly solutions.

One of the sectors that are important for the country's stable and sustainable economic development, taking place in line with social progress and nature protection, are transport companies, whose role in modern economies is extremely important; this is because this sector not only generates high shares in the gross domestic product but also supports the development of other sectors in the economy (Pereira et al., 2017; Comporek et al., 2022; Chen et al., 2023). Due to the changing regulations in environmental protection and increasingly higher environmental protection standards, the transport and storage section has implemented several improvements to support reducing emissions of toxic substances into the atmosphere (Kucharčíková, Mičiak, 2018; Xie, 2022; Remyha et al., 2023).

The literature on the subject emphasizes that the sustainable development of transport enterprises has a slight positive trend, while its level depends on several factors related to legal regulations and macroeconomic and geopolitical conditions of countries, as well as the situation inside the sector (Comporek et al., 2021; Richnák, Fidlerová, 2022).

Researchers emphasize that the financial and property situation and financial security are important for socially and ecologically responsible investments (Sachs et al., 2019; Misztal, 2021). However, there is no consensus on which areas of the ratio analysis of the assessment of the financial and property situation are crucial, and what is more, it has not been fully examined whether external or internal factors are more important for the sustainable development of transport enterprises.

Financial liquidity is important for sustainable development as it allows for the settlement of the company's current liabilities towards contractors, employees and payments to the Social Insurance Institution and the Tax Office. On the other hand, it enables the company to make new investments, thanks to which it can develop further. The criterion of financial liquidity also allows assessment of the company's financial condition, and banks often consider it during credit granting. Profitability reflects the effectiveness of the capital held by the entrepreneur and the efficiency of asset management. High values of profitability ratios create an opportunity for the company's development and increase in its value in the future (Bobinait, 2015; Wang et al., 2017; Sadiq et al., 2022). Efficient operation and proper debt management are important for the company's perception by investors and for creating the right conditions for making new social and environmental investments.

3. Research methodology

The study's main aim is to assess the impact of the financial and property situation on the sustainable development of Polish transport enterprises from 2008-2020. The transport sector was analyzed due to its large role in economic development, high emission intensity, and at the same time, new legal regulations in the field of environmental protection, which had to be introduced into business practice.

The research period covers the period from 2008 to 2020, i.e. the time from the financial crisis to the Covid-19 pandemic, which will allow noticing the situation of sustainable development and its three pillars of economic, social and environmental transport enterprises. The data for the analysis were taken from the Eurostat database, and they are annual data; the availability of economic, social and environmental data conditions their collection.

To verify the research goal it is used the Ordinary Least Square Method (OLS) and the Seemingly Unrelated Regression (SUR) methods to verify the central research hypothesis, which is as follows "Profitability and debt level are essential for the sustainable development

of transport companies in Poland from 2008 to 2020". Such a hypothesis results from the assumption that profitability and a low level of debt are conducive to new investments supporting the multiplication of profits in the future.

Moreover, the following sub-hypotheses were formulated:

- The dynamics of the economic development of transport enterprises is higher than the social and environmental development in Poland in the years 2008-2020;
- The Covid-19 pandemic did not significantly affect the level of sustainable development indicators and the economic, social and environmental pillars in 2020;
- There is a strong diversification as to the impact of financial areas on economic, social and environmental pillars of sustainable development of transport enterprises.

The study was conducted in the following stages:

- Stage 1: Creation of synthetic indicators of economic, social and environmental development, and based on them, the indicator of sustainable development of transport enterprises. These indicators are based on the following diagnostic variables:
 - economic development (E), based on stimulants: Enterprises - number Turnover or gross premiums were written - million euros Production value - million euros Gross operating surplus - million euros Total purchases of goods and services - million euros;
 - social development (S), based on stimulants: Wages and Salaries - million euro Social security costs - million euro Gross investment in tangible goods - million euro Employees - number Apparent labour productivity (Gross value added per person employed) - thousand euro Investment per person employed - thousands of euros and destimulants: Personnel costs - one million euros;
 - environmental development (Env): destimulants: greenhouse gas emissions.

Normalization of diagnostic variables was based on the following formulas:

- for the stimulants:

$$z_{ij} = \frac{x_{ij}}{\max_i \{x_{ij}\}}, z_{ij} \in [0; 1]; \quad (1)$$

- for the destimulants:

$$z_{ij} = \frac{\min_i \{x_{ij}\}}{x_{ij}}, z_{ij} \in [0; 1] \quad (2)$$

where:

z_{ij} stands for the normalized value of the j -th variable in the i -th year;

x_{ij} is the value of the j -th variable in the i -th year;

$\min_i \{x_{ij}\}$ is the lowest value of the j -th variable in the i -th year;

$\max_i \{x_{ij}\}$ is the highest value of the j -th variable in the i -th year.

To calculate the indicator of SD, E, S, and Env I assume the same impact of different indices on the aggregate measure and use the following formula:

$$SI_i = \frac{1}{n} \sum_{j=1}^n z_{ij}, \quad (i = 1, 2, \dots, n) \quad (3)$$

where:

SI_i stands for the indicator in the i -year;

n is the number of metrics; others as above.

- Stage 2: I created a model for assessing the impact of financial areas on the sustainable development of transport enterprises:

$$SD_i = \beta_0 + \beta_1 \cdot CR_i + \beta_2 \cdot QR_i + \beta_3 \cdot ROS_i + \beta_4 \cdot ROA_i + \beta_5 \cdot ROE_i + \beta_6 \cdot IS_i + \beta_7 \cdot RR_i + \beta_8 \cdot DR_i + \varepsilon_i \quad (4)$$

where:

CR - current ratio,

QR - quick ratio,

ROS - return on sales,

ROA - return on assets,

ROE - return on equity,

IS - Inventory/stock turnover ratio (in days)/Inventories cycle,

RR - Receivables turnover ratio (in days)/Receivables cycle,

DR - debt ratio.

- Stage 3: A model of interdependent equations was created, which I estimated using the Seemingly Unrelated Regression (SUR) method, based on the formula:

$$\begin{cases} E = \beta_0 + \beta_1 \cdot CR_i + \beta_2 \cdot QR_i + \beta_3 \cdot ROS_i + \beta_4 \cdot ROA_i + \beta_5 \cdot ROE_i + \beta_6 \cdot IS_i + \beta_7 \cdot RR_i + \beta_8 \cdot DR_i \\ \quad + \beta_9 \cdot Si + \beta_{10} \cdot Envi + \varepsilon_i \\ S = \beta_0 + \beta_1 \cdot CR_i + \beta_2 \cdot QR_i + \beta_3 \cdot ROS_i + \beta_4 \cdot ROA_i + \beta_5 \cdot ROE_i + \beta_6 \cdot IS_i + \beta_7 \cdot RR_i + \beta_8 \cdot DR_i \\ \quad + \beta_9 \cdot Ei + \beta_{10} \cdot Envi + \varepsilon_i \\ Env = \beta_0 + \beta_1 \cdot CR_i + \beta_2 \cdot QR_i + \beta_3 \cdot ROS_i + \beta_4 \cdot ROA_i + \beta_5 \cdot ROE_i + \beta_6 \cdot IS_i + \beta_7 \cdot RR_i + \beta_8 \cdot DR_i \\ \quad + \beta_9 \cdot Ei + \beta_{10} \cdot Si + \varepsilon_i \end{cases} \quad (5)$$

The formula for the SUR estimator is as follows:

$$\sqrt{R} \cdot (\hat{\beta} - \beta) \xrightarrow{d} N(0, (\frac{1}{R} \cdot X^T \cdot (\sum -1 \otimes I_R) \cdot X)^{-1}) \quad (6)$$

where:

R - the number of observations,

Ω - covariance matrix,

X - equations,

I_R - the R -dimensional identity matrix;

\otimes - denotes the matrix Kronecker product;

$\hat{\Sigma}$ - the matrix,

y - vector.

4. Research results

Figure 1 shows the number of registered enterprises in the section Transport and Storage (H) in Poland from 2008 to 2020. The number of enterprises increases from 148,756 to 170,508 thous. In particular years, there are slight fluctuations in the number of registered business entities, and it should be noted that in 2020 it slightly decreased compared to 2019, which may be the result of the beginning of the Covid-19 pandemic and the related restrictions.

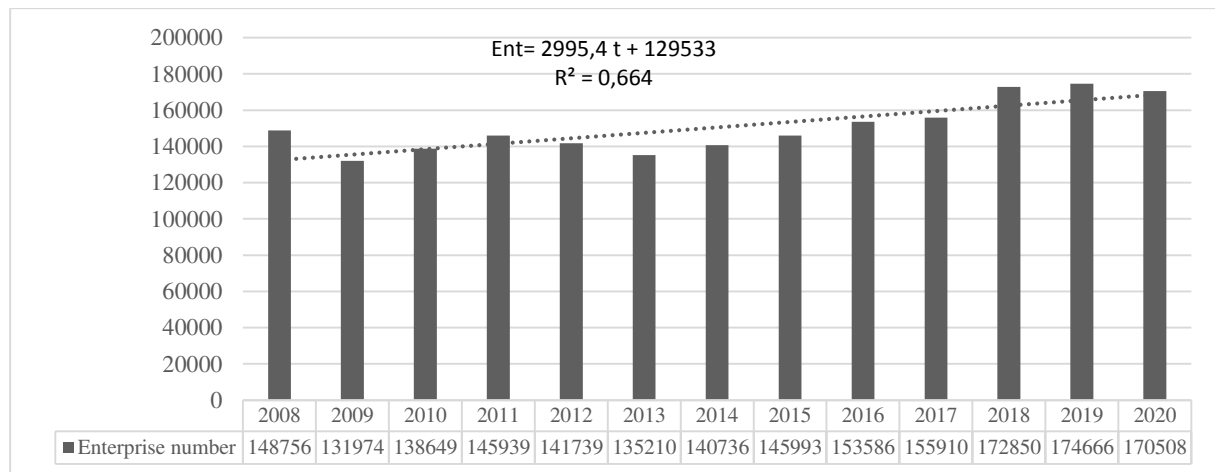


Figure 1. The number of transport enterprises in Poland from 2008 to 2020.

Source: own elaboration based on Eurostat database.

Table 2 presents indicators of sustainable development and its economic, social and environmental pillars of transport enterprises in Poland from 2008 to 2020. The results indicate that all indicators show a positive trend, with the lowest level among the indicators at the beginning of the period for the environmental development indicator.

Table 2.

Sustainable development and its pillars in transport sector in Poland (2008-2020)

Indic.	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
E	0,64	0,53	0,59	0,64	0,64	0,65	0,69	0,72	0,76	0,82	0,97	0,99	0,98
S	0,68	0,60	0,64	0,70	0,70	0,71	0,76	0,80	0,69	0,75	0,88	0,90	0,92
Env	0,60	0,59	0,56	0,55	0,55	0,58	0,56	0,54	0,47	0,42	0,41	0,92	1,00
SD	0,64	0,57	0,59	0,63	0,63	0,65	0,67	0,68	0,64	0,66	0,75	0,94	0,97

Source: own elaboration based on Eurostat database.

Descriptive statistics for synthetic indicators indicate that the highest maximum value occurs in the case of the environmental development indicator in 2020 (1.00), which may be because part of the business was closed, which reduced the emission of harmful substances. The highest median level was 0.71 for the social indicator and the lowest for the environmental development indicator (0.56). The highest dynamics of development in the analyzed period occur in the economic development indicator and the lowest in the case of the environmental development indicator, which indicates that the managers of enterprises still put the greatest emphasis on economic results.

Table 3.*Descriptive statistics for SD, E, S and Env indicators (2008-2020)*

Indicator	Max	Min	Mean	Mediana	Std. Dev.	Trend line
E	0,99	0,53	0,74	0,69	0,15	$E = 0,037 t + 0,481$, $R^2 = 0,86$
S	0,92	0,60	0,75	0,71	0,10	$S = 0,0232 t + 0,5861$, $R^2 = 0,79$
Env	1,00	0,41	0,60	0,56	0,17	$Env = 0,0159 t + 0,4844$, $R^2 = 0,13$
SD	0,97	0,57	0,69	0,65	0,12	$SD = 0,0253 t + 0,5172$, $R^2 = 0,6413$

Source: own elaboration based on Eurostat database.

Table 4 presents the results of assessing the financial situation of enterprises in selected areas of the financial and property situation. In the analyzed period, financial liquidity increases, which may indicate a gradual recovery from the crisis; moreover, in 2020, enterprises have sufficient capacity to repay their liabilities on an ongoing basis. Section H enterprises need help with equity, assets and sales profitability. As indicated by the debt ratio (DR), the increase in the sector's debt is a worrying phenomenon.

Table 4.*Indicators of the financial situation of transport enterprises in Poland in 2008-2020*

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CR	1,31	1,24	1,30	1,33	1,31	1,39	1,42	1,52	1,62	1,52	1,51	1,48	1,58
QR	1,17	1,11	1,17	1,21	1,20	1,29	1,31	1,41	1,49	1,39	1,38	1,35	1,45
ROS	0,01	0,02	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,04	0,02
ROA	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,03	0,03	0,03	0,01
ROE	0,01	0,03	0,05	0,06	0,05	0,06	0,06	0,07	0,09	0,08	0,08	0,09	0,04
IS	8,31	8,41	7,20	6,60	6,11	6,02	6,36	6,06	8,23	7,94	7,64	7,55	7,71
RR	56,65	59,32	56,63	57,91	56,72	59,23	60,02	63,33	63,31	63,97	65,61	63,52	64,87
DR	0,55	0,55	0,55	0,57	0,59	0,60	0,63	0,64	0,66	0,66	0,66	0,67	0,68

Source: own elaboration based on Eurostat database.

Descriptive statistics for individual areas of the assessment of the financial situation are presented in Table 5. The median of the current liquidity ratio is 1.42, slightly below the assumed values (1.5-2). The median return on sales is 3%, return on assets (2%) and equity (6%). The median of the total debt ratio is 63%.

Table 5.*Descriptive statistic of indicators of the financial situation of transport enterprises in Poland in 2008-2020*

Indicator	Max	Min	Mean	Mediana	Std. Dev.
BP	1,62	1,24	1,43	1,42	0,11666
BPS	1,49	1,11	1,30	1,31	0,116299
ROS	0,04	0,01	0,03	0,03	0,010042
ROA	0,03	0,01	0,02	0,02	0,007074
ROE	0,09	0,01	0,06	0,06	0,022359
Rotza	8,41	6,02	7,24	7,55	0,868428
Rotna	65,61	56,63	60,85	60,02	3,21877
Zad	0,68	0,55	0,62	0,63	0,046981

Source: own elaboration based on Eurostat database.

The estimation results show that the sustainable development of transport enterprises is negatively influenced by the profitability of sales and the level of debt (Table 6). It should be emphasized that the estimation of the OLS maintained all the conditions necessary to apply this

method. It is checked the assumption of the method, including unit root tests (KPSS tests), homoscedasticity (the White test), autocorrelation (the Durbin-Watson and Breusch-Godfrey tests), normality (the Doornik-Hansen test), and collinearity (Variance inflation factor). The negative sign in front of the variable return on sales may result from its low level and the fact that companies striving to increase the return on sales forget about the business's social and ecological responsibility. In turn, the positive impact of debt indicates that loans taken out by enterprises positively impact the sustainable development of the sector.

Table 6.

The OLS estimation: Dependent variable = SD

	Coefficient	Std.dev.	t-Student	p-value	R2
Const	-0,854390	0,321403	-2,658	0,0240	0,7
ROS	-6,96800	2,82254	-2,469	0,0332	
Z	2,84197	0,603334	4,710	0,0008	
White Test: LM = 7,46368 with p = P(Chi-kwadrat(5) > 7,46368) = 0,188376					
Test for normality of residual distribution: Chi-kwadrat(2) = 2,93442 with p = 0,230568					
LM test: LMF = 2,23157 with p = P(F(1, 9) > 2,23157) = 0,169423					

Source: own elaboration based on Eurostat database.

The results of the SUR estimation indicate a significant degree of diversification of the impact of individual areas of the assessment of transport enterprises' financial and property situation on the pillars of sustainable development (Table 7). The greatest ratios affecting economic development are profitability of sales (negative impact), profitability of assets, inventory turnover and debt level. Social development is affected by return on sales (negative impact), return on assets and level of debt. In turn, environmental development depends on the level of social development.

Table 7.

The SUR estimation: Dependent variable= E, S, Env

		Coefficient	Std.dev.	t-Student	p-value	R2
E	const	-1,50915	0,215835	-6,992	0,0002	0,99
	ROS	-19,8418	5,60112	-3,542	0,0094	
	ROA	27,1373	6,69777	4,052	0,0049	
	Rotza	0,0605887	0,00600856	10,08	2,02e-05	
	Zad	1,56763	0,466252	3,362	0,0120	
	S	1,08884	0,113238	9,616	2,77e-05	
S	Const	-1,33523	0,298500	-4,473	0,0015	0,86
	ROS	-31,7465	9,10558	-3,486	0,0069	
	ROA	34,6754	11,0744	3,131	0,0121	
	Zad	3,61976	0,524689	6,899	7,08e-05	
Env	Const	-0,0942880	0,304898	-0,3092	0,7629	0,27
	S	0,922447	0,404074	2,283	0,0433	
Breuscha-Pagana test: Chi-kwadrat(3) = 0,994322 [0,8026]						
Hansen-Sargan test: Chi-kwadrat(3) = 4,87355 [0,1813]						

Source: own elaboration based on Eurostat database.

The SUR model indicates that although the impact of individual areas of the financial situation affects economic, social and environmental development, it should be emphasized that ecological investments depend on social development and the general economic situation of business entities.

5. Discussion

Sustainable development takes place in specific socio-economic conditions. Undoubtedly, it is influenced by legal regulations in environmental protection. It depends on endogenous and exogenous factors (Bobinait, 2015; Pieloch et al., 2021; Comporek et al., 2022; Sadiq et al., 2022).

The analysis results show that the dynamics of sustainable development of the surveyed group of enterprises is positive; this indicator increased from 0.64 in 2008 to 0.97 in 2020. This phenomenon should be assessed positively, as this sector is developing in three pillars: economic, social and environmental (Comporek et al., 2021; Misztal, 2021). The first has the highest growth dynamics, but there are positive effects on social and environmental development.

The sector of transport enterprises is struggling in a given period with several problems of a financial and property nature. The sector's liquidity is improving, but the problem is low profitability and a relatively high level of debt.

It should be noted that in 2020, i.e. the year of the outbreak of the Covid-19 Pandemic, there was no significant deterioration in the level of indicators. Moreover, the environmental development indicator increased quite significantly (Wang, Huang, 2021; Nundy et al., 2021).

The adopted central research hypothesis is true because, as the results of the OLS estimation show, the sales profitability and the level of debt in the sector statistically significantly affect the sustainable development of transport companies. Undoubtedly, the increase in the general debt ratio has a positive impact on sustainable development, which results from the fact that the increase in loans causes more investments, which translates into the improvement of the analyzed ratios.

The first research sub-hypothesis is true because, as indicated by the trend lines of synthetic indicators, economic development dynamics are higher than social and environmental development dynamics. Thus, business managers still emphasize increasing profits and improving the economic conditions for running a business.

The second research sub-hypothesis is also true because the Covid-19 pandemic did not significantly affect the deterioration of sustainable development indicators. Moreover, the environmental development indicator increased due to temporary restrictions and restrictions on doing business.

The third research sub-hypothesis is also true because there is a strong differentiation as to the impact of individual areas of assessing the financial situation of economic entities on their sustainable development.

The study results confirm the importance of maintaining the enterprise's proper financial, property and capital relations. A good financial and property condition is conducive to making socially and environmentally responsible investments.

The study has research limitations related to the availability of statistical data, the selection of the research sample, the adopted study period, the normalization method of variables and estimation methods.

6. Conclusions

Sustainable development of enterprises means improving the dynamics in three pillars: economic, social and environmental. The sector of transport companies plays a key role in creating economic growth and development of the entire economy. Due to the need to reduce the emission of harmful substances, special attention should be paid to the transport sector.

The study results indicate that from recovering from the financial crisis until the Covid-19 pandemic, the dynamics of sustainable development and its pillars are positive. Liquidity is improving, profitability is low, and the sector's debt is increasing.

The results of the OLS and the SUR estimation indicate that the impact of individual financial analysis indicators on sustainable development and its pillars is varied. Increasing profitability may occur at the expense of achieving ecologically and socially responsible goals. In turn, the increase in debt translates into green investments.

The undertaken analyses bring some theoretical and empirical implications. Theoretical implications include a literature review on the subject, an indication of one's definition and the development of one's research methodology. The empirical implications include that the results of the analyses can support the managers of enterprises in making operational and strategic decisions.

Further research will determine which external or internal factors are more important for the sustainable development of transport companies in the European Union.

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THE PROSPECT OF AI USING IN SHAPING THE EMPLOYEES' WELL-BEING

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Purpose: The purpose of this paper is to test the role which AI tools may play in the promotion and maintaining the employees' well-being, examining both theoretical foundations and practical applications.

Design/methodology/approach: The paper is an attempt to identify, analyse and check the prospect of using AI tools to optimise the working environment conditions in order to minimise the occupational risk connected with negative aspects (e.g. Job Stress, Anxiety, Depression). The paper analyses the accessible source materials (scientific publications, research reports, legal acts) referring to the issue of using AI in the area of employees' well-being. The data from the secondary empirical research was used in the research.

Findings: It turns out from the discussion presented in the paper that the main determinants of the well-being are "Job Satisfaction" and "Job Security". From the employer's point of view, "Job Security" is the most significant determinant of the wellbeing. Whereas, "Job Satisfaction" is the most expected action shaping the level of well-being from the worker's point of view. At the same time, "Job Stress" and "Overall Health" are the least significant determinants of the well-being both for employers and workers. The performed identification and analysis of the Internet platforms with the built-in AI tools available in the market may support HR departments in the companies in drawing up effective strategies aimed to improve the working environment conditions, increase the workers' engagement and decrease the risk of occupational burnout.

Originality/value: The paper contributes to the scientific discourse referring to the possibilities of using AI technologies in the area of shaping employees' well-being. Numerous examples of AI tools available at the market show how the AI technologies may be used effectively to support the employees' well-being, raising the employees' professional life quality and contributing to the better performance of an organisation. The issues presented in the paper will give the possibility to create recommendation for HR specialists, how to integrate AI tools with the human resources management effectively in order to support the employee's well-being. The paper is original due to its multi-aspect approach to the scientific issue – considering both the employer's and employee's point of view.

Keywords: employees' well-being, artificial intelligence, working environment.

Category of the paper: general overview, point of view.

1. Introduction

The tools of artificial intelligence (AI) affect various aspects of the company organisation from the automatization of simple tasks to supporting decision-making processes at the highest management levels. They are getting more and more important as potential allies in shaping employees' well-being – in particular in corporate environments where the pressure on effectivity and adaptivity is constant. The employee's well-being understood as a condition of general job satisfaction, security, mental and physical health is getting more and more important in the context of competitive advantage and sustained growth. The use of AI tools may play a key role in harmonising the business requirements with the employees' needs.

The advantages of using AI tools in the context of employee's well-being comprise among others the personalisation of the career paths, monitoring and promoting of work-life balance and identification of stressogenic factors in the workplace. Nevertheless, the implementation of AI tools to support the employees' well-being is also connected with numerous technological, organisational, ethical or legal challenges which require detailed analysis.

The purpose of this paper is to check the role which AI tools may play in promoting and maintaining the employees' well-being examining both theoretical foundations as well as practical applications. The research focuses on the identification of ways in which the application of AI tools may contribute to the better understanding of employees' needs, optimisation of working conditions and counteracting the risk factors connected with the occupational burnout and other negative issues in the working environment.

The attempt to answer the following research questions may be helpful to meet the purpose of the paper:

- RQ1. What are the main determinants of the employees' well-being and is their impact on the employees' well-being equally significant?
- RQ2. How do the employees' expectations concerning the actions directed to the well-being culture in the workplace differ from the actions really taken by companies?
- RQ3. What categories of AI tools may be used to support the actions aimed to maintain or increase the employees' well-being?

The exploration of the above research questions will enable the preparation of recommendations for HR specialists how to integrate AI tools with the practices of human resource management in order to support the employee's well-being and at the same time to maintain the ethical and responsible approach to using personal data and keeping the privacy.

2. Literature review - employee's well-being

The literature presents the issues of life quality, happiness, well-being in the context of extremely important zone of professional life. The employees' well-being in the organisational meaning has a multi-aspect nature and is often subjective, it is a complex issue. The term of well-being is connected with a subjective assessment of the individual's life both in a cognitive context as well as the emotional one showing the level of life realisation and satisfaction (Karaś, Cieciuch, 2017; Diener et al., 2018). The well-being indicates the level of individual's life quality (WHO, 2022)¹, which is affected by the professional and personal life quality and experiencing positive emotions (Juchnowicz, Kinowska, 2023). The well-being means satisfaction of the significant needs for the organisation participants with the feeling of widely understood job security and satisfaction (Kinowska, 2021). The well-being as an multi-aspect issue joins both hedonic as well as eudaimonistic aspects (Deci, Ryan, 2008; Ciesielska, 2013; Fisher, 2014).

Well-being in the workplace contributes to the increase in productivity, the improvement of employees' morale and decreases the sickness absence which results in better effects of the whole organisation. Joining the well-being of the employees with the company performance, the identification, analysis and assessment of employees' well-being management practices is becoming the key issue in the area of HRM (Alfes et al., 2012; Kowalski, Loretto, 2017). Thus, the employee's well-being is connected with satisfying the needs arising from work process, feeling of safety, job security and satisfaction (Kozioł, Wójtowicz, 2016; Kulig-Moskwa, Nogeć, 2018; Wychowaniec, 2022). According to Grant et al. (2007), the achievement of assumed and expected objectives in the work process is a result of employees' well-being, which is visible in a psychological, physical and social dimension². Whereas, Budd and Spencer (2015) completed the above model with a crucial, fourth dimension of well-being, which is a financial dimension. Seligman (2018) applied a five-indicator PERMA model (five measurable elements of well-being) in the research on employee's well-being in the work process. In the model the following elements were used: Positive emotion (P); Engagement (E); Relationships (R); Meaning (M); Accomplishment (A).

The model proposed by Peter Warr, so called vitamin model, may be used to draw up good practices of employees' well-being management (Warr, 2010). It covers twelve most important features of work useful to analyse and assess the level of employees' well-being as well as the condition of the whole company. The comparison of features characterising the work process

¹ The term well-being was introduced to the health definition adapted by WHO in 1948 defining health as the condition of full physical, mental and social well-being and not only the lack of disease or disability (Bircher, 2005).

² The psychological area refers to subjective employee's feeling, his perception of reality concerning professional satisfaction, feeling of own possibilities. Physical dimension refers to experiencing physical health, occupational health and safety, health protection. Whereas, the social dimension is characterised with the quality of interpersonal relations, cooperation, support, trust.

to the occurrence of vitamins in the human body makes it possible to diagnose positive or negative effects of their existence for an individual as well as for the whole organisation. Dodge et al. (2012) pay attention to the fact that the majority of approaches describing the well-being focuses on its dimensions and not on its issue. According to them, the well-being should be characterised as the balance point between the set of psychological, social and physical resources which the unit possesses and the challenges it faces, whereas the level of well-being falls as a result of the advantage of challenges over resources. According to International Labour Organization, the well-being of each organisation participants determines its strategic efficiency (ILO). The well-being in the workplace refers to all employees covering both the material working environment conditions as well as psycho-social conditions, organisational climate, interpersonal relations (Guest, 2017). Thus, the human well-being depends on internal, external factors and their interactions included in the organisational culture, management methods and leading styles (Białas et al., 2023).

3. AI tools in the HR area

The number of AI tools addressed to HR (Human Resources) departments of an organisation has increased for a few years. Over 250 various solutions were identified in the research referring to the review of this kind of tools available in the market (Figure 1). They are used within the whole cycle of employee's life in an organisation (Hollister, Acarkan, Jyotishi, 2021)³. The AI toolss supporting the organisation activities aimed to maintain the employees' well-being constitute 9% of all recognised tools. The ones used in the process of employees' recruitment constitute the most umerous group of AI tools (30%). However, it should be expected that the number of AI tools in the area of employees' well-being may grow significantly in the future. It may be confirmed with, among others, the fact that the European Union is introducing the AI Act. Pursuant to the justification of the request referring to the regulations creating the harmonised provisions about AI (proposal of EU regulation AI Act) *AI should be a tool used by people and the force contributing to the well-being of society, the final goal of which is to increase human well-being* (AI Act, 2021).

In the context of maintaining employees' well-being, AI is becoming an important tool which supports the management of employee's mental and physical health. Using the AI tools by HR managers in organisations enables the analysis, predictions and reaction to employees' needs in an automated and personalised way.

³ The World Economic Forum created the project 'Human-Centred Artificial Intelligence for Human Resources' as a response to the growing use of AI in the HR area. The project gathered the various society of experts to creare rge practical set of tools for responsible AI use in HR.

One of the key AI applications in this area is the use of sentiment analysis and mood monitoring in the employees' internal communication. Such tools can identify the changes in the employees' moods analysing text data from e-mails or communication platforms, which makes it possible to detect warning signals connected with the health problems or stress early⁴.

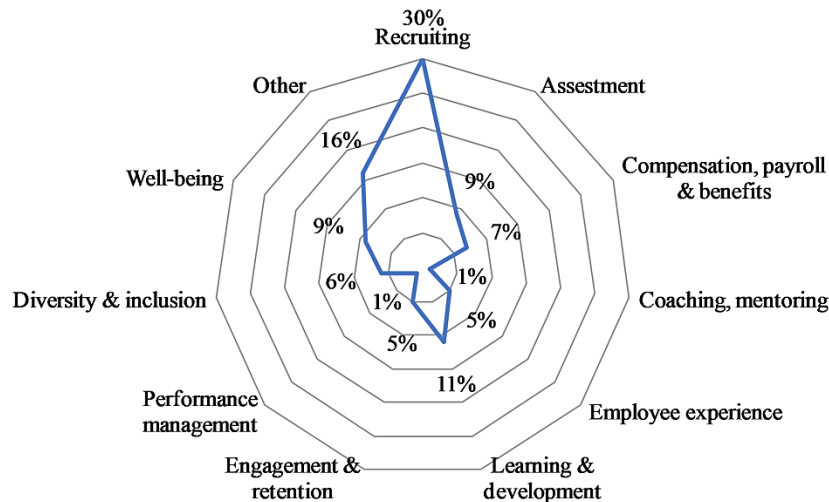


Figure 1. Number of HR tools using AI (%).

Source: drawn up on the basis of (Hollister, Acarkan, Jyotishi, 2021).

Another example is the development of personalised 'wellness'⁵ programmes with the use of machine learning algorithms. They may adapt the health and well-being recommendations to individual employees' preferences and needs suggesting appropriate exercises, diets or techniques of dealing with stress whereas, AI chatbots offer psychological support, give advice concerning 'wellness' and mental health. Thanks to natural language processing (NLP) and machine learning algorithms, these chatbots may talk to employees offering them the feeling of support and understanding⁶. They allow to personalise the users' experiences and provide efficient support in dealing with stress, fear, depression and other challenges of mental health. Using AI in supporting HR process, by the data analysis referring to absence, fluctuations and employees' assessments, enables to identify the patterns and trends which may indicate the problems with well-being. The predictive data analysis using the machine learning models to predict challenges connected with employees' well-being enables to take preventive actions pro-actively. These technologies may decrease the risk of professional burnout and other health problems. The last aspect covers the use of interactive learning platforms based on AI, which

⁴ The analysis of sentiment in the assessment of employees' well-being makes it possible to recognise and classify emotions expressed in the work-related communications in an automated way, which facilitates the understanding of the general mood among employees. Thanks to such solutions, the employers may identify positive, negative or neutral approach of employees, which allows quick reactions to the potential problems and improvement of working conditions.

⁵ 'Wellness' programmes focus on the promotion of healthy habits and lifestyle, which contributes to the improvement of life quality. They cover active health care, emotional balance, healthy nutrition, physical activity, rest and personal development.

⁶ AI chatbots may support well-being in the workplace by offering personalised advice referring to the stress management and relaxation techniques as well as by reminding about breaks for rest and exercises.

adapt the learning process to the employees' individual needs and preferences, supporting their personal and professional development⁷. Summing up, supporting the employees' well-being with the use of AI covers various kinds of tools. The proposal of their summary is presented in Table 1.

Table 1.

Categories of the Internet platform with the built-in AI tools shaping the employees' well-being in an organisation

	Categories	Name of the Internet platform with the inbuilt AI tools
1.	Analysis of sentiment and employees' monitoring	Culture Amp, Microsoft Viva Glint, Lattice, Officevibe, TINYpulse
2.	Creation of the personalised 'wellness' programmes	Gympass, Headspace for Work, Limeade, Spring Health, Virgin Pulse, Welltok
3.	Consultations with chatbots	Ginger, Joyable, Pepper, Tess by X2AI, Woebot, Wysa
4.	Supporting HR process	IBM Watson Talent, PredictiveHR, SAP SuccessFactors, UltiPro by Ultimate Software, Visier People, Workday People Analytics
5.	Predictive analysis of employees' data	Gloat, IBM Watson Talent Insights, Pymetrics, SAP SuccessFactors Workforce Analytics, Visier People, Workday People Analytics
6.	Leading employees' trainings	Cegid Talentsoft, Coursera for Business, Degreed, EdCast, LinkedIn Learning, Pluralsight, Udemy for Business

Source: own study.

The categories of the Internet platform with the built-in AI tools constitute the response to the research question RQ3. Thanks to the application of the Internet platforms with the built-in AI tools presented in Table 1, HR department may draw up effective strategies aimed to improve the working environment, increase the employees' engagement and decrease the risk of professional burnout.

4. Review of research – AI impact on well-being

Giuntella et al. (2023) conducted the research concerning the AI impact on employees' well-being and mental health in Germany (Table 2). The purpose of the research was to determine how the increasing presence of AI in the workplace affects the individual employees' feelings in the context of their job and life satisfaction, job security and general mental condition. The source of data obtained to the analysis were the data from the long-term panel research of households in Germany⁸, conducted by the German Institute of Economic Research (Deutsches Institut für Wirtschaftsforschung - DIW Berlin). The analysed data included a long, 20-year period of time (years 2000-2020) and covered the employees at the age from 25 to 65. The research was conducted on the sample of 16 thousand people (N = 16,000) who entered the labour market before 2000, i.e. much earlier than the AI technologies appeared in Germany.

⁷ Personalisation of learning not only increases the efficiency of education but also contributes to employees' greater engagement and satisfaction, which is crucial for their well-being.

⁸ German Socio-Economic Panel (German Sozio-oekonomisches Panel - SOEP).

About 62% of employees in the company pointed out the high exposure on AI in the workplace. The majority of professions endangered on AI covers programmers and IT workers.

Table 2.

Descriptive Statistics of the conducted research

	Determinants of well-being	Mean	Range
Giuntella et al. (2023) years 2000-2020 (N = 16,000)	Life satisfaction	6,90	11-degree Likert scale [0..10]
	Job satisfaction	6,89	11-degree Likert scale [0..10]
	Worries: job security	1,66	3-degree Likert scale [0..2]
	Worries: own economic situation	1,97	3-degree Likert scale [0..2]
	Mental health (MCS) ⁹	49,50	Point scale [from 0 to 100]
	Anxiety	1,98	5-degree Likert scale [0..4]
	Depression	0,08	Binary value [0 or 1]
Nazareno, Schiff (2021) years 2002-2018 N = 5718	Job Satisfaction	3,35	4-degree Likert scale [1–4]
	Job Stress	3,09	5-degree Likert scale [1–5]
	Overall Health	3,66	5-degree Likert scale [1–5]
	Job Security	3,38	4-degree Likert scale [1–4]

Source: own study on the basis of - Giuntella et al. (2023); Nazareno, Schiff (2021).

The research assumed that the employees' well-being comprises two main elements – life satisfaction and job satisfaction. The research results indicate that there has been a discrepancy in the level of life satisfaction between employees exposed on AI and the ones who are not exposed on AI in the workplace since 2015. The employees exposed on AI point out lower life satisfaction in comparison to employees not exposed. There has also been a significant fall in the job satisfaction among the employees exposed on AI since 2015. Examining the symptoms referring to the economic future, the employees exposed on AI are more anxious about their workplace safety and their personal economic situation. However, this research did not show a significant AI impact on employees' mental health, fear or depression.

The research presented by Nazareno and Schiff (2021) uses the data from General Social Survey (GSS) covering years 2002-2018 (Table 2). The analysis was performed on the group of N = 5718 employees. The research uses the main dependent variables from GSS: job satisfaction, stress at work, job safety and overall health condition for which the respondents indicated the response on a particular Likert scale.

The report 'Job safety in Poland 2023. Employee's well-being i.e. well-being at work' focused on examining the employees' and employers' prospects in the context of well-being at work. The similarities and differences in the way of perceiving the well-being were searched. Phone interviews (CATI) were performed with the representatives of employers (N = 204) and online interviews (CAWI) were performed at the Internet panel SW Panel with employees¹⁰

⁹ 'Mental Component Score (MCS)' is a measurement used in the health research and assessment which refers to the qualitative aspect of mental health and emotional well-being of the examined employee.

¹⁰ The research was conducted in the days 16.06-3.07.2023 by SW RESEARCH The Agency of Market and Opinion Research.

(Safety, 2023). The research participants were asked to define well-being. The individual defining of the ‘well-being’ term by the respondents was aimed to check how this issue is understood by employees and how by employers and what associations with this issue both groups have. The employees indicated the response ‘Calmness in life without stress’ (22% of all tested employees) as ‘well-being’ most often. Whereas, the employers chose the response ‘Mental health, mental comfort’ the most often (28% of all tested employers).

On the basis of the research results presented by Nazareno and Schiff (2021) and the report ‘Job safety in Poland 2023. Employees’ well being, i.e. well-being at work’ the proposals of the set of well-being determinants and actions directed on the well-being culture in the workplace were presented in the tabular approach (Table 3) and in the picture (Figure 2) in the light of two perspectives of actions taken by companies and actions which, according to employees, should be taken in a company.

Table 3.

Well-being actions in the work place desired from the employees’ point of view

	Well-being determinants	Well-being actions in the workplace	The actions taken by companies		The actions which, according to employees, should be taken	
			Number of indications (%)	Mean (%)	Number of indications (%)	Mean (%)
1.	Job Satisfaction	Acknowledgement by an employer	47	34,0	51	46,0
		Financing the holidays	39		47	
		Shorter Fridays	16		40	
2.	Job Stress	Individual, free consultations with a psychologist	16	21,8	24	21,0
		Equal job distribution	36		38	
		Webinars/trainings about well-being	17		15	
		Possibility of engagement in social activity	18		7	
3.	Overall Health	Vouchers to the gym / physical activity / massages / physiotherapy	29	23,3	27	29,7
		Financing meals	23		27	
		Additional holidays / partial work	18		35	
4.	Job Security	Introducing flexible working time	37	36,0	35	32,0
		Possibility of working from home	35		29	

Source: own study on the basis of – Nazareno, Schiff (2021); Safety, 2023.

As it results from the information presented in Table 3, ‘Job Security’ (flexible time and work forms, on average 36,0%) is the most significant determinant of well-being from the employer’s point of view). Whereas, ‘Job Satisfaction, (recognition of the employee’s engagement, financial support of holidays, shorter work time on Fridays – on average 46,0%) is the most expected action shaping the level of well-being from the employee’s point of view.

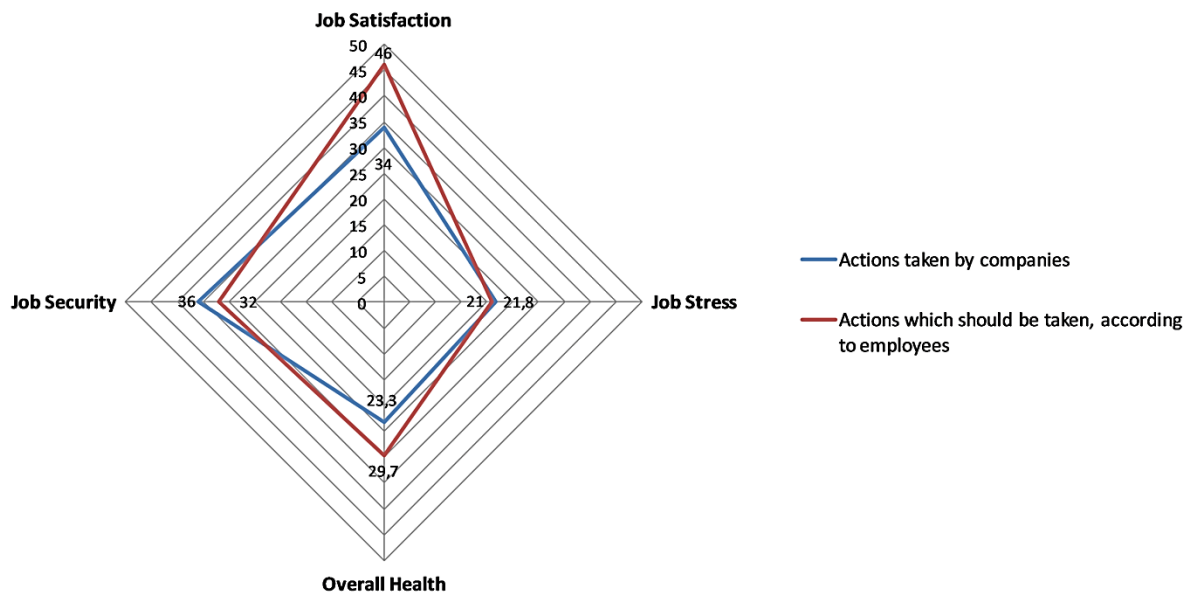


Figure 2. Well-being determinants – the average number of employees' indications (%).

Source: own study on the basis of – Nazareno, Schiff (2021); Safety, 2023.

At the same time, it can be noticed that 'Job Stress' (mean 21.8% and 21.0% respectively) and 'Overall Health' (mean – 23.3% and 29.7%, respectively) are the least significant determinants of well-being for both employees and employers. Referring to the formed research question RQ1, it is possible to state that 'Job satisfaction' and 'Job Security' are the main determinants of well-being. The impact of the employees' well-being is differentiated.

When it comes to the research question RQ2, the employees' expectations referring to the actions directed on the culture of well-being in the workplace differs from the actions really taken by companies. These differences are the most visible in the case of well-being determinants 'Job Satisfaction' and 'Overall Health'.

5. Conclusion

The companies are more and more aware of the need to regard the employees' well-being in the workplace as a key factor. The growing tendency to draw up and implement global policies in the area of health promotion (healthy life style, diet, good mental feeling) should be emphasised. The well-being in the context of the efficiency of the organisation functioning is a condition in which employees experience positive mental health, job satisfaction and work – life balance. It covers such aspects as safety, job security, possibility of personal and professional development, appropriate support from management and positive relations between employees. Taking care of employees' well-being is expressed in the humanisation of work organisation, which means the strive to perform professional desires of the work process participants, to satisfy the needs of recognition, self-development of the employee.

It turns out from the discussion presented in the paper that the main determinants of the well-being are “Job Satisfaction” and “Job Security”. Their impact on the employees’ well-being is varied. From the employer’s point of view, “Job Security” (flexible work time and forms) is the most significant determinant of the wellbeing. Whereas, “Job Satisfaction” (recognition of the worker’s engagement, financial support of the rest, shorter work time on Friday) is the most expected action shaping the level of well-being from the worker’s point of view. At the same time, “Job Stress” and “Overall Health” are the least significant determinants of the well-being both for employers and workers. The employees’ expectations relating to the actions directed to the well-being culture in the workplace differ from the actions really taken by the companies. The differences are the most visible in the case of the well-being determinants “Job Satisfaction” and “Overall Health”. The performed identification and analysis of the Internet platforms with the built-in AI tools available in the market may support HR departments in the companies in drawing up effective strategies aimed to improve the working environment conditions, increase the workers’ engagement and decrease the risk of occupational burnout.

The attention should be paid to some limitations connected with the issues presented in the paper - the data coming from various secondary empirical research was used in the performed analyses.

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FOOD CHOICE CRITERIA IN THE ERA OF GLOBAL CRISIS

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Purpose: The aim of this research is to check how the external factors, for example the pandemic or high inflation rate, influence the behavior of food consumers.

Design/methodology/approach: The main method was the survey questionnaire conducted among 2000 consumers in Poland on a representative sample.

Findings: The external factor such as the pandemic influenced the change of consumer behavior when it comes to the food choice. Usually consumers considered less characteristics of food, but the main food choice criteria remained almost the same, such as: best before date, price, ingredients and the country of origin.

Research limitations/implications: The results are limited to the Polish market, however can be continued and expanded for other external factors and other markets.

Practical implications: The results of this study show how the participants of the food market should be prepared for various crisis.

Originality/value: This paper shows how the external conditions of various sources can influence and change the food market and consumers behavior. It is addressed to researchers and professionals operating in food market, food choice, consumers behavior.

Keywords: food choice, food, consumers, consumer behavior, pandemic.

Category of the paper: Research and review paper.

1. Introduction

The recent global crises are an important determinant of food choices, while shaping current and future consumer behavior (Kirk, Rifkin, 2010; Fitzpatrick et al., 2020; Laborde et al., 2020). Nowadays, with the identification of several complex global crises „described in the literature of the subject as the multiplication of crises (crisis network) (Mączyńska, 2022), the space in which the contemporary consumer operates is characterized by a high degree of instability and

a great dynamic of change, and “new” or “alternative” consumer trends interpreted as objective and occurring over a longer time horizon directions of general consumer choices, behaviors and preferences, are a consequence of socio-political, legal, cultural, demographic and technological changes that are permanently taking place today in the market environment.

Van Bavel et al. (2020) report that every crisis is the engine of behavioral change and the uncertainty that accompanies it affects consumer behavior during a crisis. The changes that people face in their everyday lives, combined with uncertainty, pose a health, economic, social, information or environmental threat to consumers. Depending on the perceived scope of these risks, each crisis causes distortions in consumer practices and routines. Cognitive responses to crises and related political actions can influence behavioral responses, suggesting, for example, that contemporary consumers are more likely to prefer specific groups of products that help them cope with helplessness, stress, or compensate for a sense of loss of control over their existence.

Trommsdorff (2004), Balderjahn and Scholderer (2007) and Foscht and Swobody (2007) identified two groups of consumer behavior determinants: individual factors (psychological, internal) and social factors (environmental, external).

It is worth pointing out here that eating habits, including dietary choices, are the result of a specific “mix” of different factors, including personal, cultural, socio-economic, biological (genetic origin, intestinal microflora) and toxicological (toxicological load, concentrations of essential substances, microelements, etc.). The integration of these factors and their priority levels results in food choices that exhibit a high level of interpersonal variability and play a major role in shaping food choice purchasing decisions (Barosh et al., 2014; Homenko et al., 2010; Rangel, 2013; Shanks et al., 2017; Whitelock, Ensaff, 2018). Recent research has also shown that it is primarily emotions that play a key role in times of crisis. For some consumers, high levels of stress correlated with emotional eating, and food choices associated with stress were associated to mood and comfort of consumers (Shen et al., 2020; Niewczas-Dobrowolska et al., 2024).

Food prices and individual personal preferences are most often described by some authors as the factors that currently shape the food choices of modern consumers, which is consistent with previous qualitative studies identifying similar factors, such as taste, economic or health considerations (Akbulaev et al., 2020; Aschemann-Witzel, Zielke, 2017; Livne, 2021; Zoellner et al., 2012; Verain et al., 2012). Food prices have a major impact on food choices and are a barrier to healthy eating for people suffering from food insecurity (Barosh et al., 2014; Brady et al., 2022; Shanks et al., 2017; Sheoran, Kumara, 2020; Wang et al., 2019).

The aim of this paper is to indicate the main food choice criteria as well as their changes due to the external factor (the pandemic).

2. Methods

The research process consisted of the following stages: developing research methodology, consultation of the research tool, sample selection, implementation of the measuring phase of the survey, developing a statistical report, elaboration of a final report. The research was made by a professional company operating in quantitative research method. Information on the assumed scope of the study was obtained through the use of a tool - a quantitative questionnaire. The questionnaire was built of closed-typed questions. The sample consisted of 2000 people selected taking into account the place of residence (region), gender and age. Respondents were asked to indicate the food choice criteria. The survey was made twice: in 2020 and in 2022 to show how the external risk influence the food choice. In order to put the pandemic in Poland on a timeline, it is worth noting that the first case of COVID-19 in Poland was reported on the 4th of March 2020, in May 2022 was the official end of the pandemic. Respondents were also characterized in terms of education and material status and the role during the food purchase. The study was carried out using the CAWI (Computer Assisted Web Interviewing) technique based on conducting a computer-supervised internet survey. Numeric variables were characterized using basic descriptive statistics: cardinality (N), arithmetic mean (mean), standard deviation (SD), median, lower and upper quartile (IQR), minimum and maximum values (range). Categorical variables are presented in terms of numbers and interest. Group comparisons were made using the Kruskal-Wallis or U Mann-Whitney test (for continuous variables) and the Chi-square test or Fisher test (for categorical variables). The value of significance (p) was set at 0.05. Calculations were made in the R program (ver. 3.5). 2000 respondents took part in each of these two surveys. The characteristic of the respondents reflects the structure of the population of adult Poles residing in the country of the gender, age and region of residence (Figure 1-5).

The respondents were also grouped by their engagement if food shopping (Fig. 6). Because of the COVID-19 pandemic in the survey made in 2022 the additional socio-characteristic was added – Perceived Stress Scale (Cohen et al., 1983), and also the case of trust as trust plays an important role during various crises (Fig. 7 and Fig. 8). It is one of the most commonly used tools to measure perceived stress (Mondo et al., 2021). The perceived stress influences consumers decisions and also the perception of high food quality and may result in i.e. searching for the objective proofs of high food quality such as for example the certificates. Consumers were asked to assess their level of stress.

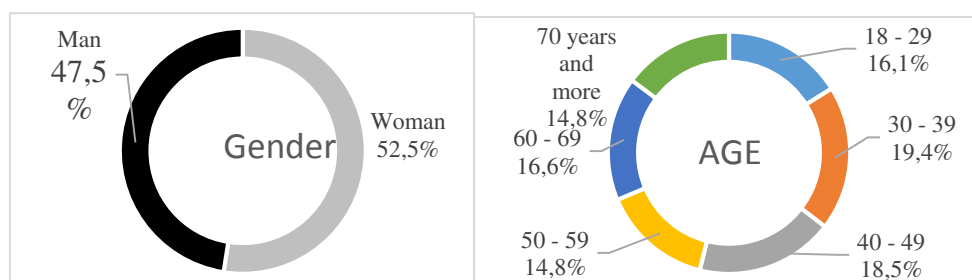


Figure 1. Characteristics of respondents in 2022 – the gender and the age.

Source: own elaboration.

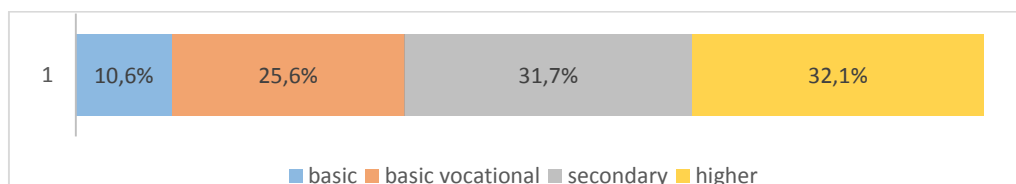


Figure 2. Characteristics of respondents in 2022 – the level of education.

Source: own elaboration.

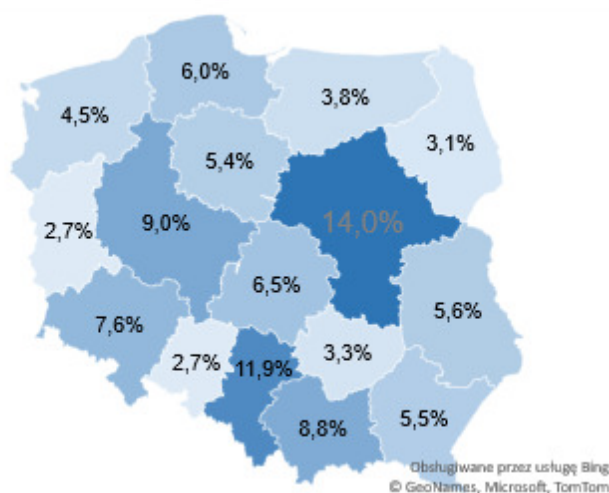


Figure 3. Characteristics of respondents in 2022 – the region of residence.

Source: own elaboration.

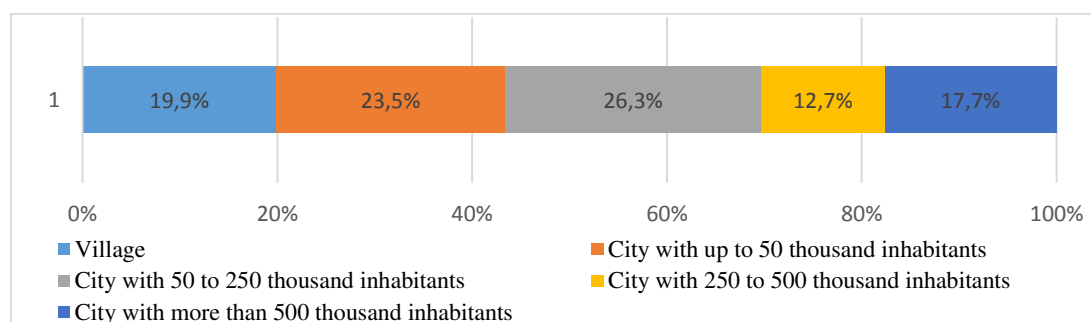


Figure 4. Characteristics of respondents in 2022 – the place of residence.

Source: own elaboration.

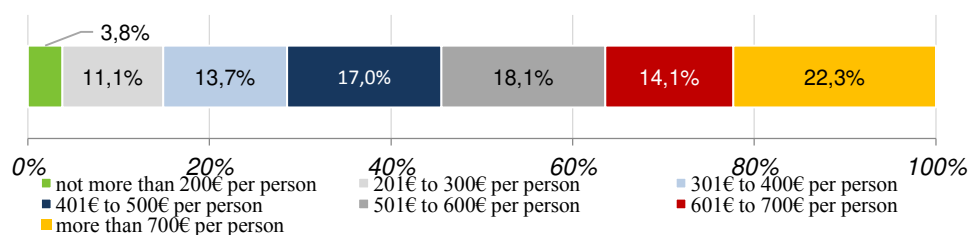


Figure 5. Characteristics of respondents in 2022 – the monthly income.

Source: own elaboration.

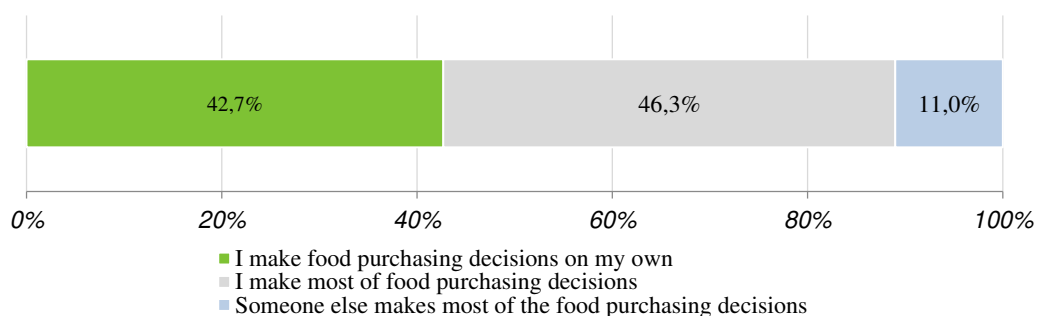


Figure 6. Characteristics of respondents in 2022 – responsibility for the buying decisions.

Source: own elaboration.

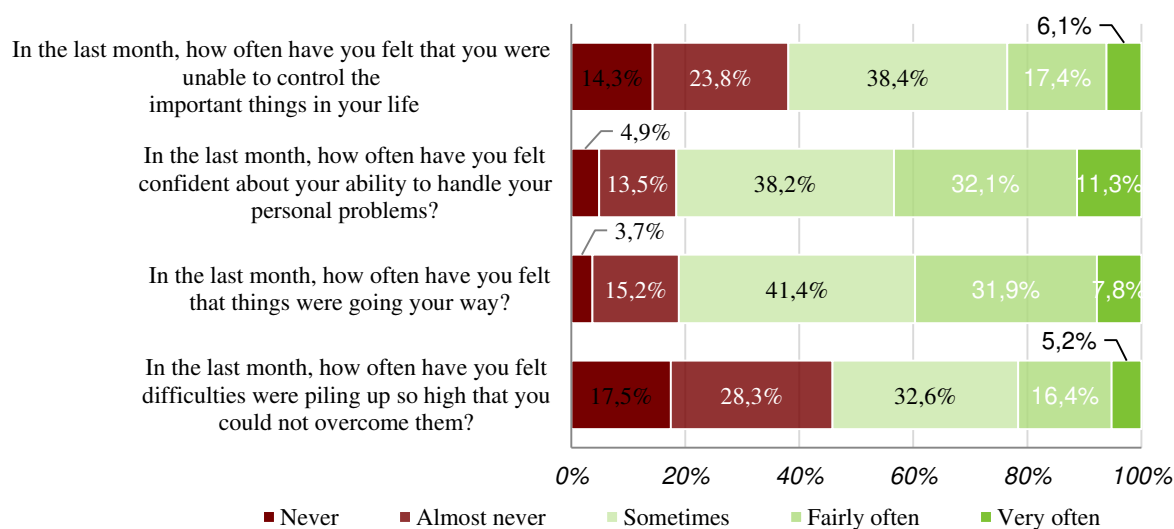


Figure 7. Characteristics of respondents in 2022 – perceived stress.

Source: own elaboration.

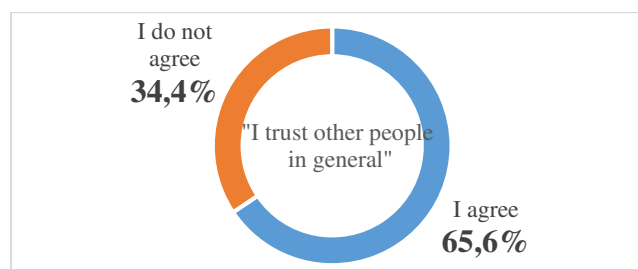


Figure 8. Characteristics of respondents in 2022 – trust.

Source: own elaboration.

3. Results and discussions

The top three food choice criteria indicated by consumers in 2022 were: use by dates/best before, price and ingredients (Fig. 9). In 2020 they were: ingredients, use by dates/best before and price. The answers varied only on the basis of the education level, so consumers with higher education level more often paid attention to the list of ingredients than other consumers (Table 1).

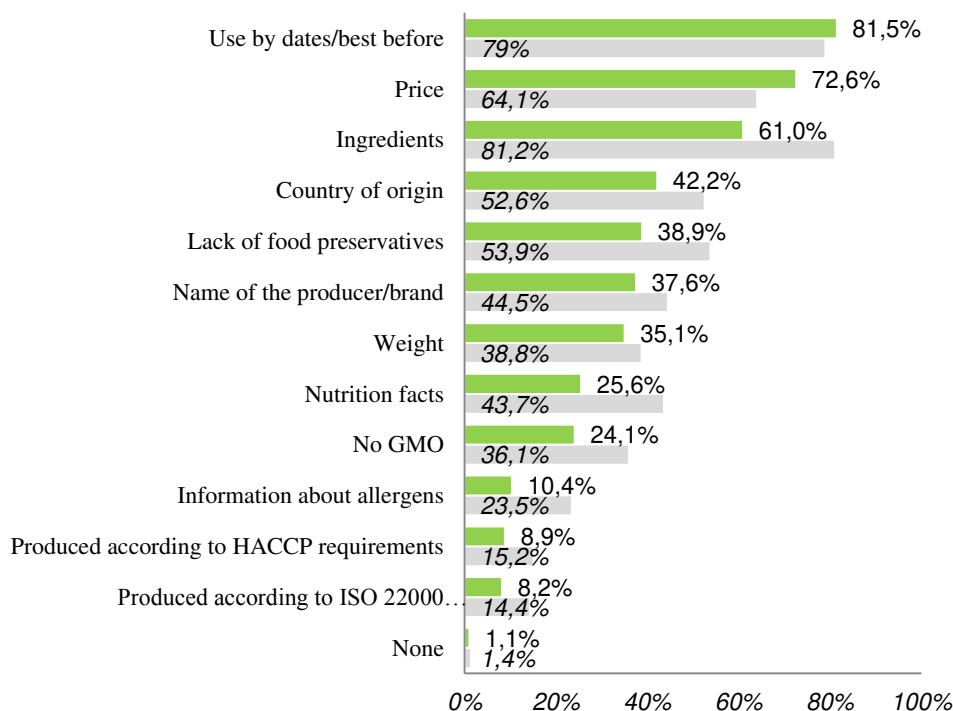


Figure 9. Food choice criteria in 2020 (in grey) and in 2022 (in green).

Source: own elaboration.

Table 1.

Importance of the level of education on the basis of Pearson's Chi-squared test

Food choice criterion	p-value	Importance
Use by dates/best before	0,30088	
Name of the producer/brand	0,05651	
Country of origin	0,07117	
Weight	0,01074	*
Ingredients	0,00014	***
Produced according to HACCP	0,39649	
Produced according to ISO 22000	0,41350	
No GMO	0,13034	
Lack of food preservatives	0,00840	**
Price	0,69623	
Information about allergens	0,02200	*
Nutrition facts	0,72670	
None	0,32413	

Source: own elaboration.

The answers varied on the basis of some PSS characteristics (Table 2 and Table 3). Consumers who felt the ability to cope with problems and being sure that things go their way more often consider country of origin, information about ISO 22000, the lack of GMOs, information about food allergens as well as the price while food choosing.

Table 2.

Importance of being sure to cope with personal problems (PSS) on the basis of Pearson's Chi-squared test

Food choice criterion	p-value	Importance
Use by dates/best before	0,21527	
Name of the producer/brand	0,04298	*
Country of origin	0,00067	***
Weight	0,00550	**
Ingredients	0,00597	**
Produced according to HACCP	0,00683	**
Produced according to ISO 22000	4,94367E-06	***
No GMO	0,00006	***
Lack of food preservatives	0,10692	
Price	0,00027	***
Information about allergens	0,02123	*
Nutrition facts	0,35204	
None	0,04079	*

Source: own elaboration.

Table 3.

Importance of being sure that things were going your way (PSS) on the basis of Pearson's Chi-squared test

Food choice criterion	p-value	Importance
Use by dates/best before	0,03767	*
Name of the producer/brand	0,09536	
Country of origin	0,05694	
Weight	0,12441	
Ingredients	0,01506	*
Produced according to HACCP	0,00531	**
Produced according to ISO 22000	0,00296	**
No GMO	0,02561	*
Lack of food preservatives	0,09686	
Price	0,00010	***
Information about allergens	0,00040	***
Nutrition facts	0,15134	
None	0,05099	

Source: own elaboration.

When we look at the most often mentioned food choice criteria in 2022 we can conclude they were usually lower than the number of food choice criteria two years ago (in 2020), however the top three criteria remains the same as: best before/use by date, price and ingredients. It shows that beside the crisis caused by the external factor (the pandemic) consumers did not change their preferences as general. On the other hand, in previous research (in 2020) the answers varied on the basis of more socio-economic characteristics. Young people aged 18 to 29 were less likely than other respondents declared to pay attention to information

about the country of origin, information about the lack of genetically modified ingredients or information about the lack of preservatives. Information about the lack of preservatives was also less frequently sought by respondents with low net income per person. The group of people who paid particular attention to information about the lack of preservatives were people with higher education. Statistically significant differences were noticed in the shopping habits of people who make purchasing decisions on their own. In their case, important information was about: country of origin, occurrence of allergens, production in accordance with HACCP principles, production in accordance with the principles of ISO 22000. It is worth to add that in 2022 consumers consider less criteria to choose food product what could also be caused by the limited time to do the shopping due various limitation to prevent the spread of the virus. They just use the standard and common food choice criteria. Consumers were also less diverse in their choices, only the level of education differentiated their choices. It is interesting that consumers who felt less stress due to the pandemic looked at more criteria and their choices were differentiated on the basis of various criteria (Table 2 and 3). When we look at answers of consumers who felt stress due to the pandemic it can be concluded the main criterion was use by date/best before information (Table 4).

A study carried out in France showed that some participants had an improvement in the quality of their diet, while others had a deterioration or remained unchanged during the pandemic (Deschasaux-Tanguy et al., 2019). In contrast, studies conducted in Canada on the adult population showed a slight improvement in the quality of the diet during the early phase of restrictions (Lamarche et al., 2021). On the contrary, a cross-sectional study conducted by Alhusseini and Alqahtani (Alhusseini, AlQahtani, 2020) shows that the quality of the food consumed has improved significantly.

Table 4.

PSS - How often in the last month did difficulties pile up so high that you could not overcome them? on the basis of Pearson's Chi-squared test

Food choice criterion	p-value	Importance
Use by dates/best before	2,9863E-06	***
Name of the producer/brand	0,80256	
Country of origin	0,29984	
Weight	0,05844	
Ingredients	0,00966	**
Produced according to HACCP	0,00254	**
Produced according to ISO 22000	0,01564	*
No GMO	0,29687	
Lack of food preservatives	0,20384	
Price	0,02168	*
Information about allergens	0,00268	**
Nutrition facts	0,80497	
None	0,20336	

Source: own elaboration.

Analysis of the importance of certain characteristics of food products purchased by consumers during the pandemic showed that, for example, German consumers indicated the following types of food: stable shelf life, healthy food, regional origin, good taste, country of origin and lower prices. Other results of a study with German consumers conducted by Klaver et al., (2020) confirmed the above conclusions, stating that more and more consumers are buying and sourcing food from local producers than before the Covid-19 pandemic. Concerns about food shortages, the perception of global food supply chains as less robust and secure, and the avoidance of large crowds have led consumers to increasingly turn to local and small food chains or initiatives (Campbell et al., 2020; Galimberti et al., 2020; Hobbs, 2020; Leone et al., 2020; Schmidt et al., 2020). Undoubtedly, the outbreak of the Covid-19 pandemic and its associated actions have led to changes in food choices and consumer behavior. McFadden and Malone (2020) and Schmidt et al. (2020) that American consumers have become increasingly interested in producing their own food, as well as obtaining food locally, while collecting food stocks. Some studies also assessed the choice of specific foodstuffs. For example, in a study conducted by Jribi et al. (Jribi et al., 2020), most respondents said that the blockages and restrictions associated with crises, especially the pandemic crisis, modified their list of shopping habits, improving its quality. Similarly, in the study of Di Renzo et al. respondents declared to buy organic food or directly from farmers (Di Renzo et al., 2020), In addition, a study by Bracale and Vaccaro showed a higher frequency of buying fruit and vegetables (Bracale et al., 2020).

Orders, blockages and restrictions on consumers' behavior have reduced their mobility while increasing anxiety (Flanagan et al., 2020; Kirk, Rifkin, 2020). In a review discussing the current determinants of food choices, Leng and others found that food consumption is driven by various emotional states, such as stress (Leng et al., 2017; Smaira et al., 2021). Stress is an important factor in shaping certain eating habits and determines food choices for some consumers – both quantitatively and qualitatively (e.g. “eating”, “replacing meals with snacks” or “increasing food supply”) (Mazzolani et al., 2020). The stress caused by the currently identified crises is undoubtedly escalating anxiety and mood disorders not only in individual individuals but even in entire populations (Ben Hassen et al., Caroppo et al., 2021; Di Renzo et al., 2020; Lima et al., 2020; López-Moreno et al., 2020; Sánchez-Sánchez et al., 2020; Slurink et al., 2022), ultimately determining the food choices.

As we can conclude from the above considerations over the last four years (2020-2023), consumer behavior is determined by a number of factors, both objective and subjective. Recent years have shown that the COVID-19 pandemic has been one of the main factors (Consumers and the New Reality, 2020, Global Consumer Experience Survey 2020, Loxton et al., 2020). In addition to the basic purchasing criteria, such as price, availability and convenience, a new criterion has emerged - hygiene (Prasetyo et al., 2021), in the face of which consumer safety has become extremely important, including the safety of the food they buy. The criterion of self-security has gained new significance in the consumer's interpretation of

the food market (Soon et al., 2021; Loxton et al., 2020; Zandi et al., 2020; Joia, Lorenzo, 2021). Consumer preferences have shifted towards local brands (Khalek, Ismail, 2015; Scuderi et al., 2016; Sumarliah et al., 2021), and the percentage of spontaneous purchases has decreased, while the proportion of scheduled purchases increased (Eger et al., 2021).

4. Conclusions

1. The external factor such as the pandemic influenced the change of consumer behavior when it comes to the food choice. Usually consumers considered less characteristics of food but the main food choice criteria remain almost the same, such as: best before date, price, ingredients and the country of origin. During the pandemic consumers indicated lower numbers of food choice criteria than before the pandemic. Almost the same number or higher number of indications was observed for the best before date and price. These are the two characteristics that can be noticed quickly so consumers didn't have to spent much time choosing the food products.
2. Consumers were very homogenous in their opinions as the level of education was the only one socio-economic characteristic that significantly varied the answers about paying more attention to the ingredients of the food products. No significant differences of answers were observed on the basis of the gender, age or income as it is usually shown in other papers and as it was in 2020.
3. The perceived level of stress influenced consumers indications. Consumers who were characterized by the lower level of stress usually indicated more food choice criteria such as: the country of origin, price, production according to ISO 22000 and no GMO, information about allergens. Consumers who felt the higher level of stress indicated less food choice criteria. It was mainly the best before date.
4. These changes could be caused by the implemented restriction of time spent for shopping. The other reason could be the buying the basic food products to be used for meals preparation at home (so for example consumers did not need to check the list of ingredients or other information on the food labels) or contrary, to reduce the level of fear and stress consumers bought more unhealthy food they know so there was no need to check various information on the food labels.
5. These results show the consequences of just a one external factor that influenced consumers food choices, it still remains open how other factors would influenced consumers behavior on the food market. This can be the subject of other studies.

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PROBLEM-SOLVING ON THE EXAMPLE OF A SELECTED ENTERPRISE FROM THE INDUSTRIAL SECTOR

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Purpose: The article presents a general outline of problem-solving based on both domestic and foreign literature. Problem-solving is an example of a system that should be considered in the context of efficiently functioning production processes within a company. The analysis of the internal problem-solving process is conducted based on staged process.

Design/methodology/approach: The following research methods were utilized in the article: analysis of domestic and foreign literature. Article also presents an original approach to the practical application of the problem-solving process concerning internal operational issues.

Findings: It was found that the process of resolving internal operational problems in the examined company consists of stages. The essence of staged problem-solving supports coping with the problem.

Originality/value: The results of the problem-solving process analysis in the company can be directed towards individuals involved in improving processes and problem-solving systems within organizations. Due to its cognitive value and significance for business practice, the article also contributes to the discussion on problem-solving methodology.

Keywords: problem-solving, root causes, Deming cycle.

Category of the paper: Research paper, Case study.

Introduction

According to what was found in the overview of the internal operational problem-solving process issue, a research gap was identified as the insufficient use of data and analytical tools to identify the root causes of operational problems. The research gap may be due to limited access to data (organizations do not always provide operational data), the complexity of operational processes or the difficulty in identifying causes. The article analyzes the staging of problem solving considering best practices, data and tools for identifying the root causes of operational problems in an enterprise. The purpose of the article is to analyze the process of

solving internal problems based on the staging of the process in terms of the smooth operation of production processes. The study uses literature analysis and a case stage.

In many companies problems appear as unavoidable challenges that must be met. However, these problems can also be seen as hidden opportunities for improving the company's performance and growth. Adopting this perspective not only promotes a proactive and innovative approach but also lays the foundation for long-term success.

Increasing organizational performance is one of the key considerations on both theoretical and practical grounds. One of the elements influencing this cycle is the organization's ability to solve problems. The selection and application of appropriate problem-solving methods and tools can contribute to being more competitive while eliminating any operations that bring losses to the organization. This approach meets stakeholders' expectations and generates the organization's ability to eliminate losses and create effective solutions, as well as involve all employees in continuous process improvement, including the problem-solving process.

Problem-solving also provides an opportunity to engage employees and promote a culture of cooperation and creativity. When employees face challenges together it encourages teamwork, gives individuals a sense of responsibility and boosts morale. Such an environment stimulates the generation of innovative approaches to problem-solving which ultimately contributes to improving company performance. Including employees in the problem-solving process can be facilitated by middle-level managers who facilitate knowledge and information exchange among employees, encourage the submission of new ideas, experimentation, and continuous improvement implementation (Floyd, Lane 2000).

Problem-solving - an overview of the issue

The problem-solving system is found primarily in organizations that practice a culture of continuous development and improvement where both management and employees strive to maximize reduction of occurring problems.

In the classical method, a problem is defined as a difficult condition from which a solution must be found. A problem is a mismatch between the existing conditions of an organization and the conditions its members strive for, it is the difference between standard conditions and actual conditions. In addition, a problem should be viewed as an opportunity to improve organizational performance (Harry, Schroeder, 2000; Watanabe, 2009; Michalko, Thinkertoys, 2006; Lockwood, 2009).

A company that recognizes problems as opportunities for improvement adopts a culture of continuous learning. Each problem solved becomes a lesson that allows the organization to accumulate knowledge and experience that can be applied to future challenges. Learning from

mistakes and failures become a powerful catalyst for progress and development. By adopting this perspective companies can turn adversity into an advantage and improve performance.

A limitation of most problem-solving research is that it focuses primarily on methods to improve problem solving. Most researches on problem-solving have focused on methods to improve problem-solving. Fewer studies have looked at decision-making in terms of problem-solving. Theoretically we do not find a systematic model of instructional design that can be applied to different types of problems (Jonassen). However, a distinction has been made between schema-based and search-based problem-solving strategies (Glick).

A classic problem-solving technique says that the most common mistake is a quick fix without conducting first a comprehensive analysis or attempting to understand the situation. A specific countermeasure will not permanently solve the problem unless the root cause is identified and determined as the problem may reappear. The key is to define the root cause to properly assess the situation otherwise results of the analysis will be unsatisfactory.

A clearly defined problem helps to avoid searching for the cause in the wrong place (Barsalou, Perkin, 2022; 2023). Another common mistake is to try to solve the abnormal problem. In such case the comprehensive approach to problem-solving is essential. It is also incorrect to seek a solution only for a single scenario as this is opposite to the entire Problem-Solving process where the basic idea is to prevent the problem from occurring in the future and not just to find an immediate solution. In some cases, problem will be solved and both corrective and preventive actions will be developed but a comprehensive analysis of the presented solution and its impact to the entire process and organization is omitted.

Examples of standard practices include manuals, diagrams, guidelines and any other tools that provide a common way to represent and share knowledge (Cowan et al., 2000). The extent to which employees use these standard practices affects how they analyze situations when solving problems (Delbridge, Barton, 2002; Cantor, MacDonald, 2009). A study by Choo et al. (2007) found that adherence to standard practices in quality improvement recommends how employees seek information and ask questions that lead to the creation of new knowledge to find solutions. As a result, once a solution is implemented it is important to evaluate whether it has had the expected effect.

A problem should not be treated as a failure but should be skillfully used to continuously learn and improve the organization. The correct approach to problem-solving is used in the Lean concept where the employee is encouraged by the management to work together to solve the problem with the full support and involvement of superiors taking the responsibility. Lean is one of the most popular practices for continuous improvement (Welo, Ringen, 2015). Continuous improvement should be also considered a key factor in a company's success (Harrington, 1995). Other studies point to the need for organizations to continuously improve to be competitive (Delbridge, Barton, 2002).

The process of continuous and methodical improvement is usually based on the Deming cycle. The Deming cycle is a schematic system of action for continuous improvement that is constantly detecting errors or work waste and finding solutions to the problems. It creates the basis of problem-solving within the Kaizen philosophy. The Deming cycle consists of four stages: Plan, Do, Check, Act. Depending on the stage specific problem-solving tools can be applied (Deming, 2018; 2000; Delavigne, 1994).

In the first step the company's areas for the further improvement must be identified and the process areas that require further developments must be written out.

The list of potential improvements should be evaluated to determine priorities. Afterwards the needs of the customer (internal or external) regarding process improvement must be identified. The next step is to gather information about the process such as the metrics that will be used and what measurements will be taken before, during and after implementation. Once the defects sources and errors have been identified within the process the next step is to identify the potential countermeasures. The result is a comprehensive action plan that includes the main objective, specific objectives, methods and timeframes, checkpoints, and responsible persons. Finalized plan is shared with the team. The most commonly used tools are a flowchart, Pareto-Lorenz diagram, brainstorming, and cause-and-effect diagram (Walton, 1991).

Implementation of established procedures with the help and knowledge of senior management is the second phase of the Deming cycle. In this phase, process improvements are made first and foremost, and the result of this part is to change the process to improve its performance or the nature of the unit, as well as to eliminate the sources of problems. Small-scale activities or findings generated in the previous phase of the cycle can also be tested at this level (Deming, 2018; 2000; Delavigne, 1994). At this point the most used tools include a flowchart, a check sheet and a flow diagram.

Step three involves measuring the results and comparing them with the assumptions from step one. In this step the measurements adopted in the plan should be highlighted. The purpose of this step is to determine whether the earlier improvement activities produced the expected results (Deming, 2018; 2000; Delavigne, 1994). The performance of the activity should be evaluated using predefined indicators and the results should be presented in a report. At this stage, it is important to gather as much information as possible to develop actions for the next phase of the cycle. If irregularities are detected the causes should be identified. In this phase of the cycle the use of check sheets among other things is recommended (Walton, 1991).

In the fourth stage, an important element is to take corrective action especially if inaccuracies are diagnosed in the established plan. The data collected at the end of the cycle should be used to plan the next stage of the improvement cycle (Deming, 2018; 2000; Delavigne, 1994). As a result, the key is to implement those solutions that had a positive impact on the process and improve those with a negative impact. If the established plan is not feasible, a new one should be developed with the resulting conclusions. If there are no abnormalities,

the stage should be continued in the mindset of continuous process improvement without overlooking customer's participation and expectations. Each process activity should be authenticated through appropriate procedural documents. The most commonly used tools at this stage include process mapping and flow diagrams (Walton, 1991).

As a result of using PDCA to solve problems, members of the organization create and implement new challenges and a continuous improvement process is applied in the company which is often considered a critical factor in the company's success (Harrington, 1995).

Proper problem solving in enterprises contributes to the rational use of resources involved in production, improvement of product quality, optimization of production potential and, as a result, to increase the efficiency of the enterprise as a whole (Nakova, Abakova, Kurgambekov, Saule, 2024)

Problem-solving in an enterprise – Case study

The company where the research was performed operates in the metal industry and has been in operation for more than 15 years. Production processes carried out in the organization include the extrusion of sheet metal parts, welding, sealing, varnishing and final assembly at automated, semi-automated and manual stations. At the end of the process products are labeled or marked. A small part of production is directed to customers in Poland, but most products are sold abroad, mainly in Europe.

In 2009, during the economic crisis to prevent the reduction of human resources company decided to invest time and competence in improving the existing processes. At this time the company's problem-solving system was developed and exists till today. Of course, it has went through several changes to respond to "process deviations" and resulted in improvements of problem-solving area. Company also has other systems related to continuous improvement such as the Kaizen system or lean projects that have their origin in value stream mapping, but they are not a part of the problem-solving system, they are functioning independently.

Problem-solving in the examined company involves a system of solving problems when 3 conditions are met:

1. There is a significant difference between the expected state and the actual state which can be defined as a problem. This can be for example an indicator whose target is not met or an adverse event in the form of "passing" a non-conforming product through the machine.
2. The cause is unknown. We are not sure what is the cause of the actual condition, and we need to collect data that will help to determine the issue.

3. It is necessary to find the cause to take effective action. If we have a problem but the other conditions are not met then we are only talking about improvement projects/initiatives for which we use other systems and processes (e.g. Lean projects, Just Do It projects).

In a metal company the problem-solving system consists of several processes depending on the type of problem we are dealing with. These are:

- Internal operational problem-solving process (e.g., for low OEE, high scrap rates, etc.),
- Process for solving quality problems related to customer complaints - QRQC (Quick Response Quality Concern) and 8D for customer communication,
- The process of solving complex problems, mostly connected with the quality that require variability reduction - Six Sigma methodology,
- Process for resolving health and safety incidents (accidents and near misses).

The publication describes the process of solving internal operational problems, meaning, problems where the information source is from within the organization. The first step in problem-solving is awareness of the problem existence. One source of information about the problem is data analysis from the MES (Manufacturing Execution System) which collects real-time information from machines about production performance and downtime. In this case, the most commonly considered indicator is OEE (Overall Equipment Efficiency). Another source of information about the problem is a weekly and monthly analysis of scrap levels by process. At the monthly operational review, decisions are made on which areas and to what extent they will be required to open problem-solving projects. Ownership of the process is taken by the owner of the area usually the coordinator or area production manager. If the scope does not involve production, it is the manager of the department to which the scope applies. For projects related to quality problems, the owner is not a person from the quality department but the coordinator/production manager of the area where the problem was identified. Figure 1 shows the first 4 stages of the problem-solving process related to data collection, data analysis, goal setting and the root causes of problem.

The project owner defines the team but for defined production area the people who support area quality, technology, logistics and maintenance side are indicated. Therefore, most often the owner invites all the people from the supporting departments to the project except those who are not affected by the problem, such as logistics. The CFT or Cross Functional Team takes the challenge to solve the problem.

Before any corrective action is taken, a problem-solving project must begin by gathering detailed information about the problem such as: what exactly is the problem and what is its scale, how was it identified and by whom, how long has the problem been apparent and what is its trend. This is a similar analysis to the 5W2H method. Analysis of this data allows to discard a group of potential causes that the collected data does not support on the early stages of the project. The fourth stage of the process is divided into 4 phases.

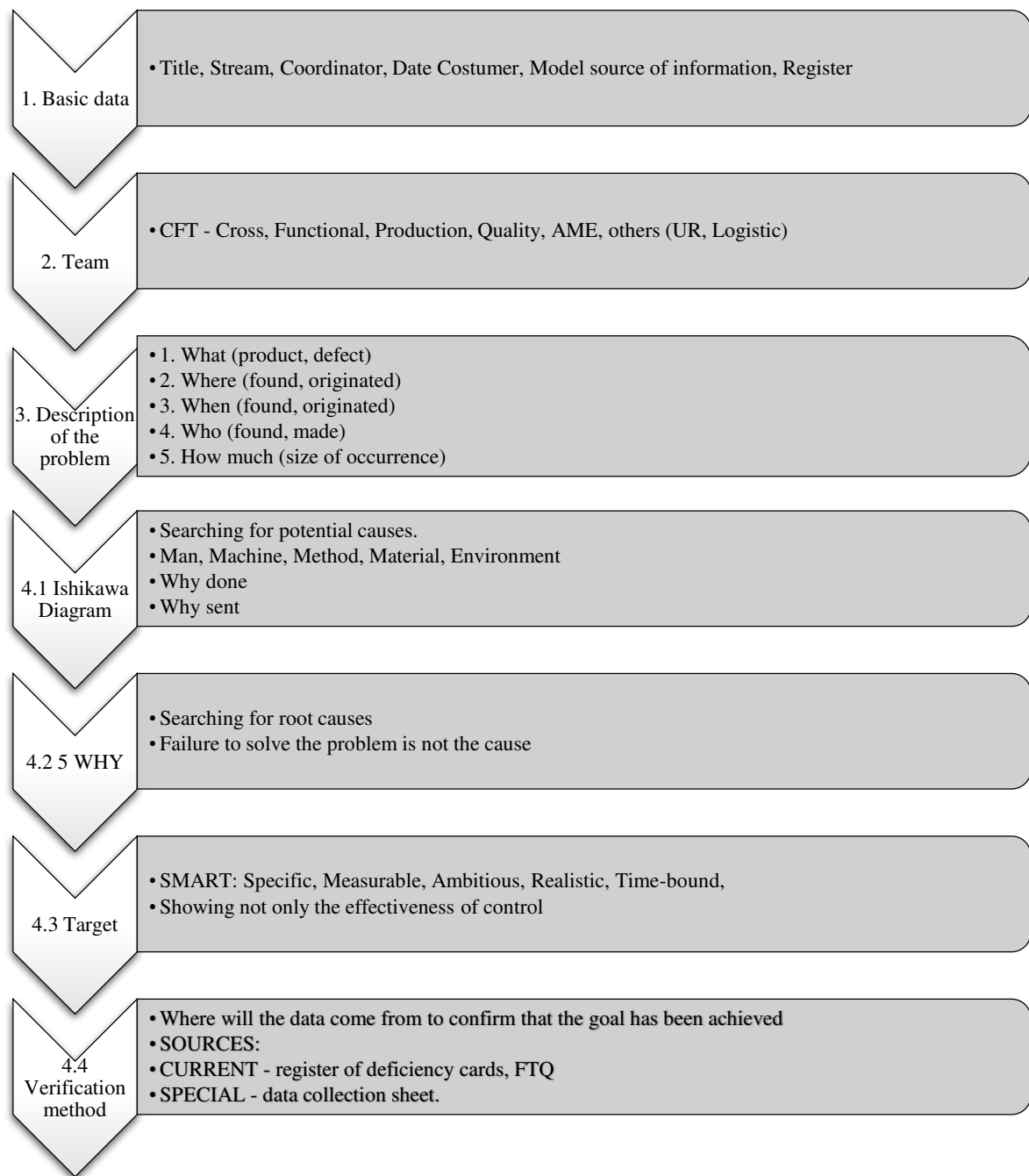


Figure 1. Analytical stages of the problem-solving project.

Source: own elaboration based on company data

The first phase concerns collecting all potential causes of the problem and identifying the most probable ones, which are subjected to verification, i.e. checking whether they are the real reason of the problem existence. Confirmed causes in the next phase of fourth stage are subjected to analysis to determine what is the root cause of the problem (so-called "root cause"), i.e. the elimination of the cause which will significantly affect the solution of the problem, e.g. significantly increase the OEE rate. Here the most common technique is the 5 WHY, or 5 times "why." Some problems will have more than one cause, in which case root cause analysis should be done for each of them. In the third phase of this stage the value of the target

indicator is determined, meaning, the target value (not necessarily representing the ideal state) that meets the SMART rule. The final phase of this stage is to specify by what method and what sources of information will be used to assess whether the defined goal has been achieved.

The first four stages of the problem-solving project are analytical and centered around the collection of data on the current state. Going through all those stages allows to draw the right conclusions and determine the causes of the problem. The key to problem-solving is not to take improvement actions before full analysis of the problem nature and scale. The next steps (5 to 10) will be centered around the actions needed to eliminate the problem and verify the effectiveness of those actions (Figure 2).

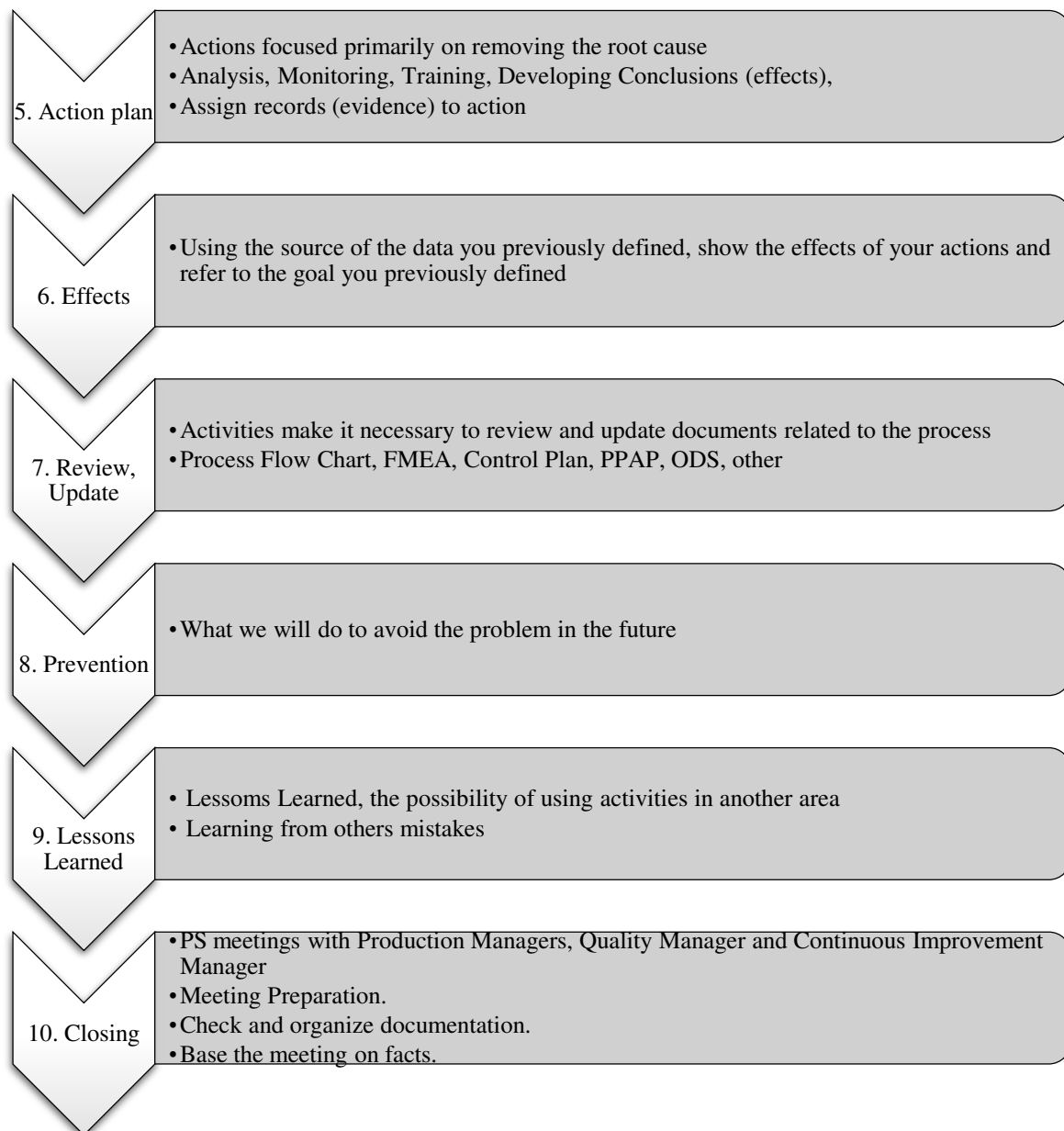


Figure 2. Stages of the problem-solving project including problem-elimination activities and their effectiveness verification.

Source: own elaboration based on company data.

The key to successful problem-solving is the principle of not taking action before the root cause(s) of the problem has been identified and confirmed. Once the cause is known corrective actions should be focused on its elimination. This is what the fifth stage of the problem-solving process is all about. Once all actions are in place the next stage focuses on the results. Results are compared to the value defined as the target (the third phase of the fourth stage) using the verification method defined in the last phase of the fourth stage. If the results obtained are equal to or better than the target established, this confirms the effectiveness of the corrective measures introduced.

The seventh stage helps to maintain the result over the long term and stop the self-reversion to the status quo before the introduction of the measures. To this end, documents and standards are changed to introduce a new "status quo." As a preventive measure, or the next stage, an analysis is made of whether similar causes and actions apply in other areas (e.g., on similar production lines or similar products). Lessons Learned is the eighth stage and allows to reach back to systems and processes and answer the question of whether they require fundamental changes due to the knowledge gained during the problem-solving. However, not every problem-solving ends with the determination of Lessons Learned.

The final stage of problem-solving is the official closing during a specially organized meeting with the company's management. The problem-solving team presents not only the results but the entire process of the project. If there is no doubt about the problem-solving process itself and its results the project is considered successful and officially closed. If not - the actions to be performed by the team before the next attempt to close the project are agreed upon.

All the described stages of problem-solving in the studied enterprise contribute to the organization and knowledge development in this area and its use in the future in terms of solving or eliminating problems more efficiently.

Summary and conclusions

The outline of the problem-solving literature presented in the article indicates the need for research on internal operational problem-solving processes. The analysis of the literature paves the way for further research on problem-solving projects. The article attempts to respond in this area, fitting in with issues such as process improvement, problem-solving or, more specifically, internal operational problem-solving.

The research method used (case stage) contributed to proving the research objective of prioritizing the phasing of problem-solving projects.

The occurring problem is a signal that highlights areas which need attention and improvement. In the company described this results in the opening of a problem-solving project. By identifying the root cause of the problem company can gain valuable insight into inefficiencies or weaknesses in the processes, systems, or strategies. This knowledge is important for creating the effective solutions and improving overall company's performance. Staged problem-solving helps structure and organize the process of solving internal problems by breaking it down into smaller steps or stages. This allows for a better understanding of the problem, the identification of key issues, and the establishment of intermediate goals, all of which contribute to effective problem-solving. What's more, breaking it down into steps allows to track progress and make changes to the process as needed.

The analysis of the problem-solving project can be used to improve the solution of internal operational problems in enterprises. It should also be emphasized that the information obtained contributes to the development of knowledge about problem solving processes. The study also provides valuable information on effective problem-solving strategies in an industrial environment, highlighting the importance of the problem solving stages of internal operational issues.

In summary, a properly structured problem-solving can help companies to remain adaptable and resilient in a dynamic market landscape. Problem-solving can lead to process optimization and productivity gains. In the aspect of the described case study, through Lessons Learned it is possible to re-evaluate existing workflows and procedures and company can identify bottlenecks and improve operations.

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IS IT WORTH REPORTING CSR DATA? THE IMPORTANCE OF SOCIALLY RESPONSIBLE INFORMATION

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Purpose: The aim of the article is to present the importance of non-financial reporting by enterprises in the small and medium-sized (SME) sector of the economy.

Design, methodology and approach: Results of surveys conducted at the end of 2023 among 123 SMEs operating in Czestochowa County were used in this study, in addition to the analysis of the literature on the subject. Logit models were used in the empirical analysis workshops, thanks to which 4 models were estimated (2 complete and 2 reduced), taking into account their determinants in 4 categories.

Findings: The research has shown that as the company grows, the interest in non-financial reporting increases.

Originality/value: The study draws attention to the issues of reporting CSR data in the context of activities of SMEs. It provides valuable information on increasing the transparency of activities and responsibility towards society and the environment.

Keywords: social responsibility, CSR communication, social reporting, GRI guidelines.

Paper category: Research paper.

1. Introduction

Corporate communications have changed significantly in recent years in terms of channels, content and audiences. To maintain accountability, modern enterprises strive to meet the needs of their stakeholders who are increasingly interested in non-financial information related to social responsibility activities (Balluchi et al., 2021). A solution in this area may be a CSR reporting, also known as a “sustainable development reporting”, “social reporting”, “social and environmental reporting”, “social accounting” or “social audit” (Eccles, Krzus, 2010; Matuszczyk, 2015; Aluchna, Roszkowska, 2018).

The academic literature on CSR reporting has been significantly enriched through the development of practices in this area. According to Soderstrom et al. (2017), many corporate accounting, business, finance and management practices now include undertaking and

measuring CSR activities such as organizational disclosure, as well as measuring various aspects of corporate environmental, health and social performance. According to Miloud (2024), disclosing this information is now considered part of the dialogue between the company and its stakeholders.

In recent years, an increasing number of companies around the world have begun reporting on non-financial matters to meet their accountability obligations (Skouloudis et al., 2010; Grewal et al., 2021). According to Lev & Gu (2016), current financial reporting is not a company assessment criterion that would suffice to meet the growing needs and expectations of its stakeholders. The increasing popularity of social reporting is an expression not only of a responsible approach to management, but also a result of changes in the organizations' environments. It can be said that social reports are a tool for communication between the company and its environment, with individual stakeholders, but they are also an element of the market game with competitors. Together with the financial accounts, the CSR report gives a complete picture of the company's performance and allows it to be better assessed (Eccles, Serafeim, 2011).

Taking into account the above, it is important to answer the title question of this paper – is it worth reporting CSR data? This study fills a gap in the existing literature and contributes to research on this topic in the following ways. The hitherto research focused on large and strong organizations (corporations, banks and stock exchange-listed companies) (e.g.: Fonseca et al., 2014; Nazari et al., 2017, Hamed et al., 2022; George et al., 2023). Little is known about the reporting of CSR data by SMEs, in particular those operating in Poland. This lack of data on the sustainability and reporting practices of SMEs is due to the fact that they report voluntarily and are guided by other “driving factors” (Ortiz-Martínez et al., 2023). Second, this study complements existing research on the importance of socially responsible reporting (Koseoglu et al., 2021; Van Hoang et al., 2023).

2. Literature review and conceptual framework

In recent years, external CSR reporting has become a standard, and increasingly more widespread, business practice worldwide. This development is driven by the need to tell various stakeholders that environmental and social risks are being properly managed (Karaman et al., 2021). According to Liao et al. (2017), communication on socially responsible activities is not only an effective technique for gaining social recognition but also an essential ingredient of modern business management. Additionally, consumers are increasingly aware of the impact of business on society and the environment, and they expect companies to act in accordance with ethical principles and care about social welfare. CSR communication is a tool that allows

companies to show that they understand these expectations and take responsibility (Sparacino et al., 2024).

The importance of disclosing non-financial (social and environmental) information dates back to the 1940s, when Stanford University professor T.J. Kreps argued that standard accounting for corporate profits was insufficient. In the course of his research, he considered ways to measure the contribution of enterprises to the achievement of the overall goals of the economic system (Aluchna et al., 2018). In the 1950s, when the concept of CSR began to develop and evolve, companies began to increasingly consciously take actions aimed at influencing society and the environment – outside their core business. This trend was studied by Bowen who proposed a system for external auditors to assess corporate performance at length. However, audit results were used only by corporate executives (Hess, 2008). Finally, companies adopted social audits of their activities in the 1970s, as a result of the debate about the social role of business. This trend gained on momentum in the 1990s when a number of environmental disasters occurred and several national and international initiatives and frameworks related to sustainable development and social responsibility were launched (Khatri, Kjærland, 2023).

Initially, reports focused on environmental and environmental matters. As society escalated their demands on businesses, these reports were supplemented with other (non-financial) subjects, such as sustainability, ethics, management, community, employees, health and safety (Vartiak, 2016). Accordingly, CSR reporting has emerged as a result of stakeholder concerns about “social and environmental implications of business activities and the corporate governance reform around the world” (Zainal, Zainuddin, 2013). As Ting (2021) notes, CSR reporting is somewhat symbolic of social responsibility. On the one hand, reporting allows for the refinement of CSR practices, while identifying areas requiring improvement, which may also have a positive impact on the company’s bottom line. On the other hand, CSR reports can be used as “perception management” strategies to create a symbolic image of social responsibility even without significant commitment to CSR practices. Fuente et al. (2017) believe that disclosing information on the implementation and use of CSR practices is the most frequently used means to improve relations with stakeholders.

Currently, there is no single mandatory template for preparing a social report. There is freedom as to the level of detail of information presented in such reports. Nevertheless, the literature on the subject offers a number of guidelines and standards regarding CSR reporting. This framework proposes criteria for the selection of relevant non-financial data and for the format of its reporting (Róžańska, 2015). The most popular reporting guidelines include: OECD guidelines for multinational enterprises, Global Reporting Initiative (GRI) guidelines, Global Compact guidelines, Standard AA1000, ISO 26000 standard, CERES Principles, SA 8000 Standard, Carbon Disclosure Project, Sustainability Global Reporters Program, International Federation of Accountants – Sustainability Framework (Badura-Mojza, 2017; Chojnacka, Wiśniewska, 2016; Subramaniam et al., 2023). Despite so many guidelines,

CSR reports are sharply criticized for lack of credibility, pseudo-transparency and poor quality (Lock, Seele, 2016). On the other hand, social reports bring a number of benefits both to the enterprise (building trust and credibility among stakeholders, monitoring progress in implementing sustainable development strategies, building competitive advantage, increasing transparency) and stakeholders (better awareness of CSR activities, stronger motivation for action, having reliable information about the company and its ethical standards and compliance with the law, building a sense of shared responsibility) (Ćwik, 2013).

The following assumptions have been defined regarding the reporting of CSR data by SMEs:

- A1: There is an increased need to provide socially responsible information by SMEs,
- A2: There is a growing interest in reporting CSR data among SMEs.

3. Research methodology and research sample

A survey was conducted using the PAPI and CAWI questionnaires in order to explore the practices of non-financial reporting among SMEs. 123 correctly completed questionnaires were obtained for data analysis.

Based on the research of Ortiz-Martínez et al. (2023), the following three organization features were accepted as the grouping criteria: “Size”, (business) “Profile” and “Maturity”. The “Sector” (of the economy) was an additional criterion.

Analysis of the collected material shows that:

- 47.15% of the SMEs are micro-enterprises (up to 9 employees), 35.77% are small (10-49), and 17.07% are medium-sized (50-249).
- 48.65% have been operating on the market for over 10 years, 40.55% for 1-10 years (8.11% – 1-3, 16.22% – 3-5, 16.22% – 5-10) and the remaining 10.81% shorter than 1 year.
- 70.27% declared that they business as services, 13.51% as mixed, 10.81% as commercial and 5.41% as production.
- 56.76% run their business on local markets, 21.62% on a national scale, 18.92% on regional markets, 2.7% on the European market.

The starting point for the statistical analysis was the econometric modeling instrumentation in the form of a multidimensional ordered logit model (Kufel, 2007). The estimated models included only boolean variables coded based on the respondents' answers (explained variables). It was assumed that the explained variable (Y) defines the respondent as follows:

- $y_i = 1$ if the i -th enterprise declares its willingness to publish CRS (i.e., non-financial) data,
- $y_j = 0$ if the j -th enterprise is not interested in publishing CSR data.

The input set of independent variables (X) included variables relating to the characteristics of the entities covered by the study. In order to properly analyze the data, the following were selected as reference groups: micro-enterprises, enterprises younger than one year, commercial enterprises, enterprises operating on local markets. Taking into account the explained variables (Y), they were coded based on respondents' answers for $W1$ and $W2$.

4. Results and discussion

Implementing CSR is a form of implementing a social contract, as well as an attempt to build its legitimacy in the eyes of stakeholders (Bernardi, Stark, 2018; Olejniczak-Szuster, Dziadkiweicz, 2022). Disclosure of sustainability reports is also becoming essential for SMEs as they are the backbone of the economy and play an essential role in the global goal of sustainability. However, for these companies, this should be proportionate (Ortiz-Martínez, Marín-Hernández, 2023).

It is them who pay more and more attention to the ethical, social and environmental aspects of business. Taking into consideration the selected organization features, two logit models were built using the GRET (Olejniczak-Szuster, 2023) software suite for each of the analyzed response variables (y – $A1$ and $A2$), including:

- 2 complete models covering all the variables (x),
- 2 reduced models covering only significant variables (x).

The results of the analyses are presented in Table 1.

Table 1.

Results of the estimation of the logit model for $A1$

Category		Factor	Standard error	z	p	Significance
Model 1: Complete logit model for $W1$						
Const		-0.161249	1.24833	-0.1292	0.8972	
Size	S	-17.3128	1.31019	-13.21	<0.0001	***
	M	0.297241	0.845015	0.3518	0.7250	
Maturity	P10	-1.06052	1.31742	-0.8050	0.4208	
	5-10	-1.26175	1.34306	-0.9395	0.3475	
	3-5	-1.85354	1.40677	-1.318	0.1876	
	1-3	16.2464	1.68679	9.632	<0.0001	***
Profile	Serv	1.81213	0.960364	1.887	0.0592	*
	Mix	1.75347	1.00740	1.741	0.0818	*
	Prod	-1.05561	1.20150	-0.8786	0.3796	
Market	Local	-1.07197	0.724621	-1.479	0.1390	
	Poland	-0.569298	0.710694	-0.8010	0.4231	
	Europe	-0.365834	0.808373	-0.4526	0.6509	

Cont. table 1.

Model 2: Reduced logit model for A1						
Const		-1.60944	1.09545	-1.469	0.1418	
Size	S	-16.9143	1.03409	-16.36	<0.0001	***
Maturity	1-3	17.6094	1.03409	17.03	<0.0001	***
Profile	Serv	1.23848	1.20729	1.026	0.3050	
	Mix	1.26931	1.12665	1.127	0.2599	
Model 3: Complete logit model for A2						
Const		-1.24798	1.15244	-1.083	0.2789	
Size	S	18.9029	1.45420	13.00	<0.0001	***
	M	-0.828039	1.09243	-0.7580	0.4485	
Maturity	P10	1.06307	1.07362	0.9902	0.3221	
	5-10	1.33729	1.05023	1.273	0.2029	
	3-5	2.06246	1.13954	1.810	0.0703	*
	1-3	-15.2482	1.46921	-10.38	<0.0001	***
Profile	Serv	-1.20682	1.11718	-1.080	0.2800	
	Mix	-1.22939	1.07856	-1.140	0.2544	
	Prod	0.350034	0.914628	0.3827	0.7019	
Market	Local	1.15193	0.761583	1.513	0.1304	
	Poland	0.418820	0.761543	0.5500	0.5823	
	Europe	-0.544828	0.775613	-0.7024	0.4824	
Model 4: Reduced logit model for A2						
Const		-0.625094	0.200998	-3.110	0.0019	***
Size	S	17.9787	1.02000	17.63	<0.0001	***
Maturity	3-5	0.625094	0.611338	1.023	0.3065	
	1-3	-16.6817	1.02000	-16.35	<0.0001	***

Explanation: Levels of significance of the parameters – *** $\alpha = 0.01$, ** $\alpha = 0.05$, * $\alpha = 0.1$.

Source: Own study.

Looking at the results of the estimation of the logit models (Table 1), the “Market” was never a statistically significant factor influencing the probability of reporting socially responsible data by SMEs. There may be a number of likely reasons for the lack of this statistical significance. Firstly, the market may not have a direct impact on decisions regarding reporting socially responsible data. Another reason may be the lack of adequate precision or accuracy of the variables used to describe the market. However, as Ko et al. (2021) research has shown, the role of CSR is important internationally, as foreign institutional pressures can influence the CSR strategies of small and medium-sized enterprises.

Such significance, at the $\alpha = 0.01$ level, was demonstrated by variables relating to the “Size” of the enterprise (in each complete and reduced model). It can therefore be concluded that as a company grows, its impact on society and the environment also increases, which makes it necessary to report more comprehensively on socially responsible and sustainable development activities (Zastempowski, Cyfert, 2021; Magrizos et al., 2021; Moursellas et al., 2023).

Statistical significance can also be noticed for the “Maturity” of the enterprise. The level of significance in models 1 and 2 is $\alpha = 0.01$. The same α value is observed in models 3 and 4, for 1-3 years old enterprises. It should be noted that $\alpha = 0.1$ is also valid in the complete model 3, for 3-5 year-olds. Considering the foregoing, it can be concluded that reporting non-financial data is more often the domain of enterprises with a longer track record.

Based on the data obtained, it can also be concluded that there is a relationship between the company's "Profile" and the reporting of CSR data (the complete model for A1, with the significance level $\alpha = 0.01$). Obviously, the stronger commitment to CSR, the broader the reporting and *vice versa*. Research by Reimsbach et al. (2018) indicate that company size, development opportunities, and profitability are positively correlated with the adoption of non-financial reporting.

In order to qualitatively evaluate the estimated models, Table 2 presents measures of data fit for individual models.

Table 2.
Data fit measures for estimating logit models 1-4

Measure	Model 1	Model 3	Model 2	Model 4
	Complete		Reduced	
Likelihood Ratio Test	9.64835 [0.6468]	10.1545 [0.6024]	4.52147 [0.4770]	3.95887 [0.2659]
Akaike Information Criterion	182.5396	177.3966	173.6665	165.5923
Bayesian Information Criterion	219.0980	213.9550	190.5396	176.8410
Hannan-Quinn Information Criterion	197.3896	192.2466	180.5203	170.1615
Log likelihood	-78.26981	-75.69832	-80.83325	-78.79614
Number of cases of 'correct prediction'	75 (61.0%)	79 (64.2%)	74 (60.2%)	79 (64.2%)

Source: Own study.

Analyzing the measures of data fit to logit models presented in Table 2, it can be concluded that all the estimated models show statistical accuracy. As a result of the modeling, a high χ^2 test statistic was obtained (in all the estimated models). The comparison of parameters for assessing quality of the estimation models shows that models 2 and 4 are more econometrically accurate, as evidenced by the largest number of instances of correct prediction: 64.2%. This means that in the case of the variable y_2 decisive for A2, the prediction coincides with the reality to the greatest extent. Equally high estimation quality can be seen in models 1 and 3. The share of "correct prediction" cases in these models is 60.6% on average. The results obtained can be considered satisfactory.

Conclusion

In recent years there has been a sharp increase in interest in CSR reporting. Researchers and entrepreneurs have noticed the importance of such communication presenting social and environmental aspects of the company's business (Liu, Liu, 2023). SMEs play a particularly important role in the economic landscape, accounting for a significant share of the world's business. Therefore, the increasing need to provide socially responsible information by SMEs is extremely important. Even though SMEs may have smaller financial and human resources than large corporations, they can add enormous social value by committing to the world of

CSR. Therefore, SMEs should actively pursue such policies and regularly communicate relevant initiatives.

It should be emphasized that the issues raised by the author do not exhaust the list of areas of her studies. This paper refers only to the interest in CSR reporting and the importance of publishing socially responsible information. It is also worth remembering that the logit model may not take into account all important factors influencing the interest in reporting CSR data among SMEs.

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DRIVERS AND BARRIERS TO THE USE OF ALTERNATIVE CONSTRUCTION MATERIALS IN AFRICA

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Purpose: The deepening housing deficit in Africa appears unmanageable by the current escalating costs of conventional building materials from economic recession. The shortfall is exacerbated by the rising population growth, particularly in Nigeria. Despite the research evidence of the capability of alternative construction materials (ACMs) to replace conventional materials, their use in building construction is established to be low in the country. This study therefore examines the drivers and barriers of ACMs in building construction in Nigeria.

Design/methodology/approach: The study conducts a self-study structured questionnaire survey on building construction professionals. The professionals, the unit of analysis, are purposively sampled. The study area is Nigeria.

Findings: The key drivers to using ACMs include minimization of construction waste, low cost of ACMs, promotion of sustainable development, and energy efficiency. The analysis shows that these variables are significant in facilitating the use of ACMs in the Nigerian building sector. The results also establish an existing correlation between the barriers to the use of ACMs within eight (8) main components. These are cost-related barriers, support-related barriers, design-related barriers, market-related barriers, professional-related barriers, convention-related barriers, social barriers, and policy-related barriers.

Practical implications: The instruments of government support that enhance a large commercial scale production of ACMs and use are expedient to raise the level of confidence of stakeholders on the use of ACMs in Nigeria. Institutions of learning, professional bodies, and technological research and development institutes also have crucial roles to play in the general acceptance of ACMs in building construction.

Originality/value: The study provides information to solving social housing problems towards national economic development and growth.

Keywords: Alternative Construction Materials, Barriers, Drivers, Building, Nigeria.

Category of the paper: Research paper.

1. Introduction

There is a high-rising level of awareness of alternative construction materials (ACMs) in Africa, particularly in South Africa, Ghana, and Nigeria (Masia, Kajimo-Shakantu, Opawole, 2020). Studies establish that ACMs are low-cost, locally available, structurally sound, green, and environmentally friendly (Evison, Kremer, Guiver, 2018). However, the extent of use of ACMs in building construction is rather low in Africa (Opawole, Kajimo-Shakantu, Olapade, 2022). Currently, the housing shortfall in Africa is overwhelming. Nigeria has a housing deficit of 14-16 million, about 3.7 million in South Africa, 1.7 million in Ghana, and an annual demand of up to 250,000 units in Kenya (Habitat for Humanity, 2022). Addy et al. (2020) aver that the economic issues of building production remain the major concern in Africa. Iwuagwu, Iwuagwu (2015) added that the impact of the escalating costs of conventional construction materials (CCM; predominantly adopted for building construction) on housing units' unaffordability in Africa is massive. The status quo of housing deficits in Africa is salvageable, if alternative materials to CCMs are given due consideration. Solving the problem of housing shortfalls through the use of ACMs calls for urgent attention in Africa (Habitat for Humanity, 2022; Iwuagwu, Iwuagwu, 2015).

ACMs have the structural fitness to partially or fully replace conventional materials in building construction, without compromising on quality (Van Deventer et al., 2010). Examples of ACMs include bamboo, bituminous substance, timber, reinforced plastics, tempered glass, fiber-reinforced polymer, Ferro-cement, soil conditioning agent, polyester fibers, palm oil fly ash, structural insulated panel, clay-based materials, waste-based materials (i.e. plastic in concrete, coconut fiber in concrete, waste phosphor-gypsum and natural gypsum in soil block (Zarman et al., 2022; Shubbar et al., 2019; Danso, 2018; Nweke, 2017; Gomez, Raut, 2016; Ede et al., 2015). Other ACMs established to be highly sustainable are aluminum thatch, low emissivity glass windows and doors, solar tiles, cellular lightweight concrete, Sulfo-Aluminate cement, adobe block, earthbags, ceramics, autoclaved aerated concrete, strawbales, low volatile compound paint, grasscloth wallpaper, terrazzo, eco surface, medium density fiberboard, grass pavers, faswell, etc. (Maisia et al., 2022; Opawole et al., 2022; Iwuagwu, Iwuagwu, 2015).

Studies like Van Deventer et al. (2010, 2012) establish that the capabilities of ACMs to emit less greenhouse gases and to technically as well as commercially replace the CCMs are the drivers of their uses in building construction of developed nations. The geopolymers of ACMs are composed of fly ash, metallurgical slags, and natural pozzolans characteristics which produce up to 80% lesser carbon emission than OPC. Moreover, ACMs are safe, durable, and cheap in building construction (Magutu, 2015). It is believed that ACMs are cheap because they are locally produced and there is a reduction in the transportation cost to be incurred, unlike the imported materials. Magutu (2015) opines that the use of ACMs in building construction reduces the cost of production and supply of decent low-cost housing units that are affordable

to low-income earners. Vejaratnam et al. (2020) claim that the awareness of green materials coupled with the individual beliefs and acceptance of the procurers are crucial drivers to their adoption.

Rather than the environmental benefits of ACMs, the economic effectiveness of ACMs is asserted to be the main driver of their use in developing countries, particularly Africa (Addy et al., 2020). For example, Masia et al. (2020) aver that the operational cost-saving potential of a green building is the strong force that has given impetus to the use of ACMs in South Africa. The lifecycle cost-saving potentials of ACMs are envisaged to allay the fear of the risk-averses in the country. Also, increased demand for office spaces and political incentives are stressed to be the drivers of the use of ACMs in the country. Afunanya, Job (2016) and Gbadebo (2014) stress that the drivers of ACMs in Nigeria are their capabilities to solve socio-economic problems of unemployment and deficient housing spaces, reduce construction time because it is easy to work with, and their cost-effectiveness. Zami (2015) reveals that the drivers for the use of ACMs in Zimbabwe are enhanced technologies, developments in innovative earth construction, public media promotion of earthen construction by stakeholders, the introduction of degree programmes on earth architecture in universities, and organization of training workshops for stakeholders. Addy et al. (2020) reveal that the development of government policies and regulations on green building, and regulating the standardization of green building are the drivers of ACMs in Ghana.

The empirical findings by Simpeh et al (2021) give a suitable taxonomy of the barriers to the practice of green building procurement in South Africa. The barriers are costly green technologies and materials, unaffordability of green building certification, poor data management and motivation system that limited the incorporation of ACMs in building projects, vague regulatory and steering approaches for the implementation of green parameters in building development, scarce professionally skilled human resource to execute green building procurement, and behavior-averse of stakeholders to green building materials. Moreover, Mbambo, Agbola, Olojede (2021) stress that the barriers to ACMs in housing delivery for black South Africans, especially the AV light steel house, are low consumer education and acceptance of ACMs, weak buy-in and marketing of the innovative building by both the private sector and the government, insufficient government subsidies for new entrant suppliers, and lack of synergy between suppliers and contractors.

Addy et al. (2020) identify the barriers to the broader development of housing facilities with ACMs in Ghana as lack of awareness of the materials, lack of educational inclusion, absence of fiscal incentives to motivate professionals and low demand for innovative buildings. The Centre for Affordable Housing Finance in Africa (CAHF, 2019) aver that over 80% of Ghanaians cannot afford the cheapest housing unit which consequently informs the low demand for innovative construction in Ghana. In Malaysia, Samari et al. (2013) reveal the barriers to the adoption of ACMs in building construction to include scarce resources to reduce the upfront cost, project investment risk, low demand for ACMs, high final cost of building development,

lack of technology, lack of expertise, and absence of government support. The study by Pradhananga, Elzomor, and Kasabdjji (2021) on the barriers to sustainable construction practices in Venezuela stresses that the prevailing unstable economies, monopoly, political cataclysms, and inadequate policies are the impediments to the adoption of ACMs in building construction. Oyewole, Ojutalayo, and Araloyin (2019) establish that the ACM building market is a capital-intensive venture that discourages developers in Nigeria from investing in such a venture. Developers are reluctant to embrace green procurement because the immediate economic benefits of ACMs are not easily achievable, except for the lifecycle cost benefits (Choi, 2009). Also, the building developers insist on the use of CCMs because they are already accustomed to them, and the users are prejudiced against using ACMs in Nigeria (Iwuagwu, Iwuagwu, 2015; Gbadebo, 2014). Table 1 displays some other barriers inhibiting the use of ACMs in building constructions in developing nations.

Table 2.
The barriers to the use ACMs in building construction

Critical barriers	Countries	Authors
Limited resources to cover the upfront cost, investment risk, lack of demand for ACMs, and higher final cost	Malaysia	Samari et al. (2013)
Perceived high initial costs, dearth of knowledge of innovative buildings and technological difficulties, lack of demand and strategies to promote sustainable construction, higher financial cost, poor public awareness and government support, shortfall in the diffusion of knowledge and practice of GB certification, lack of education and awareness, no standard green building tool, limited of expertise, no fiscal incentives from government, limited of research and case studies, more focus on capital costs than on operating cost, lack of eco-labeling for products and materials	Ghana	Opoku, Ayarkwa, Agyekum (2019); Djokoto, Dadzie, Ohemeng-Ababio (2014); Ampratwum et al. (2019); Agyekum, Adinyira, Oppon, (2019); Addy et al. (2020)
Poor knowledge of true investment returns, dearth of knowledge and education of green building, paucity of existing green building projects for sufficient knowledge gaining for designers, reluctant developers/contractors, limited practical knowledge and expertise of building owners and designers, undue overestimation of initial cost of innovative building by estimators, clients' apathy, lack of reliable benchmarking data for performance rating of green building	South Africa	Chan et al. (2018); Bond, Perrett (2012); Darko, Chan (2016)
Reduced commitment from higher management, lack of management support, perceived higher cost of green procurement, lack of government enforcement, high costs, lack of awareness and passive culture, lack of tools and indicators for environmental assessment	India	Mojumder et al. (2022)
Conflicting prejudice by professional builders; lacking resources and technologies; lacking protective legislation for earthen buildings; inaccessibility of credit facilities and insurance cover; lacking policy to minimize CCMs usage; misconception of users and ill-fated cultural belief; lacking academic provisions for training on earthen building construction in universities; lower professional charges from earthen construction; lacking market demand for earthen buildings by users; lacking requisite expertise of professionals and understanding by users	Zimbabwe	Zami (2015)

2. Methods

This study adopts a quantitative research approach using a questionnaire survey to identify the drivers of the use of ACMs and to investigate the barriers to the use of ACMs for building construction in Africa, particularly Nigeria. The questionnaire was well structured and close-ended to enable the respondents to accurately attend to the objectives of the study, while also expressing their practical views from construction experience (Kumar, 2011). The drivers and barriers drawn from the review of similar studies formed section B of the questionnaire design, while the profile of the respondents formed section A of the questionnaire design. The questionnaire was self-administered to professionals from architectural firms, contracting firms, and quantity surveying firms in Lagos State, Nigeria. Lagos is the commercial nucleus of Nigeria, the most populous city in the country having 15.4-24 million population, with the highest rate of urbanization, and the top-ranked State with the highest demand for building infrastructure (Egbo, 2022; Ugochukwu, Chioma, 2015). The State is the nation's construction hub.

The professionals who have been engaged in the design of buildings with ACMs, who have given cost advice on the financial implications of ACMs for building construction, and who have executed building construction with ACMs, were the target population for the study. Since the construction practices and experience with ACMs are not as prevalent as the construction practices and experience with CCMs (Harte, 2017; van Deventer et al., 2010), the professionals who have an awareness of ACMs and have been involved in the use of ACMs for building construction were purposively sampled for the study, to obtain accurate and correct data on the drivers and barriers to the state-of-the-art uses of ACMs in building construction. As a result, the survey captured and retrieved complete responses from nine architects, four builders, one developer, twenty-two engineers, and thirty-one quantity surveyors (QS). These professionals (67) surveyed are the key construction professionals in the construction industry.

The data obtained, on the drivers and barriers variables (see Table 2), from the expert opinions of the professionals, were analyzed by the SPSS statistics v22. Descriptive and inferential statistics were the statistical tools employed for the analysis. The descriptive tools were frequencies, percentages, and mean scores. The variables of drivers and barriers of ACMs were examined using Mean Score (MS) to identify the drivers and barriers that predominate the Nigerian building construction sector. A five-point Likert scale of 5 to 1 ($5 > 4 > 3 > 2 > 1$) was adopted, where the respondents were asked to rank the drivers on a scale of 5 = most important, 4 = more important, 3 = important, 2 = slightly important, 1 = not important. The respondents were asked to rank the barriers on a scale of 5-1; 5 = most critical and 1 = not critical. The mean score calculation was based on the expression (Cheung et al., 2012):

$$MS = \sum(f \times s)/N \quad (1)$$

where:

“s” is the score given to the drivers and drivers,

“f” is the frequency of each rating (1-5) for each variable, and

“N” is the total number of responses concerning the variables on ACMs.

The inferential statistical tools were the factor analysis, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and Bartlett’s test of sphericity. The sample size to variable (STV) of the study, STV = 2.75:1, subjected to factor analysis agrees with the adequacy of STV of 2:1 or STV of 3:1 for factor analysis recommended by Glas, Raithel, Essig (2019). Also, the validity of sampling adequacy by the KMO test, KMO of study = 0.63, agrees with the acceptable and good values range of 0.5–1.0 for factor analysis recommended by Kaiser (1974).

Table 2.

Drivers and barriers of ACMs

	Drivers		Barriers
D1	Minimization of construction waste	B1	Lack of funding and insufficient capital
D2	Low cost of ACMs as against the high cost of CCMs	B2	Poor policy environment
D3	Promotion of sustainable development	B3	Low market demand for ACMs
D4	Education on the green benefits of ACMs	B4	Lack of technical expertise
D5	Energy efficiency	B5	Unavailable cost data on benefits of ACMs
D6	Increase of client’s awareness about ACMs and demand	B6	Unwillingness and lack of support from end users
D7	Locally manufactured and available	B7	Lack of performance evaluation indicator
D8	Noise insulation benefits of ACMs	B8	Risks in adopting new practices
D9	Low cost of maintenance	B9	Low technological innovations
D10	Massive investment in building technology	B10	Lack of green building codes
D11	Affordability	B11	Unwillingness of professionals
D12	Non-toxicity of material	B12	Low public awareness of ACMs
D13	Increasing building regulatory pressure	B13	Lack professional knowledge
D14	Water efficiency of ACMs	B14	Ignorance of green benefits of ACMs
D15	Increase of clients’ awareness about the cost benefits of ACMs	B15	Lack of regulation
D16	Rapidly renewable	B16	Conservativeness of management to CCMs
D17	Political support and increasing incentives	B17	Low-scale availability of ACMs
D18	Promotion of cultural heritage	B18	Cultural belief on the less aesthetic appearance of ACMs
D19	Recyclability	B19	High maintenance cost
D20	Energy efficiency and user’s wellbeing	B20	Ineffective application from immature technology
		B21	Lack of government incentives
		B22	Complexity of design that supports ACMs
		B23	Lack of organizational structure

3. Results

3.1. The respondents' profile

Table 3 displays the background information about the respondents on their professional and academic qualifications, years of construction work experience, and the number of projects they have executed and/or been involved in. The respondents captured are key construction professionals from both contracting and consulting firms. About 46.3% of the respondents are quantity surveying, 32.8% are engineers, 13.4% are architects and 6% are builders. The average construction work experience of the respondents is estimated at approximately eleven years. The respondents have handled the construction of buildings with ACMs at approximately twelve projects. This profile information about the respondents authenticates the adequacy of information obtained for this study.

Table 3.
Demographic information of respondents

Profile	Attribute	Frequency	%
Profession of respondents	Architect	9	13.4
	Quantity surveyor	31	46.3
	Engineers	22	32.8
	Builder	4	6.0
	Developer	1	1.5
Highest academic qualification of respondents	OND/HND	10	14.9
	B.SC/B.Tech	45	67.2
	M.Sc/M.Tech	12	17.9
Year of construction work experience	1-5	23	34.3
	6-10	16	23.9
	11-15	10	14.9
	16-20	9	13.4
	21-25	9	13.4
Number of projects executed	1-5	16	23.9
	6-10	18	26.9
	11-15	8	11.9
	16-20	12	17.9
	21-25	13	19.4
	Total	67	100.0

3.2. Drivers of ACMs in building construction in Nigeria

The study reveals that up to 19 drivers are important in boosting the use of ACMs in building construction in the country (Table 4). The MS values of the drivers range from $3.45 \leq MS \leq 3.99$. Just one of the drivers is revealed by the study to be more important in fostering the use of ACMs in building construction in the country. The more important driver is the minimization of construction waste ($MS = 4.10$). A test of significant difference among the drivers rated by the professionals was conducted using the Kruskal Wallis H test. A significance value range of $p \leq 0.000$ is known to be of significant difference, while $p > 0.005$ is of no significant difference (Kaiser, 1974 in Field, 2009). The result indicates that there exists

no significant difference in the ranking of the level of importance of the drivers to the use of ACMs in building construction in Nigeria by all the professionals, with a significance range of $0.983 \leq p \leq 0.065$.

Table 4.

The drivers of ACMs in building construction in Nigeria

Drivers	All professionals		Architects		Quantity surveyors		Engineers		Builders		Kruskal Wallis h test
	MS	R	MS	R	MS	R	MS	R	MS	R	
D1	4.10	1	4.44	1	4.00	2	4.09	3	4.00	7	0.712*
D2	3.99	2	4.22	2	4.06	1	4.00	6	2.50	20	0.065*
D3	3.93	3	4.11	5	3.97	3	3.91	8	3.25	15	0.983*
D4	3.91	4	3.89	7	3.55	9	4.27	1	4.50	1	0.106*
D5	3.78	5	3.67	11	3.52	11	4.05	5	4.50	1	0.264*
D6	3.73	6	4.22	2	3.74	4	3.41	19	4.00	7	0.171*
D7	3.73	7	4.22	2	3.74	4	3.55	17	3.25	15	0.293*
D8	3.73	8	3.44	15	3.48	12	4.14	2	3.75	11	0.202*
D9	3.73	9	3.78	9	3.71	6	3.77	11	3.25	15	0.560*
D10	3.69	10	3.56	14	3.68	8	3.64	13	4.25	3	0.841*
D11	3.69	11	3.78	9	3.71	6	3.50	18	4.00	7	0.748*
D12	3.60	12	3.33	17	3.48	12	3.95	7	3.00	19	0.301*
D13	3.58	13	3.44	15	3.23	19	4.09	3	4.25	3	0.092*
D14	3.57	14	3.89	7	3.48	12	3.59	15	3.25	15	0.861*
D15	3.55	15	3.67	11	3.55	9	3.64	13	3.50	13	0.606*
D16	3.54	16	4.00	6	3.39	16	3.41	19	4.25	3	0.489*
D17	3.52	17	3.33	17	3.19	20	3.86	9	4.25	3	0.122*
D18	3.51	18	3.67	11	3.26	17	3.77	11	3.50	13	0.692*
D19	3.49	19	3.33	17	3.26	17	3.82	10	3.75	11	0.472*
D20	3.45	20	3.22	20	3.42	15	3.59	15	4.00	7	0.290*

**significant difference, *no significant difference, R = Rank.

3.3. Barriers to ACMs in building construction in Nigeria

The study reveals that up to 9 barriers are more critical barriers militating against the use of ACMs in Nigerian building construction (Table 5). The MS values of the more critical barriers range from $4.00 \leq MS \leq 4.75$. About 14 barriers are revealed by the study to critically militate against the use of ACMs in building construction in the country, having the MS values range of $3.00 \leq MS \leq 3.75$. A test of significant differences among the barriers rated by the professionals was conducted using the Kruskal Wallis H test. A significance value range of $p \leq 0.000$ is known to be of significant difference, while $p > 0.005$ is of no significant difference (Kaiser, 1974 in Field, 2009). The result indicates that there exists no significant difference in the ranking of the critical levels of 22 barriers to the use of ACMs in building construction in Nigeria by professionals, with a significance range of $0.949 \leq p \leq 0.171$. However, there exists a significant difference of $p = 0.021$ in the ranking of the critical level of the barrier of poor policy environment by the professionals in the country.

Table 5.*The barriers to ACMs in the Nigerian building construction sector*

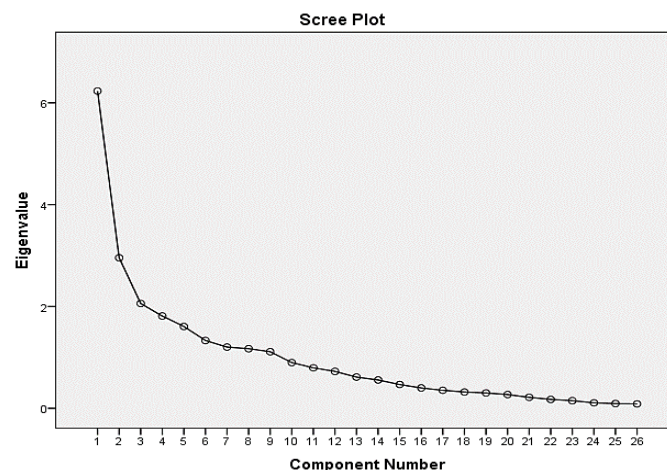
Barriers	All professionals		Architects		Quantity surveyors		Engineers		Builders		Kruskal Wallis H test
	MS	R	MS	R	MS	R	MS	R	MS	R	
B1	4.75	1	4.09	1	4.33	1	3.97	2	4.00	2	0.544*
B2	4.00	6	3.88	2	3.44	12	3.68	13	4.27	1	0.021**
B3	4.50	2	3.88	2	3.78	3	3.81	6	3.86	4	0.582*
B4	4.25	3	3.88	2	3.56	8	4.13	1	3.55	19	0.191*
B5	4.00	6	3.84	5	3.56	8	3.97	2	3.68	12	0.549*
B6	4.00	6	3.82	6	3.44	12	3.97	2	3.68	12	0.589*
B7	3.50	12	3.82	6	3.56	8	3.81	6	3.95	3	0.708*
B8	4.25	3	3.75	8	3.78	3	3.74	10	3.59	18	0.631*
B9	3.75	10	3.75	8	3.89	2	3.71	11	3.68	12	0.730*
B10	4.00	6	3.73	10	3.11	18	3.81	6	3.86	4	0.263*
B11	3.00	21	3.69	11	3.22	17	3.81	6	3.82	9	0.549*
B12	4.25	3	3.69	11	3.67	6	3.87	5	3.27	21	0.313*
B13	3.50	12	3.66	13	2.89	22	3.71	11	3.86	4	0.286*
B14	3.75	10	3.64	14	3.33	15	3.68	13	3.64	15	0.602*
B15	3.50	12	3.64	14	3.00	20	3.65	15	3.86	4	0.185*
B16	3.25	18	3.61	16	3.56	8	3.65	15	3.64	15	0.992*
B17	3.25	18	3.57	17	3.44	12	3.39	23	3.86	4	0.403*
B18	3.25	18	3.55	17	3.67	6	3.58	18	3.55	19	0.949*
B19	3.00	22	3.54	19	3.33	15	3.55	20	3.64	15	0.605*
B20	3.50	12	3.51	20	3.11	18	3.48	21	3.77	10	0.495*
B21	3.00	23	3.43	21	3.78	3	3.58	18	3.09	23	0.303*
B22	3.50	12	3.43	21	3.00	20	3.61	17	3.27	21	0.398*
B23	3.50	12	3.43	21	2.44	23	3.45	22	3.77	10	0.171*

**significant difference, *no significant difference, R = Rank

A further inferential statistical analysis of the ranked barriers of ACMs from Table 5 were carried out using the factor analysis. This is important to establish the correlation adequacy among the variables. Table 7 displays the result of the principal component analysis (PCA) by the orthogonal rotation (varimax) with Kaiser normalization, conducted on the initial 23 barriers. The PCA correlated the barriers by reducing them to eight (8) components. The KMO measure of sampling adequacy (Table 6) verifies the sampling adequacy for the analysis at KMO = 0.63 (good, according to Hutcheson, Sofroniou, 1999 in Field, 2009). The KMO values for the barrier variables are > 0.60, which is well above the acceptable limit of 0.50 (Kaiser, 1960). The Bartlett's test of sphericity was adopted to check for the appropriateness and suitability of the data for factor analysis. The Bartlett's test of sphericity, $\chi^2(276) = 767.65$, $p = 0.000$ (Table 7), indicates that the correlations between the barrier variables were sufficiently large for the PCA. The initial analysis run to obtain eigenvalues for the individual barriers gave values > 1 (this is > the Kaiser's criterion of 1; Kaiser, 1960). Cumulatively, the 8 components explain a 72.99% of the variance between the barriers. Interpreting factor loadings > 0.50 is averred adequate to underscore the substantial importance of a component (Anyanwu, 2013). Therefore, the factor loading of 0.50 is used as a cut-off point for the variables of the barriers of ACMs for each component. The scree plot displayed in Figure 1 also shows the inflexions that justifies retaining the 8 components. Thus, given the sample size adequacy, the exceedance of the Kaiser's criterion, and the convergence of the scree plot on the 8th component, the number of the 8 components are established as the barriers impeding the use of ACMs for building construction in Nigeria.

Table 6.*Factor loading on barriers to ACMs, KMO, and Bartlett's test on barriers of ACMs*

Factor	Factor loading	Total	% of variance	Cumulative %
Component 1: Cost-related barriers		6.172	25.716	25.716
Lack of government incentives	0.675			
Low-scale availability of ACMs	0.638			
High maintenance cost	0.763			
Lack of professional knowledge	0.526			
Component 2: Support-related barriers		2.692	11.215	36.931
Lack of funding or insufficient capital	0.586			
Low technological innovations	0.595			
Unwillingness and lack of support from the end users	0.785			
Lack of green building codes	0.562			
Component 3: Design-related barriers		1.979	8.244	45.175
Lack of organizational structure	0.682			
Complexity of design that supports ACMs	0.676			
Ineffective application from immature technology	0.760			
Component 4: Market-related barriers		1.610	6.710	51.885
Low market demand for ACMs	0.671			
Lack of performance evaluation indicators	0.739			
Lack of technical expertise	0.703			
Component 5: Professional-related barriers		1.587	6.612	58.497
Unwillingness of professionals	0.682			
Unavailable cost data on benefits of ACMs	0.816			
Component 6: Convention-related barrier		1.227	5.113	63.610
Conservativeness of management to CCMs	0.770			
Low public awareness of ACMs	0.638			
Component 7: Social barrier		1.151	4.796	68.406
Ignorance of the green benefits of ACMs	0.812			
Cultural belief on less aesthetic appearance of ACMs	0.706			
Component 8: Policy-related barrier		1.100	4.585	72.991
Poor policy environment	0.806			
Lack of regulation	0.796			
KMO and Bartlett's test on barriers of ACMs				
Kaiser-Meyer-Olkin measure of sampling adequacy				0.627
Bartlett's test of sphericity				
Approx. chi-square				767.651
df				276
Sig. (p)				0.000

**Figure 1.** The scree plot showing the barrier components.

4. Discussion

The study reveals the generic nature of the drivers for the use of ACMs in building construction in Africa. This is because all the drawn drivers of ACMs in Africa from reviewed literature confirm their importance in Nigeria as well, from the blinded expert judgment of the professionals by their rankings. All the professionals indicate the importance of the 20 drivers of ACMs in building construction in the country with the MS values range of $3.45 \leq MS \leq 3.99$ (Table 4). These drivers for the use of ACMs in Nigeria corroborate their suitability for building construction in Africa as they also pertain to South Africa, Zimbabwe, and Ghana (Masia et al., 2020; Addy et al., 2020; Zami, 2015); although the peculiarities of these individual countries attribute varying degree of importance to the identified drivers. The study establishes no variance in the importance of the identified drivers to boost ACMs in building construction in Nigeria because there exists no significant difference in the expert judgment of the professionals ($0.983 \leq p \leq 0.065$). However, the minimization of construction waste (D1) maintains consistency in its rating ($4.00 \leq MS \leq 4.44$) by all the professionals as a more important driver of ACMs in the country. The highest index of no existence of significant difference ($p = 0.065$) in the rating of D2 (high cost of CCMs) as an important driver of ACMs confirms the assertion by Addy et al. (2020), that the economic benefits derivable from the use of ACMs constitute a high impetus to their use in building construction in Africa. Other important drivers of ACMs that maintain their consistence across the line of expert judgment by each of the professionals are low cost of maintenance (D9: $3.25 \leq MS \leq 3.78$), non-toxicity of materials (D12: $3.00 \leq MS \leq 3.95$), water efficiency of ACMs (D14: $3.25 \leq MS \leq 3.89$), increasing awareness of cost benefits (D15: $3.50 \leq MS \leq 3.67$), promotion of cultural heritage (D18: $3.26 \leq MS \leq 3.77$), and recyclability (D19: $3.26 \leq MS \leq 3.82$).

This study establishes that nine (9) barriers are more critical barriers militating against the use of ACMs in building construction in Nigeria. These are lack of funding and insufficient capital (B1: MS = 4.75); poor policy environment (B2: MS = 4.00); low market demand for ACMs (B3: MS = 4.50); lack of technical expertise, risks in adopting new practices, and low public awareness of ACMs (B4, B8, B12: MS = 4.25 respectively); unavailable cost data on benefits of ACMs, unwillingness and lack of support from the end users, and lack of green building codes (B5, B6, B10: MS = 4.00 respectively). The remaining 14 barriers are revealed to be critical barriers of ACMs, having the MS values range of $3.00 \leq MS \leq 3.75$. The study gives singular evidence of a significant difference in the expert judgments of all the professionals to the barrier of poor policy environment (B2: $p = 0.021$). However, no evidence of significant differences ($0.949 \leq p \leq 0.171$) in the critical level of the remaining 22 barriers is underscored by all the professionals. Conversely, the quantity surveyors argue that the barriers of lack of professional knowledge of ACMs (B13: MS = 2.89) and lack of organizational structure (B23: MS = 2.44) have an insubstantial influence on the use of ACMs in building construction in Nigeria.

The study further establishes the inferential statistical evidence of the existing correlation between the barriers of ACMs by principal component analysis, which reduced and grouped the 23 barriers into eight (8) main components. The components are cost-related barriers, support-related barriers, design-related barriers, market-related barriers, professional-related barriers, convention-related barriers, social barriers, and policy-related barriers.

4.1. Component 1: Cost-related barriers

The first component is highly correlated with cost-related barriers. This component explains 25.72% of the total variance of the barriers of ACMs in building construction in Nigeria. The cost-related barriers have variable loadings of barriers with a score range of $0.526 \leq 0.763$. The highest-ranked barrier in this component is high maintenance cost, with a factor loading of 0.763. The component is also clustered with a lack of government incentives, low-scale availability of ACMs, and lack of professional knowledge with factor loadings of 0.675, 0.638, and 0.526 respectively. The high maintenance cost of housing facilities built with ACMs is a critical barrier to the demand for ACMs by building owners in Nigeria. The inference for this is drawn from the low technological innovations in the branding of ACMs for building construction and the ineffective application of ACMs from immature technology in the country. The high maintenance cost of ACMs in housing facilities in the country disagrees with the operational cost savings of green buildings reinforced by Masia et al. (2020) in South Africa. This calls for technological advancement for innovative solutions in the production of ACMs. The absence of government incentives to encourage the production of ACMs in Nigeria is inferred as the reason for the low-scale production and availability of ACMs for building construction in the country.

4.2. Component 2: Support-related barriers

The second component accounts for 11.22% of the total variance of the barriers of ACMs for building construction in Nigeria. The component is highly correlated with support-related barriers, having the barrier variable loadings of $0.562 \leq 0.785$. The factor loadings of the component are lack of funding or insufficient capital, low technology innovations, unwillingness and lack of support from end users, and lack of green building codes with their factor loadings of 0.586, 0.595, 0.785, and 0.562 respectively. The construction market force is controlled by the demand and supply of building products. The demand for building products being determined by the needs of the end-users influences what is supplied. When the end users or building clients (individuals, corporate bodies, or governments) do not demand for ACMs from their unawareness or conservativeness in favor of CCMs, a critical barrier is therefore constituted. The lack of green building codes that are compatible with the construction of buildings with ACMs is also a critical barrier, which is an indication of the absence of government support for ACMs in building construction in the country. The large-scale manufacture of ACMs for the construction of housing facilities that are fit for habitation

requires intensive capital, therefore insufficient capital by the manufacturers (SMEs) is a critical barrier to the use of ACMs in the country. This challenge faced by SMEs in the country is an update to the findings by Gbadebo (2014) on SMEs' production of ACMs in Nigeria. Insufficient capital is also deemed to influence the use of inappropriate technology which is unattractive to the end users. These barriers are replicas of the barriers of limited resources to cover upfront costs and lack of demand for ACMs in Malaysia, as well as poor government support in Ghana (Samari et al., 2013; Opoku et al., 2019).

4.3. Component 3: Design-related barriers

The third component is highly correlated with design-related barriers and explains about 8.24% of the total variance of the barriers to the use of ACMs for building construction in Nigeria. The component has the factor loadings of ineffective application from immature technology (0.760), lack of organizational structures to support ACMs (0.682), and complexity of design that supports ACMs (0.676). The lack of organizational support for ACMs and the complexity of design (to be produced by architects and engineers) suggest the perceptions of the contracting management team and professionals that the use of ACMs in building construction is a disruptive technology (Evison et al., 2018). This is because these stakeholders have already been accustomed to the uses of CCMs for several years, therefore restructuring their system partially or completely in compliance with the use of ACMs to accommodate changes seems unpalatable. The immature technology for ACMs brings about a lack of clarity in design tools to be adopted by the designers and thus constitutes a serious problem of complexity of design for building construction with ACMs in the country.

4.4. Component 4: Market-related barriers

The fourth component accounts for 6.71% of the total variance of the barriers of the use of ACMs in building construction in Nigeria. The components of this factor are low market demand for ACMs, lack of performance evaluation indicators for ACMs, and lack of technical expertise with factor loadings of 0.671, 0.739, and 0.703 respectively. This component is highly correlated with market-related barriers. The non-commercial scale of production of ACMs in the country impedes increased demand for ACMs and their inability to compete with the current larger scale of OPC production and availability in the construction market. Unlike the existing green building standard rating of 25% - 50% for assessment projection of water and energy efficiency in South Africa (Masia et al., 2020), the standard rating for green assessment projection and evaluation indicator of the performance of ACMs in Nigeria is inaccessible. The low level of educational inclusion in the training of ACMs by construction-related programme in higher institutions of learning gives rise to the lack of technical expertise.

4.5. Component 5: Professional-related barriers

The fifth component is highly correlated with professional-related barriers. The component explains up to 6.61% of the total variance of the barriers to the use of ACMs in building construction in Nigeria. The component is clustered with unavailable cost data on the benefits of ACMs (0.816) and unwillingness of the professionals (0.682). The dearth of data banks for construction-related matters is a common phenomenon in Nigeria (Babatunde et al., 2015). Therefore, the lack of available cost data that will inform the stakeholders about the cost benefits associated with the use of ACMs for building construction during the buildings' lifecycle, to influence the use of ACMs is a critical barrier in the country. The unwillingness of the professionals is inferred to be attributed to the confidence in the use of CCMs from their age-long use in the industry (Hart, 2017; van Deventer et al., 2010). The professionals are the key players in the construction industry, therefore their reservations about the use of ACMs in building construction pose a serious threat to the wider acceptance of ACMs for construction and the practices of sustainable building technology in the country.

4.6. Component 6: Convention-related barriers

The sixth component is highly correlated with convention-related barriers and accounts for 5.11% of the total variance of the barriers of ACMs in building construction in Nigeria. The component is grouped with conservativeness of management to CCMs (0.770) and low public awareness of ACMs (0.638). Although the awareness of the public about the use of ACMs and the constructability of housing facilities with ACMs is rising in the country (Opawole et al., 2022), they are reluctant to embrace the reality of the full use of ACMs in building construction. This is because the contracting managements are customarily used to the CCMs and they are not ready to alter their organizational arrangement to embrace the new change (that is, the use of ACMs). This barrier gives an empirical validation to the cause of the low frequency of use of such ACMs as strawbales, plastic bottle waste rice husk, Ferro-cement, faswell, etc., in Nigeria, being asserted by Opawole et al. (2022).

4.7. Component 7: Social barriers

The seventh component is correlated with social barriers. The component explains 4.80% of the total variance of the barriers to the use of ACMs in building construction in Nigeria. The component is grouped with ignorance of the green benefits of ACMs (0.812) and cultural belief in the less aesthetic appearance of ACMs (0.706). While the developed countries are empirically convinced and driven to the use of ACMs for sustainable building construction because of the environmental, eco-friendly, and green benefits of ACMs, the developing countries, particularly Nigeria are not well informed. This is evident by the established barrier of ignorance of the green benefits of ACMs by the construction players. The cultural belief that the façade of housing facilities constructed with ACMs is unattractive when compared to those

constructed with CCMs is revealed by this study to be a critical barrier to the use of ACMs in building construction in the country.

4.8. Component 8: Policy-related barriers

The eighth component is correlated with policy-related barriers and it accounts for 4.59% of the total variance to the use of ACMs in building construction in Nigeria. The component is grouped with a poor policy environment and lack of regulation, with factor loadings of 0.806 and 0.796 respectively. Poor policy environment and absence of regulation to encourage the construction stakeholders to fully embrace the use of ACMs in building construction are common phenomena in the practices of sustainable building construction in some developing countries (Pradhananga et al., 2021); unlike South Africa which operates the green policy by the Green Building of South Africa (Masia et al., 2020). Research findings establish that the enabling green policies and government regulations in support of the use of ACMs for building construction are the government instruments that have successfully encouraged the technological advancement in the supply of ACMs and the use of ACMs in building construction in developed countries. This is evident in the growth of ACMs, i.e. mass timber construction technology, in New Zealand, Australia, and some other European countries. Therefore, for ACMs technology to thrive in the Nigerian construction industry, the government instruments adopted in the the developed nations for ACM have to be adapted.

5. Summary

This study establishes the importance of 20 drivers of ACMs in building construction in Nigeria. These are minimization of construction waste, low cost of ACMs as against the high cost of CCMs, promotion of sustainable development, education on the green benefits of ACMs, energy efficiency from ACMs, low cost of maintenance, among others. These drivers are very germane to enable Nigeria to keep up with the growth of sustainable development in building construction of other developing countries, like South Africa. Empirical inferences drawn from this study establish the prevailing critical barriers of ACMs in building construction in Nigeria. These are cost-related barriers, support-related barriers, design-related barriers, market-related barriers, professional-related barriers, among others. Rather than concentrating on the waste minimization potentials and the economic values of ACMs in building construction as confirmed by this study, the eco-friendly benefits of the ACMs should be given more priority, to enable the country properly conform with the global Net-Zero Carbon Emission agenda of the Sustainable Development Goal (SDG) goals by 2050 (Zaman et al., 2022).

The government is both the major employer/client in the construction industry and the major regulator of construction policy. Therefore, for ACMs technology to thrive in the Nigerian construction industry, all the three tiers of governments (i.e. federal government, state government, and local government) have to be awakened to their roles in formulating and implementing green policies and regulations that comply with the use of ACMs in building construction. The policies and regulations are expedient because they will encourage construction professionals, clients and suppliers to accept the ACMs technology and application in building construction. This study recommends that the government formulate green building codes and enact regulations in compliance with ACMs for building design and construction, introduce government incentives to suppliers of ACMs to encourage the production of commercial scale of green building materials, reduce tax tariffs for ACMs-inclined building projects construction by developers and contractors, and use work experience in past ACMs-inclined projects and evidence of technical expertise in ACMs application as selection criteria for bidders of government projects. The study also recommends that the governments give directives for the design of building plans of mass housing development schemes in compliance with ACMs, and fund research and development to generate innovative solutions to the production and use of ACMs in building construction in the country.

The diffusion of these government instruments for the use of ACMs in building construction in the country will build the confidence of construction professions, clients and supplies. This will also eliminate the barriers of the complexity of design of ACMs-inclined buildings for the architects, engineers and builders; foster effective production of cost data for green buildings by quantity surveyors; increase local availability of ACMs at larger commercial scales; raise the market demands for ACMs by building owners, and facilitate a boom in the delivery of housing development projects with ACMs by developers and/contractors. Thus, this study concludes that the results of this research work will bring about practical realities of increased number of home owners, increased gross domestic products (GDP) of the country, and increased national economic growth of Nigeria.

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ECO-CENTRIC LEADERSHIP – TOWARDS A CONCEPTUAL MODEL

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Purpose: Environmental problems, such as climate change and biosphere degradation, present new business challenges. On the one hand, companies are striving to maintain efficiency and gain a competitive advantage, while on the other, they are obligated to balance environmental, social and economic objectives. Such a new reality of business requires a rethinking of the role of leadership in taking conscious and effective ecological action by modern companies. It also calls for research efforts to develop alternative leadership models that promote sustainable development.

Design/methodology/approach: The paper is theoretical and based on an in-depth review of the literature, including, on the one hand, an analysis of well-established leadership models (and how they relate to companies' effective eco-innovation activities) and, on the other, a characterization of the new leadership theories needed to overcome the challenges of sustainable development.

Findings: The paper aimed to develop a theoretical conceptualization of eco-centric leadership that complements the leadership literature and is relevant to understanding the research landscape of this new leadership style. The considerations presented in the paper point to the need for further scientific work that can use the developed conceptual framework to clarify the importance of eco-centric leadership in achieving harmony and balance between human activities and the natural world.

Originality/value: The paper's critical scientific contribution includes the developed conceptual framework, which covers five domains representing character, characteristics, people practices, institutional practices, and outcomes. This framework allows a more comprehensive characterization of this new and valuable leadership style.

Keywords: Eco-centric leadership, conceptual model, theoretical framework.

Category of the paper: Research paper.

1. Introduction

The impact of leadership on companies' environmental performance is not a new one, as it is characterized by a broad literature linking various and interrelated behaviors, practices, and leadership styles leading to the achievement of sustainability goals (Avery, Bergsteiner,

2011; Chen, Chang, 2013; Hallinger et al., 2018; Knight, Paterson, 2018; Egri, Herman, 2000; Singh et al., 2020; Wang et al., 2021; Boeske, Murray, 2022; Nisha et al., 2022; Zafar et al., 2022; Boeske, 2023; Eustachio et al., 2023; He et al., 2023; Saif et al., 2023). Leaders directly influence organizational members by setting formal rules and procedures that determine the organization's structure and culture (Boeske, Murray, 2022), play a crucial role in formulating and implementing organizational strategy (Liu et al., 2023), inspire subordinates and motivate them to generate innovation (Vaccaro et al., 2012), and help create an organizational climate that stimulates organizational creativity (Chen, Chang, 2013).

While researchers generally agree that leaders are the 'key interpreters' of how organizations respond to environmental challenges (Boeske, Murray, 2022), existing research needs to be more conclusive. Boeske (2023) argues that due to the complexity of environmental issues, no single leadership style (or set of behaviors) required of environmental CEOs can be identified. Nevertheless, for companies' environmental activities not to be incidental, concern for the environment should be ingrained in the executives' minds, and respect for environmental issues should almost be part of their DNA. Consequently, the concept of eco-centric leadership has emerged in the literature, which, unlike other leadership styles, involves the implementation of a clear and committed strategy, making environmental ideals the basis of a company's ethos (Biswas et al., 2022; Zafar et al., 2023). This leadership approach prioritizes environmental issues, emphasizing environmental responsibility and taking action beyond expected levels of environmental performance (Al-Amin et al., 2021; Hasan et al., 2024).

The concept of eco-centric leadership, like any new concept, has yet to be recognized in the literature and, as a result, opens up a vast and valuable field of research in management theory. The critical review of the literature indicates that one of the two leading streams of research is to relate the well-recognized models of leadership – transformational, transactional, ethical, responsible, and servant – to effective eco-innovative activities in companies. A consequence of this research and its indisputable contribution to management theory is the characterization of green transformational- (Chen, Chang, 2013; Singh et al., 2020) and green transactional leadership (Saif et al., 2023), environmentally responsible leadership (Wang et al., 2021), as well as environmentally specific servant leadership (Zafar et al., 2022). The second broad research stream attempts to develop new leadership theories by characterizing the leadership goals and practices necessary to overcome sustainable development challenges. This domain of literature encompasses narratives on sustainable leadership (Avery, Bergsteiner, 2011; Hallinger et al., 2018; Nisha et al., 2022), sustainability leadership (Knight, Paterson, 2018; Eustachio et al., 2023) and environmental leadership (Egri, Herman, 2000; He et al., 2023), based on both empirical findings and bibliographic analyses, complemented by researchers' (Boeske, 2023) attempts to compare these three related leadership approaches.

Undoubtedly, these two research streams are relevant to understanding the research landscape of eco-centric leadership. They are also complementary, so it is possible to apply them together. This observation is relevant to the development of an eco-centric leadership

framework, which is the intention of the author of this paper. Another critical assumption is that leadership is often a paradox (Mango, 2018), and therefore, as in the analysis of other paradoxes in management, it is embedded in a context that both determines it and provides a strategic reference for it.

The paper aims to develop an integrated (i.e., based on synergy concerning the two research streams indicated above) concept of eco-centric leadership, which, to the best of the author's knowledge, has yet to be presented in the literature. The point of reference was Mango's (2018) synthesis of well-recognized leadership theories, providing the basis for describing the analytical framework of eco-centric leadership in five domains representing the character, characteristics, people practices, institutional practices, and outcomes. The proposed conceptual model represents the most current and dynamically developing research area concerning environmental activities at the organizational level. In addition, the conceptual framework attempts to contribute to management theory and can be the basis for conducting well-planned and consistent future empirical research.

2. Theoretical Background

2.1. Well-recognized models of leadership vs environmental activities

Numerous definitions of leadership have been formulated in the literature. Despite their differences, there are three common elements: leadership is a group phenomenon, involves interpersonal influence to achieve established organizational goals, and is a process focused on taking specific actions (Boeske, 2023). Mango (2018) defines leadership as influencing internal and external stakeholders by challenging the status quo, developing a clear vision, engaging subordinates, and taking action to meet short- and long-term development goals. Many conceptual models describing leadership in organizations have been developed in the literature. Northouse (2016) analyzes 16 of them, Mango (2018) synthesizes 22 theories representing fundamental conceptualizations of leadership, and Kellerman (2012) goes a step further, stating that there are more than 40 leading theories in the described domain of literature. Relating well-recognized leadership models to undertaking and conducting ecological activities, transformational and transactional, ethical, accountable, and servant leadership receive the most attention from researchers.

According to the model by Bass (1985), the critical difference between transactional and transformational leadership is the degree of the leader's involvement and the nature of his relationship with subordinates. Transactional leadership refers to building a bond between the leader and the organizational members based on the mutual benefits of such a relationship (Vaccaro et al., 2012; Kang et al., 2015). Con-tingent reward dimension and active or passive

management by exception represent the spectrum of transactional leadership behavior (Bass, Avolio, 1993). Both dimensions deal with the contractual relationship between the leader and subordinates by reinforcing their commitment through monitoring and correcting the assigned tasks and giving rewards for effective and timely their completion (Vaccaro et al., 2012; Kang et al., 2015; Pichlak, 2020). On the other hand, transformational leadership is based not so much on extrinsic motivation (an exchange relationship) but on intrinsic motivation. Such leaders consider not only the interests but also the psychological needs of subordinates (Pichlak, 2020). This leadership style emphasizes not the consent or submission of subordinates but their commitment – the work becomes a challenge for them, as it goes beyond their self-interest to realize the goals of the team and the organization (Yukl, 2006). Transformational leadership implies a solid emotional connection between the leader and the organizational members and covers four dimensions: inspirational motivation, individualized consideration, idealized influence, and intellectual stimulation.

By referring transactional leadership to the company's environmental activities, researchers not only expand on the term 'green transactional leadership' (Saif et al., 2023) but also argue that through an open, feedback-based relationship between the leader and subordinates and, in particular, by clearly expressing expectations and setting environmental goals, this leadership style can positively influence environmental actions (Boeske, 2023). The literature also emphasizes that the growing environmental awareness of consumers and social and legal pressures to reduce negative environmental impacts reinforce the need for CEOs to set simple and transparent goals and principles for their environmental activities (Pichlak, 2020). Moreover, as Vaccaro et al. (2012) argue, such a leadership style can foster the generation of innovation, as it contributes to reducing organizational complexity, which often significantly limits the effectiveness of the innovation process. Also prevalent in the literature is the notion of 'green transformational leadership' (Chen, Chang, 2013; Singh et al., 2020), understood as such behaviors of leaders that provide subordinates with a clear vision and inspiration, motivate them to take environmental activities, and support their development needs towards achieving the environmental goals of the organization. The results of studies conducted in the literature (Chen, Chang, 2013; Kang et al., 2015; Pichlak, 2020) indicate that this leadership style's impact on effective pro-environmental activities is positive and significant. Through inspirational motivation, leaders are catalysts for change, motivating subordinates to acquire new knowledge and develop eco-innovations (Singh et al., 2020). Through individualized consideration, transformational leaders recognize the efforts of organizational members by indicating that their work matters and is valued by the management team. Through idealized influence, leaders stimulate the creativity of subordinates. Intellectual stimulation means that leaders use their knowledge to increase the awareness of organizational members (regarding the economic viability of opportunities and the environmental and social implications of their exploitation), encouraging subordinates to seek environmentally safe – not just economically efficient – solutions (Pichlak, 2020).

Another leadership theory applied in the literature in the context of conducting environmentally friendly business is ethical leadership, defined 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’ (Brown et al., 2005, p. 120). Initially, the ethical leadership style was analyzed within the framework of transformational leadership theory (Şengüllendi et al., 2023), according to the assumption that leaders motivate and inspire subordinates and become role models for them by a high level of morality and high ethics. After the groundbreaking work of Brown et al. (2005), ethical leadership developed as a stand-alone leadership style in which the central idea is the normative aspects, i.e., ethics, morality, and integrity (Brown, Trevino, 2006) and responsibility (Ren et al., 2020) of leaders. It has also been proven that an ethical leadership style can increase the effectiveness of subordinates and lead them to develop environmental behavior (Şengüllendi et al., 2023). The results of other studies further indicate that ethical leadership positively influences the green creativity of organizational members and their propensity to generate eco-innovations (Khalili, 2016) and strengthens the use of green human resource management practices in the organization (Ren et al., 2020).

Normative issues, including an emphasis on an ethical business, are also highlighted within the concept of responsible leadership, defined as ‘a relational and ethical phenomenon that occurs in social processes of interaction with those who affect or are affected by leadership and have a stake in the purpose and vision of the leadership relationship’ (Maak, Pless, 2006, p. 103). This leadership style extends the sense of responsibility of the CEO from internal to external stakeholders and even to society as a whole (Wang et al., 2021) and future generations (Liu et al., 2023). Responsible leaders consider the interests of all parties – organizational members, customers, suppliers, partners, and other stakeholders – ethically and inclusively, balancing their economic priorities with meeting social goals (Maak, Pless, 2006). Regarding environmental behavior, the results of studies conducted in the literature indicate that CEO environmentally responsible leadership is indirectly and positively related to companies’ commitment to eco-innovation (Wang et al., 2021) and positively stimulates sustain-able business performance (Liu et al., 2023).

Similar to the concept of responsible leadership, servant leadership theory is also gaining increasing academic attention. The central idea of this theory, introduced by Greenleaf, is that the welfare of subordinates is to prioritize the welfare of subordinates over the self-interest of leaders. The second central idea is that the leader shares power and status to meet the needs of subordinates, the organization as a whole, and the people the organization serves (Washington et al., 2014). Some researchers note the similarity between servant and transformational leadership (Washington et al., 2014). However, Chin and Smith (2006) argue that although both types of leadership aim to achieve similar goals (appreciating, motivating, and inspiring subordinates), they are driven by different motivations, strategies, and personal values of the leaders. Finally, by relating servant leadership to initiating and conducting effective

environmental activities, Zafar et al. (2022) introduce the concept of environmentally specific servant leadership and argue that this leadership style is positively associated with voluntary pro-environmental behavior through organizational identity.

2.2. New leadership theories vs environmental activities

Despite the unquestionable contribution of well-recognized leadership models to undertaking environmental activities, the changes in organizations' environments led to the development of new leadership theories, described in the literature as sustainable leadership, sustainability leadership, and environmental leadership. Although some researchers treat the above terms interchangeably (Hallinger et al., 2018), the paper analyzes each concept separately, pointing out their vital distinguishing goals and unique leadership roles.

Sustainable leadership is distinguished by its emphasis on leaders' social and environmental responsibility (Boeske, 2023). Collective concern for the environment indicates that the central idea in this theory is sharing the leadership roles (Nisha et al., 2022) rather than taking action only by the leaders (Hallinger et al., 2018). In other words, sustainable leadership is realized through collective or distributed efforts involving multiple stakeholders from within and outside the organization (Hallinger et al., 2018). An equally important feature of sustainable leadership is the preservation and maintenance of the organization (Boeske, 2023), i.e., the leader's pursuit of not only the short-term but, more importantly, the long-term vision of its development. Avery and Bergsteiner (2011, p. 5) point out that 'sustainable leadership requires taking a long-term perspective in making decisions; fostering systemic innovation aimed at increasing customer value; developing a skilled, loyal, and highly engaged workforce; and offering quality products, services, and solutions'.

In sustainability leadership, a leader must take action based on sustainability values (Boeske, 2023). In other words, the role of the leader is to take both sustainable and economically viable actions. Eustachio et al. (2023) define sustainability leader as 'person who motivates and influences followers in order to overcome sustainability barriers and address sustainability challenges, guaranteeing that society meets the needs of the present without compromising the ability of future generations to meet their own needs'. Moreover, in this theory, leaders are more results-oriented (Knight, Paterson, 2018), planning and developing business goals immanently linked to reducing growing environmental pressures and meeting changing societal expectations.

Finally, the environmental leadership model primarily emphasizes leaders' values, beliefs, and attitudes (Boeske, 2023). Egri and Herman (2000) describe this type of leadership as the ability of leaders to influence subordinates and mobilize the organization to achieve a long-term environmental sustainability vision. He et al. (2023, p. 2) define environmental leaders as 'the ones having a heightened sense of awareness about environmental protection, believing in eco-centric values, being more attentive to stakeholders' expectation, and being ready to implement various approaches to protect the environment, such as environmental management systems,

minimizing greenhouse gas emissions, and improving environmental ethics'. In summary, compared to other leadership concepts, environmental leaders are characterized by a personal ecological belief system and will thus engage in pro-environmental activities.

3. Eco-centric leadership

The following section presents an analytical framework for eco-centric leadership, for which Mango's (2018) synthesis of 22 leadership theories was the point of reference. Consideration of five core domains, including character, characteristics, people practices, institutional practices, and outcomes, highlights that eco-centric leadership is not only rooted in a set of leaders' personal values but is also embedded in a specific organizational context that both determines it and is its strategic reference.

3.1. The character domain

Researchers argue that ethical values and moral authority are critical attributes of a good leader. An eco-centric leader should represent high ethical and moral standards and have a deep-rooted passion for taking environmental actions. For an eco-centric leader, more efficient use of resources, cleaner technologies, product and organizational eco-innovations are non-negotiable choices. An eco-centric leader is not guided by an economic imperative since concern for the environment is one of his immanent character traits. Thus, an eco-centric leader is linked to ethical leadership by ethics, morality, and honesty, to responsible leadership by responsibility, and to environmental leadership by a system of crucial ecological values.

3.2. The characteristics domain

The characteristics domain encompasses the distinctive qualities of a leader, i.e., intelligence, reasonableness, maturity, innovation, self-awareness, and determination, which evoke the respect, admiration, and trust of subordinates and provide organizational members with a sense of the existence of shared values. It is essential to highlight not only the similarity to ethical leadership, but also to transformational leadership, through idealized influence, the behavioral equivalent of charisma. Eco-centric leaders (like ethical and transformational leaders) – respected and widely trusted – are an authority for subordinates, which makes organizational members deeply convinced of the possibility of realizing the vision of an eco-centric leader and wanting to emulate him. This emphasis on trust and respect in eco-centric leadership not only makes the audience feel secure and confident in their leadership but also inspires them to strive for similar qualities.

3.3. The domain of people practices

Some leadership theories view the process of exerting influence through developing a strong emotional bond between the leader and sub-ordinates (transformational leadership). In contrast, others point to establishing contractual ties (transactional leadership). In eco-centric leadership, the leader's beliefs and value system provide the source of motivation and inspiration and are a vital element in building his relationship with his subordinates. Such an assumption is the basis of social learning theory (Bandura, 1977), according to which subordinates learn by observing the behavior of their superiors and adopt their attitudes by building a network of mutual interactions (Şengüllendi et al., 2023). An eco-centric leader encourages subordinates to act pro-environmentally by establishing an environmental epistemology at the individual and group levels (Al-Amin et al., 2021), thus building in subordinates an awareness of their environmental impact and developing their environmental sensitivity. Like a transformational leader, an eco-centric leader stimulates and inspires organizational members to increase their efforts by arousing their emotions toward the consequences of their work. Characterizing the domain of human practices, it is also possible to point out the similarity of eco-centric leadership to servant leadership, with the caveat that leaders put the welfare of the environment above self-interest and prompt subordinates to consider environmental impacts when taking any action.

3.4. The domain of institutional practices

The domain of institutional practices includes creating organizational goals, establishing systems, policies, and company procedures, and monitoring the degree of their implementation (Mango, 2018). Eco-centric leaders link the organization's strategic direction to achieving established environmental goals. The long-term time horizon for achieving such goals shows the similarity of eco-centric leadership to sustainable leadership. Eco-centric leaders formulate a shared and ecological vision for the organization's development, create a strategy aiming to meet environmental goals, provide the resources and support needed to achieve them, develop an effective incentive system, and build an ecological organizational culture, creating coherence between the organization's goals and shared values. When realizing such goals is uncertain, eco-centric leaders aim to reduce them as much as possible by analyzing environmental activity's internal and external risks. Such an observation indicates that an eco-centric leader can – under certain circumstances – demonstrate behaviors characteristic of transactional leaders.

3.5. The domain of outcomes

Leadership should lead to achieving specific goals, and the substantive scope of these goals is illustrated by the domain of outcomes (Man-go, 2018). Eco-centric leadership means taking action beyond expected levels of environmental performance (Al-Amin et al., 2021; Hasan

et al., 2024). Therefore, eco-centric leadership is most consistent with sustainability leadership in this domain. In other words, an eco-centric leader demonstrates an attitude of responsibility for achieving environmental, economic, and social sustainability goals and, like an ethical leader, values the company's sustainable relationships with stakeholders, including the broader community (Ren et al., 2020), whose well-being depends primarily on the state of the environment.

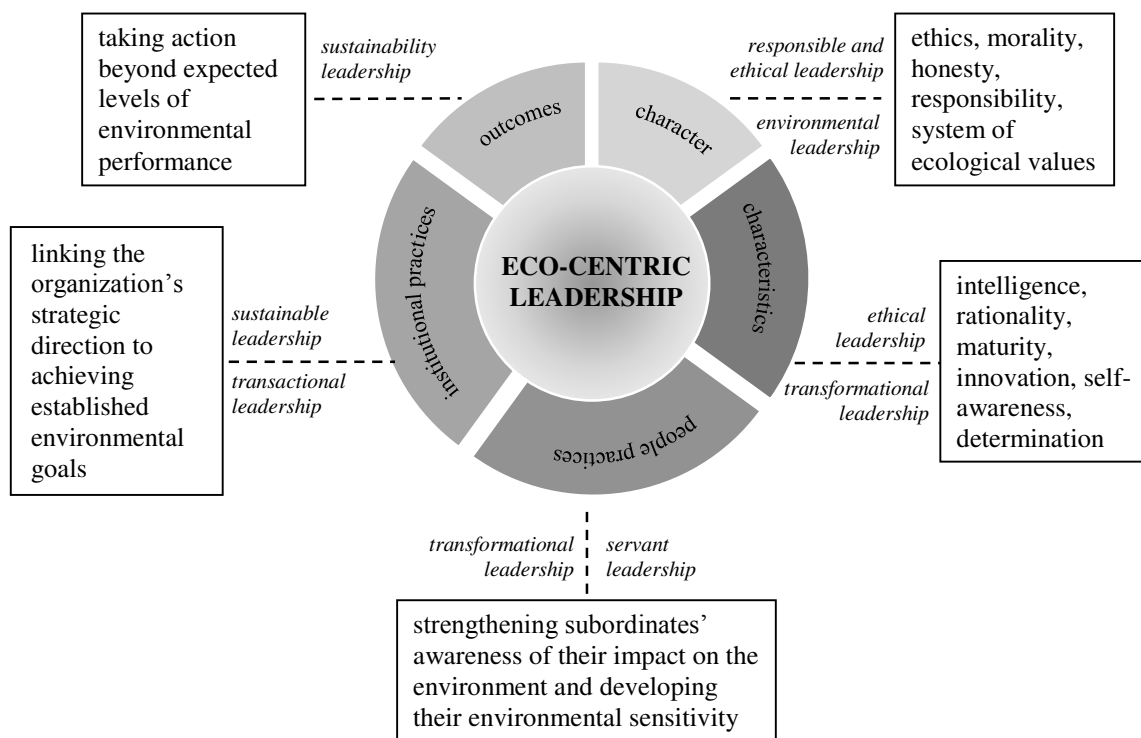


Figure 1. Eco-centric leadership – the theoretical framework.

The theoretical approach to eco-centric leadership presented in Figure 1 indicates the elements linking this new and still developing research concept to other leadership models described in the literature. The question arises, however, what then distinguishes this leadership style? First, an eco-centric leader is characterized by an innate inclination to take pro-environmental actions, treating the environment and the planet's well-being as a priority (Biswas et al., 2022; Hasan et al., 2024). In other words, such a leader, recognizing the intrinsic value of nature, shows respect for it in every dimension of the actions taken, not only seeing it as a business opportunity but also as a way to save the world. Secondly, the eco-centric attitudes of CEOs are a source of motivation and inspiration. They are vital in building leaders' relationships with subordinates (who, guided by a sense of reciprocity, will voluntarily engage in ecological activities). Highlighting the profound impact of eco-centric leadership on subordinates' attitudes, beliefs, values, and behaviors, the literature shows that eco-centric leadership promotes employees' voluntary green behavior (Al-Amin et al., 2021; Zafar et al., 2023) and is a crucial catalyst for sharing green knowledge within the organization (Hasan et al., 2024).

4. Conclusion

Global changes are significantly changing the way companies conduct business. The result is not only environmental and social pressures faced by CEOs but also growing normative pressures that call for a rethinking of the role of leadership in undertaking effective environmental initiatives.

The paper aimed to develop a theoretical conceptualization of eco-centric leadership, which is a new and growing research direction in management theory. As shown in the paper, this leadership style implies a business paradigm shift towards achieving harmony and balance between human activity and the natural world. Crucial in this context is the realization that companies will never achieve complete independence from the environment and, thus, sooner or later, will be forced to incorporate the ecological imperative into every dimension of their activities.

The paper reinforces the research arguments that eco-centric leadership, as a distinct leadership style, is of critical theoretical importance in undertaking environmental activities by companies (Al-Amin et al., 2021; Biswas et al., 2022; Zafar et al., 2023; Hasan et al., 2024). Moreover, by including domains representing character, characteristics, people practices, institutional practices, and outcomes the paper provides a more comprehensive understanding of the eco-centric leadership construct, not only fitting into the current research area but also enriching the theoretical domain of leadership research in the context of the long-term role played by companies in shaping the future of our planet.

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ORGANIZATIONAL CONTEXT FOR CIRCULAR-ORIENTED INNOVATION

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Purpose: In recent years, circular innovation has been gaining increasing attention in the management literature. The popularity of this research stems from the fact that the concept of Circular-Oriented Innovation fills a gap in operationalizing a company's transition from traditional (linear) to alternative (circular) product and service systems. Recent research further suggests that due to its complexity – resulting from fundamentally redesigning production, processes, and organization – the successful implementation of Circular-Oriented Innovation may require different contextual factors than studies relating to traditionally framed innovation have shown. Given the still inadequate academic knowledge in this area, the paper proposes a new conceptualization of organizational context elements crucial to the effective implementation of Circular-Oriented Innovation.

Design/methodology/approach: The paper is theoretical and cognitive, grounded in an extensive literature review encompassing theoretical, review, and empirical studies on understanding Circular-Oriented Innovation and its determinants. The paper's insights enrich the existing literature and enhance comprehension of innovation based on the circularity rationale. Moreover, they underscore the imperative for additional scientific endeavors, particularly comparative studies and empirical validation of the developed conceptual model.

Findings: The paper proposes that the effective implementation of Circular-Oriented Innovation results from the interplay of three key elements of the organizational context. Thus, it requires the simultaneous adoption of a circular strategic orientation, the mobilization of the CE-related resources and capabilities, and collaboration with stakeholders throughout the value creation chain. An extension of the theoretical structure of the model, resulting from the necessity of the systemic nature of Circular-Oriented Innovation postulated in the literature (i.e., making changes in all dimensions of the companies' operations), is also the inclusion of (linking the various contextual elements) organization-al processes, i.e., organizational learning processes, strategic foresight, and design processes, as well as internal and external collaborative processes.

Originality/value: The scientific contribution of the paper is the conceptual framework of crucial elements of organizational context that stimulate the effective implementation of Circular-Oriented Innovation, which goes beyond existing literature narratives on the implantation of Circular Economy principles at the organizational level. The proposed theoretical framework, taking the form of a 'dynamic triangle', aims to develop a new way of thinking about the contextual determinants of Circular-Oriented Innovation and is an original

contribution to management theory, reorganizing the potential processes that are crucial to the implementation of such innovations in all dimensions of companies' operations.

Keywords: Circular-Oriented Innovation, organizational context, theoretical framework.

Category of the paper: Research paper.

1. Introduction

One of the many research areas that aim to find ways for companies to deal with sustainability challenges is the Circular Economy (CE) concept, indicating the need for a systemic change in the basic logic of how companies conduct their business (Bocken et al., 2016; Rodriguez-Espindola et al., 2022; Geissdoerfer et al., 2020) into one that considers the consequences of the previously ignored natural limits of economic growth (Sehnem et al., 2022; Pichlak, 2023). The idea postulated in this concept of narrowing, slowing, or closing resource loops (Bocken et al., 2016; Rodriguez-Espindola et al., 2022) means implementing a system in which pro-environmental changes run parallel to economic and social changes (Bocken et al., 2014).

At the core of the CE concept is the recirculation of resources (Ormazabal et al., 2018), i.e., the creation of feedback cycles (resource-product-resource) by narrowing, slowing, or closing the loops of their flows (Bocken et al., 2016; Brown et al., 2021), according to the 3Rs principle (reduce, reuse, recycle). Reducing (narrowing the resource loops) means that it is possible for a given production level to reduce inputs and increase production efficiency simultaneously. Reusing (slowing the resource loops) involves extending the life of products based on recirculating processed materials so that they become inputs in subsequent production processes. Finally, recycling (closing the resource loops) indicates that waste can be transformed for further use (Ghisellini et al., 2016; Pichlak, Szromek, 2022; Sehnem et al., 2022).

For several years, there has been a growing body of literature on implementing CE concepts at the organizational level (Lüdeke-Freund et al., 2019; Pieroni et al., 2019; Stucki et al., 2023). These analyses focus on the broad and multidimensional identification of factors (Cento-belli et al., 2021) and barriers (Kirchherr et al., 2018; Takacs et al., 2022) to the adoption of circular actions by companies and prove that when designing the research process, researchers should change the level of analysis from a macro to a microeconomic perspective (Stucki et al., 2023). However, the overarching implication from these valuable studies is that adopting CE at the organizational level requires implementing Circular-Oriented Innovation (COI). The concept of COI boils down to undertaking 'the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle' (Brown et al., 2019, p. 3).

The practical implementation of the CE concept at the organizational level accomplished through Circular-Oriented Innovation requires systems thinking (Bocken et al., 2018; Brown et al., 2021; Bocken et al., 2016; Suchek et al., 2021). Such a perspective is not limited to designing and implementing individual innovations and reaping certain benefits from them. It requires a complete reorganization of the activities carried out by companies to separate value creation and resource use and, as a result, reduce negative environmental impacts. The demand for a systemic conceptualization of COI is not new, and researchers point to several practical ways to achieve such holistic changes. Bocken et al. (2016) describe specific strategies for product design and business models that can be useful for companies looking to design systems in line with the CE paradigm. Brown et al. (2019) point to an alternative path for systemic implementation of COI in organizations such as undertaking collaboration; the researchers' analysis includes a detailed characterization of the factors and barriers to implementing Collaborative Circular-Oriented Innovation.

Since Circular-Oriented Innovation is concerned with the systemic design and implementation of pro-environmental changes at all levels (product, process, organization, business model), it is, therefore, crucial to identify the organizational context that not only provides the framework for the fundamental – and at the same time consistent with the CE paradigm – reorganization of companies' activities, but is also determined by circular ideas. Also, recent research suggests that COI may require different contextual factors than those identified in research on traditional innovation (Mead et al., 2022). Accordingly, this paper develops a new conceptualization of organizational context critical to the effective implementation of Circular-Oriented Innovation. The basis for achieving such a research objective was to conduct an in-depth literature study – including theoretical, review, and empirical papers – the results of which indicate that implementing COI requires simultaneously developing a circular strategic orientation, mobilizing the CE-related resources and capabilities, and undertaking collaboration with stakeholders along the entire value creation chain. The proposed theoretical framework, taking the form of a 'dynamic triangle', aims to develop a new way of thinking about the contextual determinants of COI and also makes an original contribution to management theory by reorganizing potential processes crucial to the systemic development and implementation of Circular-Oriented Innovation.

2. Theoretical Background

2.1. The origin of Circular-Oriented Innovation

The notion of Circular-Oriented Innovation has its origins in the broad research stream on eco-innovation, with many valuable contributions, including multidimensional analysis of its

specifics (e.g., Carrillo-Hermosilla et al., 2010; Kiefer et al., 2017); identification of its determinants (e.g., Pacheco et al., 2017; Bitencourt et al., 2020) and the effects of its implementation (e.g., Zhang and Walton, 2017; Cai and Li, 2018). Awareness of the vital importance of eco-innovation has fostered an intensification of academic research in this area. The large number of studies on the subject has led to the emergence of related terms, i.e., green innovation (Huang, Li, 2017), environmental innovation (Kammerer, 2009), sustainable innovation (de Medeiros et al., 2014) or sustainability-oriented innovation (Klewitz, Hansen, 2014; Mead et al., 2022). These studies adopted different theoretical perspectives, were conducted in different contexts, and yielded different results (cf. meta-analytical review by Bitencourt et al., 2020; systematic literature review by Hermundsdottir and Aspelund, 2021). Although the definitional complexity of the terms mentioned above has been the subject of several valuable research analyses (Schiederig et al., 2012; Díaz-García et al., 2015), some researchers have included them as synonyms (Sáez-Martínez et al., 2015; Hermundsdottir, Aspelund, 2021).

However, the uniqueness of Circular-Oriented Innovation sets it apart from other types of innovation, such as green-, sustainable- or eco-innovation. COI encompasses a much broader conceptual scope, referring to the fundamental transformation of product, process, and organization (Rodríguez-Espindola et al., 2022). In essence, it necessitates the creation of a new business architecture that integrates a holistic combination of product, process, and organizational eco-innovation. This approach enables the implementation of the 3Rs principle central to CE in business practice (Blomsma et al., 2019; Brown et al., 2019; Brown et al., 2021).

Bringing the CE concept to reality at the organizational level is accomplished by developing circular products, which have longer life cycles than conventional ones (Franzo et al., 2021; Bocken et al., 2016; Lewandowski, 2016) based on their reusability or recyclability (Urbinati et al., 2019). The development of circular products relies primarily on the use of specific materials, e.g., biodegradable materials (Fernandez de Arroyabe et al., 2021), and, in the absence of their availability, requires efforts focused on circular processes that address CE's core paradigm of creating closed production and consumption systems (Lüdeke-Freund et al., 2018; Fernandez de Arroyabe et al., 2021). Such processes aim to eliminate waste and, in the long term, significantly reduce the use of non-renewable raw materials. This objective is also served by solutions that promote the sharing of environmental responsibility by consumers (de Medeiros et al., 2014; Lewandowski, 2016), referring, among other things, to 'designing for emotional durability' (Bocken et al., 2016), as well as measures that support shared consumption (Franzo et al., 2021). Finally, valuable tools for implementing the Circular Economy are organizational changes made through environmental management systems, which facilitate the identification and realization of cost savings and improvements in the potential level of efficiency of sustainable companies (Hojnik, Ruzzier, 2017).

2.2. The organizational context as a framework for implementing COI

In order to convert the CE concept into practical activities leading to the implementation of Circular-Oriented Innovation, the leaders must define and communicate to the organizational members a transparent and integrated circular vision that forms the basis for decision-making concerning the strategic direction of the company's future development (Blomsma et al., 2019). In this approach, the shared and ecological vision formulated by the leaders becomes part of the organizational identity and, as a result, justifies the need to design COI and determines the potential scope of its implementation. The literature emphasizes the importance of a shared vision in innovation projects (Jansen et al., 2008; Blomsma et al., 2019). Researchers indicate that a defined shared vision is a crucial guidepost for designing Circular-Oriented Innovation at intra- and inter-organizational levels (Brown et al., 2019; Blomsma et al., 2019). Bocken et al. (2016) describe a range of circular product design strategies and Circular Business Model Innovation, indicating that companies must start with an overall vision before developing in detail their circular business model and circular product design strategies. Mead et al. (2022) go even further and point out that Sustainability-Oriented Innovation is integral to a company's vision and overall long-term strategy. This notion also aligns with the arguments of Dangelico and Purjari (2010), for whom converting the core vision into the company's strategy is essential for success in taking concerted action leading to COI. Therefore, a critical contextual element necessary for Circular-Oriented Innovation is the strategic priority set by leaders. COI requires innovation at all levels of the business creation architecture, but most importantly, it requires changes in corporate strategy. Circular-Oriented Innovation should not be understood as 'sustainability and thus as cost agenda' but as 'central business agenda' (Eisenreich et al., 2021). The literature has widely discussed the significance of eco-innovation strategies. The most de-tailed typology presents Klewitz and Hansen (2014) and describes resistant, reactive, anticipatory, innovation-based, and sustainability-rooted strategies. Such sustainability-rooted strategies require a 'shift in the dominant worldview' and 'an ecocentric deep-ecology approach', and thus can be a critical contextual determinant for implementing Circular-Oriented Innovation. Blomsma et al. (2019) develop a taxonomy of circular strategies, considering the ReSOLVE, Performance Economy, Cradle-to-Cradle, or Waste Hierarchy frameworks, among others.

Since Circular-Oriented Innovation represents a continuous, radical, and organization-encompassing process of innovation and transformation (Brown et al., 2019), therefore the selection of a specific strategy requires the CE-related resources, competencies, and capabilities, i.e., information systems, technical systems, or accumulated organizational knowledge. Internal competencies and capabilities can be seen as lenses through which a company observes its environment (Hansen et al., 2002). Therefore, what is essential concerning Circular-Oriented Innovation is the resources and competencies a company possesses and the ability to improve them continuously (Fernandez de Arroyabe et al., 2021).

This conceptualization of the organizational context goes beyond the static view that characterizes the Resource-Based View of the Firm (RBV) toward adopting a dynamic perspective (Sehnm et al., 2022). According to the leading work of Teece et al. (1997), dynamic capabilities constitute higher-order capabilities and refer to the building, integrating, and reconfiguring of internal and external skills, resources, and functional competencies held within a company to meet the demands of a rapidly changing market environment. Building such capabilities is therefore particularly relevant to Circular-Oriented Innovation because the organizational learning processes underpinning its development enable the transformation of existing and the creation of new business models. These models are essential for efficiently using the resources and ultimately closing material loops (Bocken et al., 2019; Geissdoerfer et al., 2020). De Mederios et al. (2014) argue that critical to the success of Sustainability-Oriented Innovation is the development and maintenance of an innovation-oriented learning culture. Brown et al. (2019) point out that building such a capability, including aligning one's vision, developing competencies, and enabling reflexive analysis through innovation (De Mederios et al., 2014), is also critical for implementing COI.

Implementing Circular-Oriented Innovation requires resources, competencies, and capabilities, often impossible to build, especially by companies that operate on traditional business models (Prieto-Sandoval et al., 2019; Johnson, 2022). Hence, a vital element of the organizational context for COI is the establishment of cooperation with external stakeholders (Eisenreich et al., 2021; Johnson, 2022). As the Circular Economy represents an economic model leading to closed production and consumption systems and is widely viewed by researchers as collaborative (Brown et al., 2019; Prieto-Sandoval et al., 2019; Fernandez de Arroyabe et al., 2021), hence the involvement of key stakeholders (i.e., customers, suppliers, technical experts or research and development institutions) is particularly important for systemic COI implementation (Eisenreich et al., 2021). The literature emphasizes that the establishment of strategic cooperation by companies with supply chain partners determines the implementation of the 3Rs principle (Blomsma et al., 2019; Brown et al., 2019; Brown et al., 2021; Suchek et al., 2021). Analyzing collaboration with different stakeholders, Rajala et al. (2018) identify three archetypes of circular systems, i.e., inner circles, decentralized systems, and open systems, while Eisenreich et al. (2021) point to the importance of three primary forms of collaboration (dyadic alliances, network relations, and crowdsourcing) for generating and implementing innovative circular solutions. Dyadic alliances involve long-term and often formal interaction with a single partner; network relations extend these partnerships and are concerned with building networks of interactions with various independent entities, while crowdsourcing involves interaction within much broader communities and is done through, for example, virtual co-creation platforms. The main motives for establishing collaboration in the context of Circular-Oriented Innovation include the opportunity to share critical resources, skills, and knowledge (Sehnm et al., 2022), improve efficiency, reduce costs and shorten time-to-market for circular products (Bititci et al., 2006), and – or most importantly – the desire

to become a ‘CE leader’ based on reputation building and the search for new business opportunities and markets through the experimentation (Brown et al., 2019).

Based on the in-depth literature review, implementing Circular-Oriented Innovation requires the simultaneous development of a circular vision, adoption of a circular strategy, mobilization of critical resources and capabilities, and collaboration across the value creation chain. Figure 1 presents a conceptual framework capturing the three vital elements of the organizational context leading to the implementation of COI. Based on Hansen et al.’s (2002) conceptualization of environmental innovative capability, the organizational context for COI are presented as a ‘dynamic triangle’.

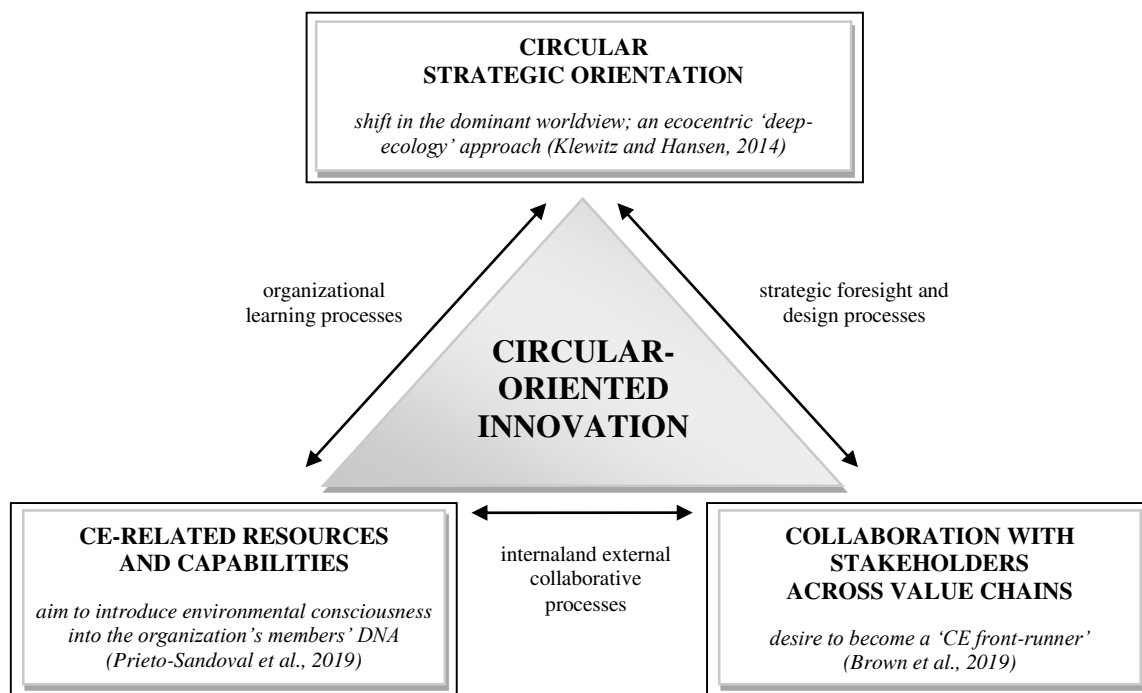


Figure 1. Organizational Context for Circular-Oriented Innovation – the theoretical framework.

According to the conceptual framework, the implementation of COI results from the interplay of critical contextual factors. Integrating CE goals and principles into organizational practice requires adopting a circular strategic orientation, mobilizing the CE-related resources and capabilities, and collaborating with stakeholders across value chains. In addition, the successful design and implementation of Circular-Oriented Innovation involves maintaining organizational systematicity, developing organizational learning processes, strategic foresight and design processes, and internal and external collaborative processes.

Organizational learning processes are a reference point for making critical strategic choices, and, on the other hand, they can prevent the occurrence of so-called ‘strategic blindspots’ (Teece et al., 1997), thus facilitating the implementation of COI by strengthening existing and building new organizational capabilities (Johnson, 2022). In addition, the systemic nature of COI enforces the implementation of strategic foresight and design processes necessary for ‘mapping’ the system and creating CE strategies. These processes ‘should connect goals,

motivations and interrelationships between the market, potential technologies, and required resources to identify those processes that may require external partners to realize the COI' (Brown et al., 2021:3). Finally, since COI involves using resources embedded in inter-organizational activities and procedures and the collaborative learning of employees working together, the proposed conceptualization includes internal and external collaborative processes. Such processes not only enable access to new or complementary resources held by collaborative partners but also open up the possibility of achieving the benefits associated with the occurrence of complementarity effects in the context of organizational learning and sharing knowledge regarding COI.

3. Conclusions

The Circular Economy concept, which is one of the pathways for companies to deal with the challenges of sustainability (Bocken et al., 2016; Pieroni et al., 2019; Rodriguez-Espindola et al., 2022), represents a strategic paradigm shift in how they conduct business (Prieto-Sandoval et al., 2019) and signifies the replacement of the traditional linear model of resource management (Ormazabal et al., 2018) with a model leading to the creation of a regenerative system (Bocken et al., 2016; Eisenreich et al., 2021).

At the core of the CE concept, the 3R (reduce, reuse, recycle) principle means taking actions aimed at narrowing or slowing the resource loops in industrial ecosystems (Bocken et al., 2016; Brown et al., 2021) and ultimately closing them by changing the value generation process (Pieroni et al., 2019). The popularity of the CE concept caused the original 3R principle to be extended first to the 4Rs, then to the 6Rs, and later on evolved to the 9R concept and even to the 12Rs (considering recover, refuse, rethink, repair, refurbish, remanufacture, repurpose, redesign, research). However, the existence of various alternative R-strategies remains the same logic of CE understanding, implying the need to create economic, social, and environmental value (Pichlak, Szromek, 2022).

The fulfillment of CE principles is accomplished through Circular-Oriented Innovation, which justifies undertaking research in this new research stream. Successful implementation of COI is based on indicators of long-term ecological and economic efficiency (Sehnem et al., 2022) and refers to implementing environmental changes in the company at all levels of business strategy (Brown et al., 2019). By narrowing, slowing, or closing resource and material loops, this fundamental redesign of processes, products, and value-creation system should ultimately reduce the negative environmental impacts that naturally follow the production and consumption of physical goods (Fernandez de Arroyabe et al., 2021).

Since Circular-Oriented Innovation is related to systemic organizational changes and thus goes beyond traditional innovation research (Mead et al., 2022), it requires a rethinking of the organizational context necessary for its effective design and implementation. This issue is an ever-evolving field of research, which makes it still in the conceptualization phase. Therefore, the primary purpose of this paper was to add to the existing literature by proposing a conceptualization of the essential elements of organizational context for COI. Following the logic of Hansen et al. (2002), the paper considers three vital contextual factors in the form of a ‘dynamic triangle’, the construction of which indicates that taking action leading to the systemic integration of CE goals and principles into organizational practice must be done in an integrated manner. It requires simultaneously adopting a circular strategic orientation, mobilizing the CE-related resources and capabilities, and undertaking collaboration with stakeholders across value chains in which the circular economy is implemented.

Designing and implementing Circular-Oriented Innovation in companies implies a new way of thinking about innovation, as it requires the development of a new circular vision and the formulation of a circular strategy as the basis for fundamentally redesigning product concepts, service offerings, and industrial processes toward solutions with a long lifecycle. However, systemic creation and implementation of COI in all dimensions of companies’ operations (Brown et al., 2019; Brown et al., 2021) can be risky, especially when companies lack experience in circular operations (Johnson, 2022). Therefore, effective implementation of Circular-Oriented Innovation requires developing specific resources, competencies, and capabilities, particularly dynamic capabilities. The building of these capabilities stems from the development history of the organization, and the process of improving them is done cumulatively by intensifying organizational learning and expanding the existing knowledge base (Sehnem et al., 2022). Finally, companies are forced to interact within broader ecosystems to effectively implement COI, moving from a company-based operational logic to one focused on collaboration across the value creation chain (Pieroni et al., 2019).

In summary, the paper is theoretical and cognitive, and its main scientific contribution refers to conceptualizing Circular-Oriented Innovation from the perspective of its crucial contextual factors. The relevance of exploring the organizational context for COI is not only theoretical. Conducting such analyses is also essential for managers developing business strategies based on Circular-Oriented Innovation, thus adapting their companies’ ongoing production (or service) activities to increasingly stringent regulatory standards and dynamically changing societal demands.

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FINANCIAL SITUATION OF ENTREPRISES IN THE TSL SECTOR IN POLAND IN THE YEARS 2018-2022

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Purpose: The aim of the article is to analyse and evaluate the financial situation of TSL enterprises in Poland in the years 2018-2022 in terms of such issues as: revenues from overall activities, revenues from sales of products (services), costs of generating revenues from overall activities, own costs of sold services, net financial result, financial surplus, depreciation, net sales profitability and the size of investment outlays.

Design/methodology/approach: The article uses a review of the literature on the subject and desk research, in which reference was made to the Statistics Poland data on enterprises from section H – *Transport and storage*. Selected methods of descriptive statistics were used. The time series takes into account the perspective before and during the Covid-19 pandemic.

Findings: The presented results indicate that between 2018-2022 we observe changes in levels and dynamics of the analysed categories and economic indicators, which was associated with a deterioration in the financial stability of TSL enterprise's. The presented analysis confirms the sensitivity of financial results of TSL enterprises to the impact of the Covid-19 pandemic.

Research limitations/implications: To obtain a complete picture of the economic and financial situation of TSL sector enterprises, the study should be expanded to include an analysis of a larger number of categories and indicators. In particular, exploring issues related to accounting liquidity and the efficiency of enterprise operations would be helpful.

Originality/value: The study should be seen as a contribution to the scientific discussion in the issue of growth and development of TSL sector.

Keywords: TSL sector, section H, financial rating.

Category of the paper: research paper.

1. Introduction

The aim of the article is to analyse and assess the financial situation of Transport-Spedition-Logistics (TSL) sector enterprises in Poland in the years 2018-2022. The selected time series takes into account the perspective before and during the Covid-19 pandemic in order to further attempt to determine the impact of this phenomenon on the variables under consideration.

The financial situation is the basis for assessing the effects of management in a given enterprise. This assessment includes many economic categories, including: revenues from overall activity, revenues from the sale of products (services), costs of generating revenues from overall activity, cost of services sold, net financial result, financial surplus, depreciation, net sales profitability or the size of investment outlays. It allows for an objective assessment of an enterprise's financial situation, considering various managerial and economic aspects. The content of financial analysis is the assessment of certain economic quantities expressed in monetary terms. Focuses on the preliminary and advanced analysis of the balance sheet, income and loss account, sources and directions of revenues and expenses, analysis of the financial result and its determinants, and analysis of the financial situation of the examined unit (Jerzemowska, 2018, p. 14).

TSL sector are considered one of the key service markets of the Polish economy¹. K. Grucki sees the sources of the increase in demand for this type of services from large manufacturers and retail chains primarily in (2006):

- the technical complexity of supply chains, which is increasingly difficult for manufacturing companies and trade networks to meet,
- requirements for handling integrated logistics chains, which enforce the demand for increasing financial resources to maintain an appropriate level of services,
- of the globalisation of manufacturing companies and trade networks and the need for their coordination on a global scale.

Meanwhile, in the B2C market, an undoubted factor in the growth of the analysed sector is the development of e-commerce. Only in the period 2013-2022, the number of on-line stores in Poland increased by over 36,000, and the average annual growth rate was at 12.0%². In this period, the value of this market increased by 130 billion PLN, and the average annual growth was at the level of 23%³. The percentage of enterprises conducting sales through websites, apps, online trading platforms, and auction services increased from 9.5% to 15.9% (Wykorzystanie technologii...).

2. Research methodology

To achieve the formulated goal, a literature analysis was conducted, as well as *desk research*, in which data from the Statistics Poland concerning Polish enterprises classified under section H – *Transport and storage* were used. As the PKD 2007 classification does not include

¹ In 2022, the share of employees in the *Transport and storage* section in the structure of employees in non-financial enterprises was 8.3% (GUS, 2023a, p. 21), while the share of enterprises in this section in the creation of Gross Value Added was 6.6% (own calculations based on the GUS Macroeconomic Data Bank).

² The average annual rate of change for chain indices.

³ Annual average rate of change for chain indices.

the section – *Transport, Spedition and Logistics*, it is assumed in the literature that the closest to these services is section H (cf: Mankowski, 2012, p. 214; Gryko-Nikitin, 2010, p. 42). According to the Polish Classification of Activities 2007, this section is divided into the following divisions: land and pipeline transport, water transport, warehousing and support activities for transport, postal and courier activities, air transport and includes: activities related to the transport of people or goods carried out by rail, pipeline, road, water or air transport; support activities for transport provided by stations, ports, railway stations, bus stations, etc., terminals in terms of traffic control, passenger service, baggage and cargo handling; rental of transport equipment with driver or crew; postal and courier activities.

Due to the limited scope of the article, the presented considerations focus on selected economic categories. In the analyses, variable⁴ and constant basis of comparisons indicators were used. The results are presented in tabular and graphical form.

3. Results

The first economic variables analysed are respectively, the revenues from overall operations and revenues from service sales. The size of the generated revenue streams speaks volumes about the financial condition of the sector and its potential for self-financing and development. The total revenue category includes net revenue from the sale of products (services), goods and materials, other operating income, and financial income. Meanwhile, net revenues from the sale of products (services), goods and materials include net revenues from domestic and export sales of finished products, semi-finished products and services produced by the unit, as well as packaging, equipment, and third-party services and net revenues from the sale of goods and materials purchased for their further resale.

Over the period under consideration, the sector under review has seen an increase in both total revenue and revenue from the sale of products (services), indicating a relatively stable financial situation (Figure 1). The dynamics of these quantities, however, varied in different years. For total revenues, it was in the years 2019 and 2020 respectively: 109.9% and 111.6% and for service revenue: 110.5% and 112.7%. In the subsequent years analysed 2021 and 2022, the dynamics were significantly higher. For total revenues, it was accordingly: 130.2% and 162.3% for revenue from the sale of services: 130.5% and 166.6%. A particularly high level of revenue dynamics from the sale of services occurred in 2022, which results from the economy emerging from the Covid-19 pandemic, but also from the level of the annual consumer goods and services price index at 114.4 (Roczne wskaźniki cen...).

⁴ Unless otherwise specified, the terms ‘dynamic index’/‘dynamics’ refer to the chain dynamic index.

The data presented in Figure 1. further shows the variation in dynamics between the different revenue categories. In all the years analysed, we observe a higher growth rate in the category of revenue from the sale of services, which indicates an increasing share of revenue streams from core activities in total revenue. A significant change occurred in 2022 (growth rate of 166.6% for service revenue versus growth rate of 162.3% for total revenue). This indicates an improvement in the financial situation of enterprises.

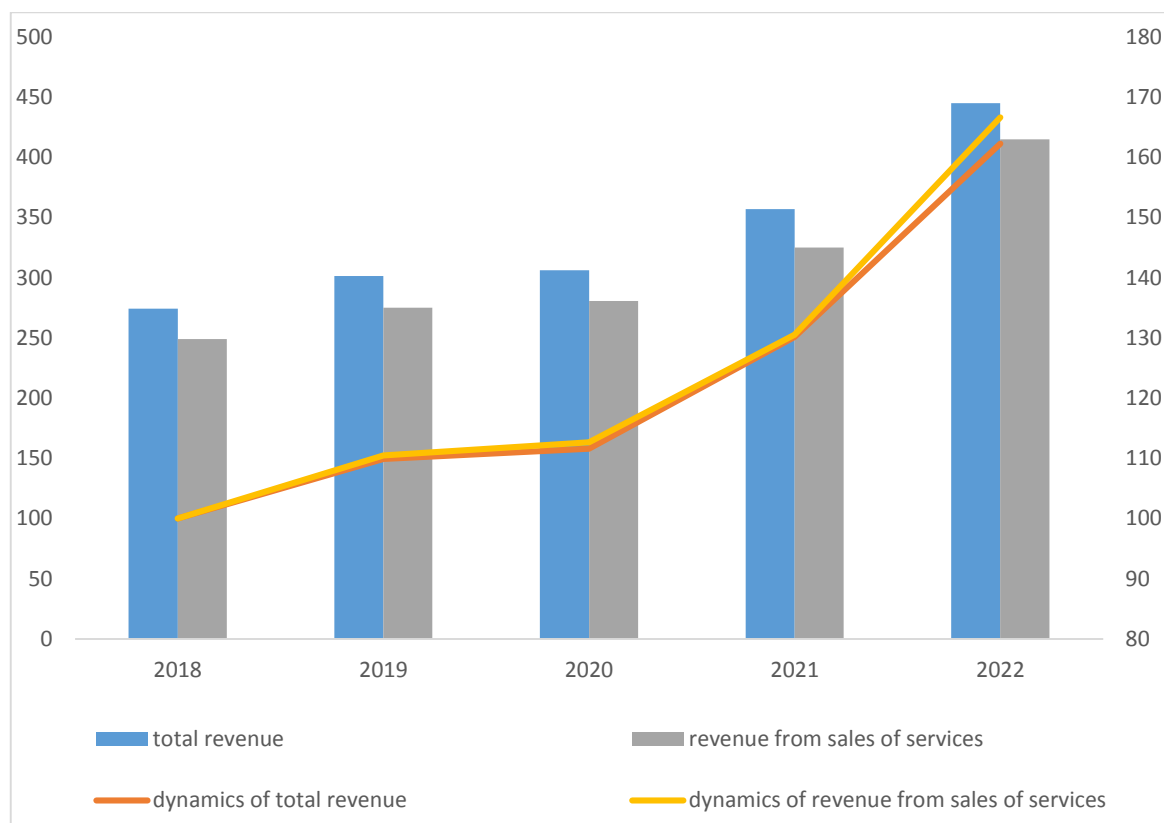


Figure 1. Value (in billion PLN, left axis) and dynamics (right axis, in%) of total revenues and sales revenues of enterprises from the *Transport and storage* section in the years 2018-2022.

Source: own calculations and elaboration on: GUS, 2019a; 2020a; 2021a; 2022a; 2023b.

During the period under review, as total revenue increased, the cost of total revenue also increased (Figure 2.). The growth rate of total revenue costs was higher than the growth rate of total revenue only in 2020 (116.3% against 111.6%). This is likely due to the negative impact of the Covid-19 pandemic on economic results. In the remaining years, the growth rate of total revenue exceeded the growth rate of costs for generating revenue from all activities. A similar situation was noted in the analysed sector in terms of the pace of revenue growth from the sale of services and the cost of services sold. The results of the analysis for the year 2022 are particularly noteworthy. In this period, we observe a clearly more favourable dynamics in the case of revenues from sales of services (166.6%) compared to the dynamics of own costs of sold services (161%).

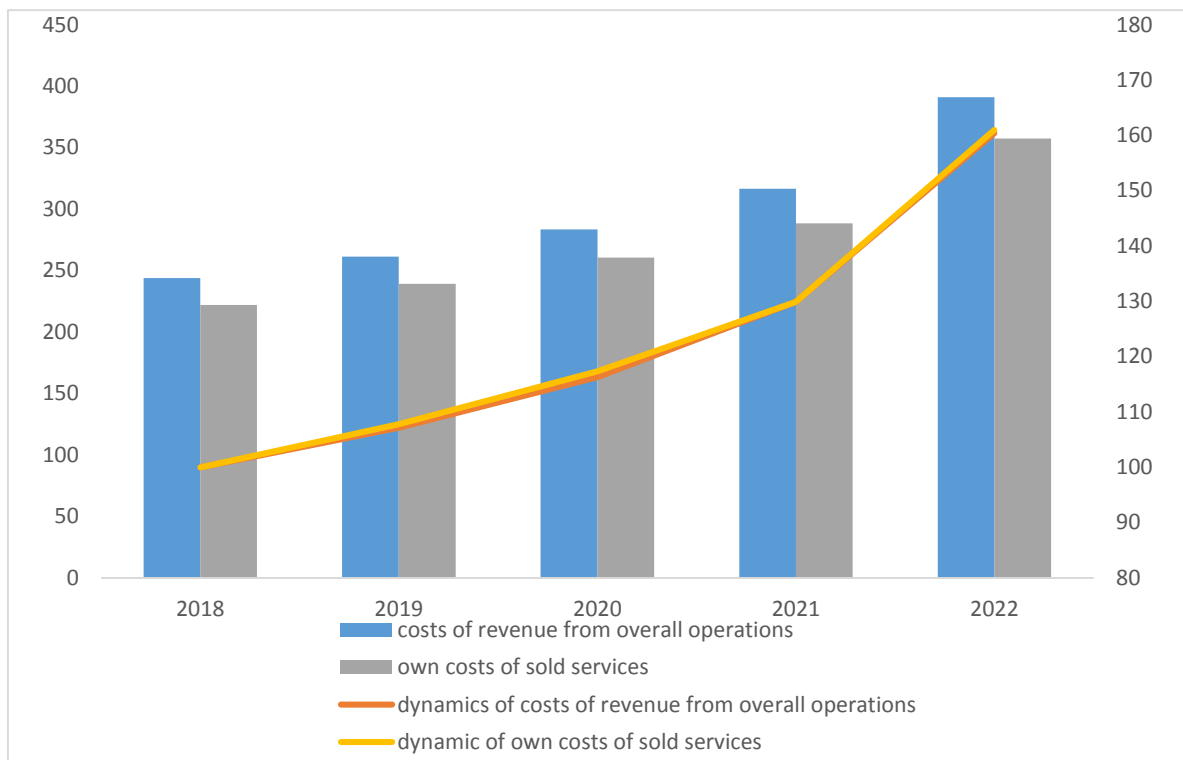


Figure 2. Value (in billion PLN, left axis) and dynamics (right axis, in %) of costs of revenue from overall operations and own costs of sold services of enterprises in the *Transport and storage* section in the years 2018-2022.

Source: own calculations and elaboration on: GUS, 2019a; 2020a; 2021a; 2022a; 2023b.

Another very important economic category in the analysis of the financial situation of enterprises is the net financial result. It represents the difference between the sum of revenues and profits achieved in a given reporting period and the sum of costs and losses incurred in obtaining these revenues, as well as charges in the form of income tax. The financial result is determined in stages. In units other than banks, insurance companies and reinsurance companies, the net financial result is composed of (Act of 29 September 1994...):

- result of operating activity (including from other operating income and expenses),
- result of financial operations,
- mandatory charges to the financial result due to income tax, for which the unit is the taxpayer, and payments equated with it, on the basis of separate regulations.

The net financial result is therefore a synthetic measure of the output of the conducted activity, and its level shapes the development possibilities of the enterprise.

The value and dynamics of the net financial result achieved by enterprises from the *Transport and storage* section against the dynamics of the net financial result in non-financial companies overall in the analysed period are presented in Figure 3. In the selected time series, both the net financial results of companies in the section H and the net financial results of non-financial companies as a whole showed a rising trend beyond 2020. The decrease in net financial results in both groups of enterprises was related to the deterioration of their financial situation as a result of the Covid-19 pandemic. However, in the TSL sector, the decline in net

financial result dynamics in 2020 compared to 2019 was more noticeable and amounted to almost 52 p.p. In the group of non-financial enterprises as a whole, the decrease in net financial result in 2020 was only 4% compared to 2019, and compared to the base year 2018, there was even an increase of 3%.

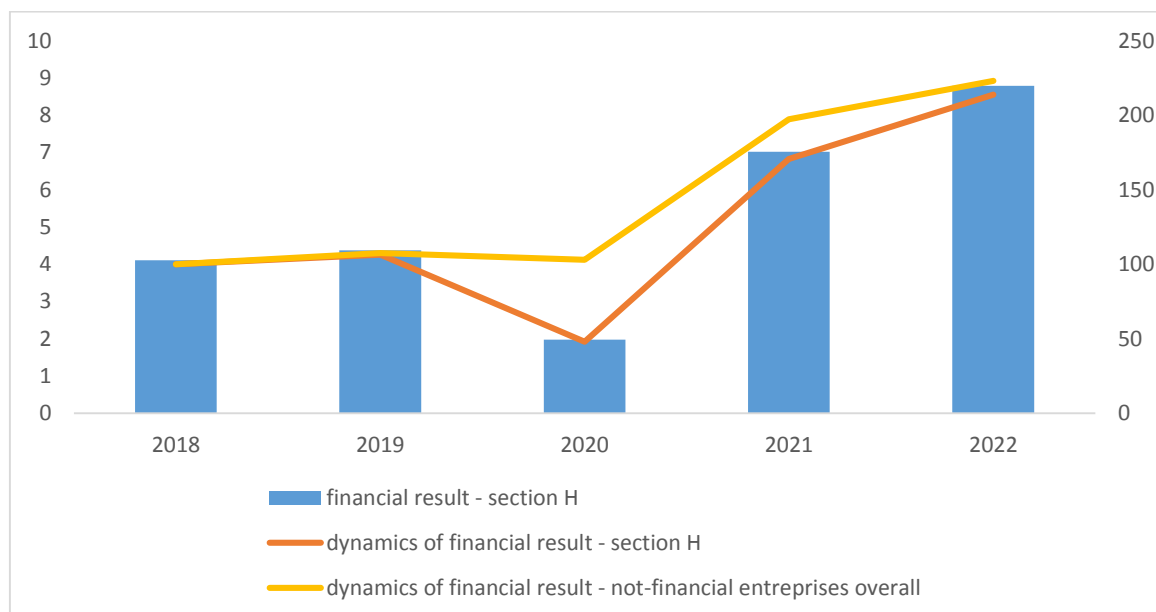


Figure 3. Value (in billion PLN, left axis) and dynamics (right axis, in%) of the net financial result of enterprises from the *Transport and storage* section⁵ and the dynamics of the net financial result of non-financial enterprises overall⁶ in the years 2018-2022.

Source: own calculations and elaboration on: GUS, 2019a; 2019b; 2020a; 2020b; 2021a; 2021b; 2022a; 2022b; 2023b; 2023c.

Another indicator used to analyse the financial situation of TSL companies is the profitability of net sales. This indicator belongs to a group of indicators presenting the financial efficiency of the company.

Net sales profitability, also known as the sales return rate or sales return, determines the share of the company's net profit in total revenue. The higher this indicator, the more favourable the financial condition of the economic unit. The net sales profitability ratio indicates how much net profit the company has generated from one zloty of total revenues during a given reporting period (Sierpińska, 2004, p. 319).

The formation of values and dynamics of net sales profitability indicators in enterprises from the *Transport and storage* section, as well as in non-financial enterprises in general in individual quarters in the years 2018-2022, is presented in Figure 4.

⁵ The presented data relates to companies employing more than 49 people.

⁶ The presented data concern non-financial enterprises (legal entities) conducting accounting books, in which the number of employees is 50 and more. The data does not include agriculture, forestry, hunting and fishing; financial and insurance activities; higher education institutions; independent health care facilities; cultural institutions with legal personality and trade unions; religious and political organizations.

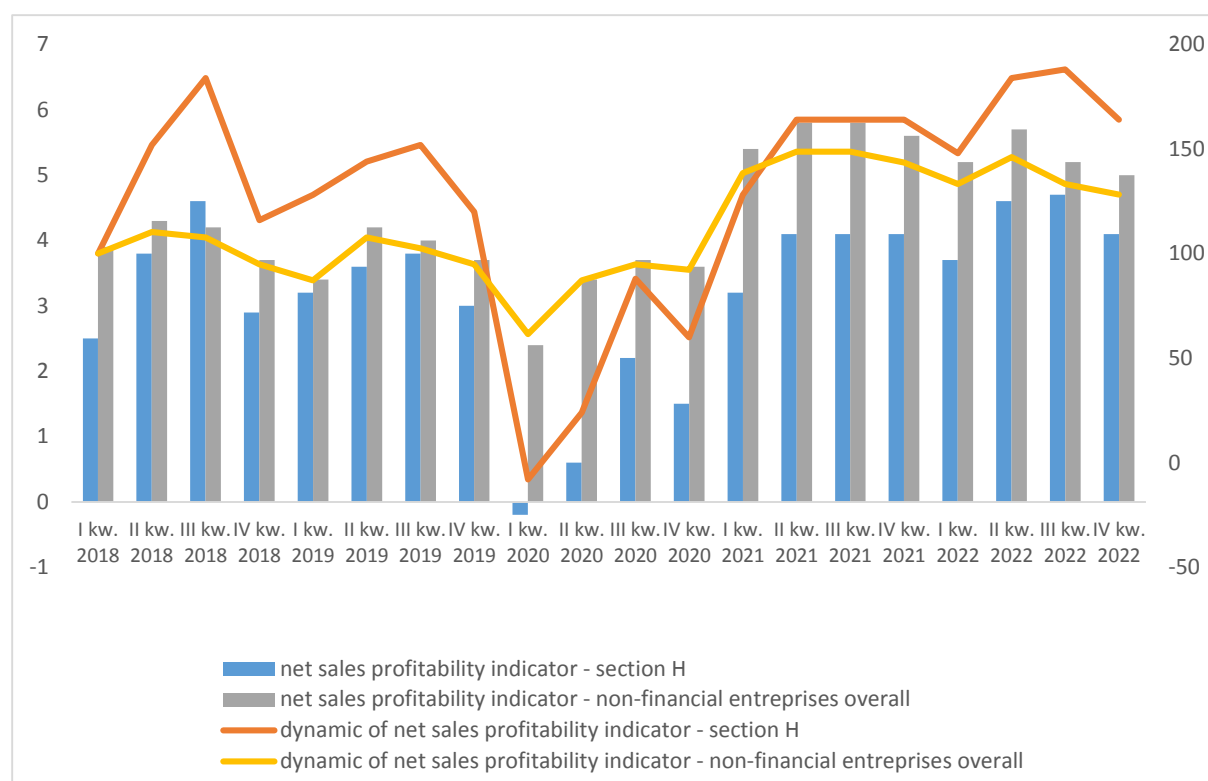


Figure 4. Level (left axis) and dynamics (right axis, in %) of net sales profitability indicators for enterprises in the *Transport and storage* section⁷ and non-financial companies in total⁸ in the years 2018-2022.

Source: own calculations and elaboration on: GUS, 2019a; 2019b; 2020a; 2020b; 2021a; 2021b; 2022a; 2022b; 2023b; 2023c.

As seen in the first quarter of 2020 there was a significant decline in the level of indicators both in the TSL sector and in non-financial enterprises overall. However, for enterprises in the *Transport and storage* section, we observe a negative net sales profitability ratio of -0.2%, and in the group of non-financial enterprises as a whole, a positive value at the 2.4% level. This situation indicates the occurrence of factors that had a negative impact on the financial results of the TSL sector. The subsequent quarters of 2020 brought an improvement in the financial situation, which is reflected in the rising levels of net sales profitability indicators. Significant improvement occurred in the first quarter of 2021. In the same quarter of the following year, there was a decline in the analysed indicators, however, this decline was insignificant. And so for enterprises in the *Transport and storage* section it was 16 p.p., and for non-financial enterprises in total 10 p.p. compared to the end of 2021.

An important economic category, which was analysed in the context of this article, is investment expenditure. Investment outlays are financial or material outlays, the aim of which is to create new fixed assets or improve (rebuild, expand, reconstruct or modernise) existing

⁷ The presented data relates to enterprises employing more than 49 people.

⁸ The presented data concern non-financial enterprises (legal entities) conducting accounting books, in which the number of employees is 50 and more. The data does not include agriculture, forestry, hunting and fishing; financial and insurance activities; higher education institutions; independent health care facilities; cultural institutions with legal personality and trade unions; religious and political organizations.

fixed assets, as well as outlays for so-called initial investment equipment. They are divided into outlays for fixed assets and other outlays (Pojęcia stosowane w...). Example capital expenditures include expenditures on buildings and structures, machinery and equipment, means of transport, interest on loans and loans financing development tasks during the investment period. However, examples of other categories are expenditures incurred for the initial equipment of an investment and costs associated with the implementation of the investment - these expenditures increase the value of fixed assets. The value and dynamics of the investment outlays of the analysed group of companies against the background of the investment outlays of national economy businesses were presented in Figure 5.

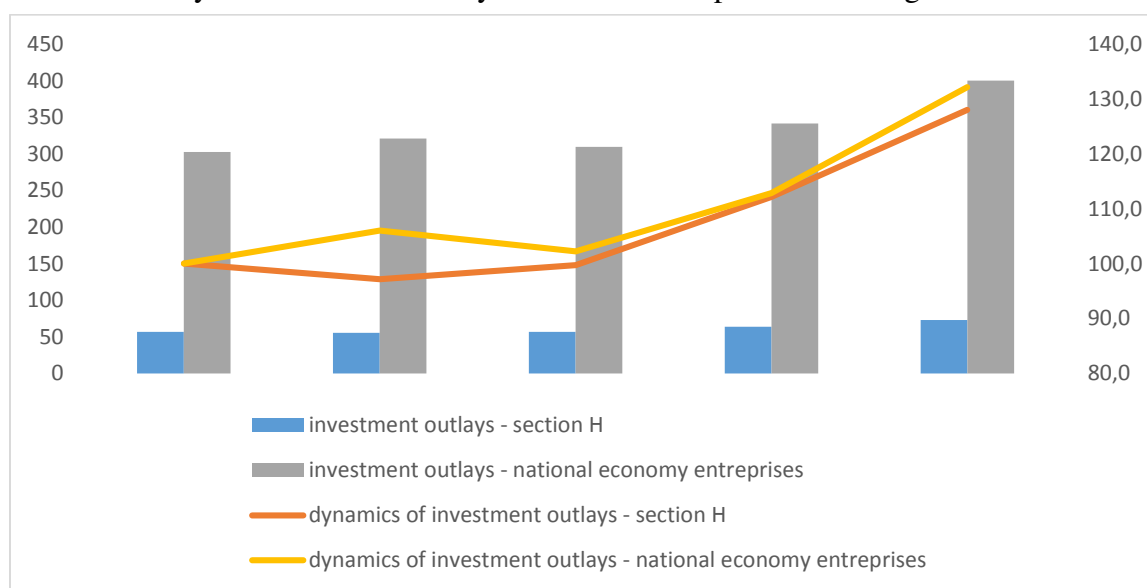


Figure 5. Level (in billions of PLN, left axis) and dynamics (right axis, in %) of investment outlays of enterprises from the *Transport and storage* section in the years 2018-2022 and of the national economy enterprises as a whole in the years 2018-2022.

Source: own calculations and elaboration on: GUS, 2019c; 2020c; 2021c; 2022c; 2023d.

As can be seen, the investment outlays of the enterprises in the analysed section constitute almost 20% of all investment outlays of Polish enterprises. In the period under review, the lowest level of investment expenditure was recorded in 2019 and 2020. In subsequent years, the level of these expenditures increased both in the analyzed section and in the entire national economy. The highest investment expenditure dynamics for TSL enterprises were recorded in 2022 (128%). This year there was an increase in expenditure by 17.57 billion PLN compared to 2019.

To complete the assessment of the financial situation of the TSL sector in Poland, investment outlays and sources of their internal financing in the analysed time series (Table 1) were presented.

Table 1.

Investment outlays and sources of their internal financing of enterprises from the Transport and storage section in the years 2018-2022

Item	2018	2019	2020	2021	2022	2022/2021	2022/2020	2022/2019	2022/2018
Investment outlays (in billions of PLN)	57,01	55,4	56,86	63,94	72,97	114%	128%	132%	128%
Financial net result (in billions of PLN)	4,11	4,38	1,98	7,02	8,79	125%	444%	201%	214%
Depreciation (in billions of PLN)	8,63	9,6	10,08	10,99	11,83	108%	117%	123%	137%
Financial surplus (in billions of PLN)	12,74	13,98	12,06	18,01	20,62	114%	171%	147%	162%
Indicators									
Financial surplus to investment outlays (%)	22	25	21	28	28	x	x	x	x
Investment outlays to depreciation (%)	661	577	564	582	617	x	x	x	x

Source: own calculations and elaboration on: GUS, 2019a; 2020a; 2021a; 2022a; 2023b.

As can be seen from the presented data, throughout the entire analysis period, the extended reproduction of fixed assets is carried out, which means that the value of investment outlays exceeds the value of depreciation. The level of extended reproduction of fixed assets amounts to an average of six times the value of depreciation. The barrier to increasing the level of investment in enterprises from the analysed section is the level of generated financial surplus. In none of the periods studied did the surplus exceed 30% of the investment outlay. The result is that businesses are dependent on external sources of funding to grow. Nevertheless, we have observed a gradual increase in the level of financial surplus from PLN 12.74 billion in 2018 to PLN 20.62 billion in 2022.

4. Discussion

The financial situation of TSL enterprises in Poland varied over the selected time series. The years 2018-2019 were a period during which revenue from all activities, including sales revenue, had a higher dynamic than the costs of generating revenue from all activities and the own costs of sold services. Thanks to this, the enterprises of the analysed sector realised an increase in net financial result by PLN 0.27 billion in 2019 compared to the previous year, thus achieving a net sales profitability of 3.0%. When comparing the financial situation of TSL sector enterprises against national economy entities, it's worth noting a decrease in the level of investment outlays by PLN 1.61 billion at the end of 2019 compared to the previous year. On one hand, this can be viewed negatively, but on the other, it's worth noting the positive effect of such actions. Retaining financial surplus allowed for maintaining accounting liquidity in the following year.

The next period is 2020, during which there was a noticeable deterioration in financial results, especially in terms of net sales profitability. The introduced state of epidemic Covid-19

in March 2020 likely contributed to a negative profitability level recorded in the first quarter. Negative net turnover profitability in the analysed sector was due to the necessity of incurring costs generated by the effects of supply chain disruption and the need for enterprises to adapt to safety conditions during the pandemic period. Nevertheless, there was an increase in the net sales profitability index of 32 p.p. compared to the first quarter in the next quarter of 2020. This was possible due to the increase in demand for courier services, mainly for food items and cleaning supplies. At the end of 2020, there was an increase in total revenue of PLN 4.74 billion compared to 2019. The net sales profitability in the analysed sector was 1.5% in 2020. It should be noted that this is 2.1 p.p. less compared to the total number of national economy enterprises.

The last period of assessment of the financial situation of the analysed group of enterprises covers the years 2021-2022. Both the year 2021 and 2022 are characterized by high sales dynamics of total revenues and revenues from service sales, but also costs. Analysing individual data, it's evident that the increase in revenue is higher than costs, as detailed earlier in the article. Attention should be paid to the financial results achieved in 2022. Thanks to the high dynamics of revenues from sales of services at almost 167% in the analysed sector, enterprises generated more than twice the net financial result compared to 2018. Additionally, there was a 28% increase in the size of investment outlays compared to 2018. The dynamics of investment expenditures in the last analysed year were only 4.18 p.p. lower than the dynamics of investment expenditures in the national economy as a whole.

It should also be noted that over the period under review, capital other than from financial surplus accounted for more than 70% of the financing of investment outlays. Assuming that the company paid dividends from net profit, the level of external financing was even higher.

5. Conclusion

In light of the results presented above of the *desk research* study in the years 2018-2022, we observe changes in the levels and dynamics of the analysed categories and economic indicators of TSL sector enterprises. The presented analysis indicates that the Covid-19 pandemic may have had a negative impact on the financial results of analysed group of enterprises. In 2020, there was a noticeable deterioration in financial results, particularly in terms of net sales profitability.

The study should be seen as a contribution to the scientific discussion in the issue of growth and development of TSL sector, however, it should be emphasised that the conducted research has certain limitations. To obtain a complete picture of the economic and financial situation of TSL sector enterprises in further studies, the Authors intend to expand an analysis of a larger number of categories and indicators. In particular, exploring issues related to accounting liquidity, profitability, debt and the efficiency of enterprises operations would be helpful.

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COOPERATION WITH CREATIVE BUSINESS IN THE ASPECT OF NEW SKILLS OF CULTURAL INSTITUTIONS

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Purpose: The aim of the article is to recognize the essence of cooperation between creative businesses and cultural institutions, which are increasingly improving their skills, looking for real opportunities for effective and competitive development in the cultural sector. This goal was complemented by the identification of examples of good practice in this research area.

Design/methodology/approach: The methodology applied in the article refers to the methodological canon of management sciences, including, among others, the methodology of conceptual-theoretical research. On their basis, a critical analysis of foreign and Polish literature about management sciences was carried out. At the same time, the descriptive method and the comparative method were used to interpret and analysis the collected material.

Findings: Relevant definitional approaches to creative businesses and modern cultural institutions are recognized. Types and forms of cooperation between these entities were identified. On this basis, it was shown that cooperation between cultural institutions and creative businesses, based on the presented good practices related to this, brings many benefits. This justifies the continuing need to analysis emerging approaches and types of cooperation.

Research limitations/implications: Analyzing the subject of the research in the proposed methodological approach makes it possible to systematize knowledge in the field of cooperation between creative businesses and cultural institutions. Thus, it increases the recognition of the changes accompanying them, providing cultural institutions with the motivation to develop in line with the assumptions of the knowledge economy.

Originality/value: To deepen and update knowledge on the cooperation of creative businesses with cultural institutions. To assess progressive changes in the phenomenon under study.

Keywords: creative business, cultural institutions, knowledge economy, good practices.

Category of the paper: A literature review and case study.

1. Introduction

The considerations presented in this article point to new skills for cultural institutions based on cooperation with representatives of creative businesses. These actors are currently facing numerous challenges in the transition to an economy based largely on knowledge, skills and

creativity (Kosińska, 2020; Szostak, Sułkowski, 2021; Lewandowska, 2015; Ingram, 2016). The new reality triggers the need for change, including building and developing collaborative partnerships with the creative sector.

These issues determine the problem scope of the article, the aim of which, in the theoretical layer, is to analyze selected notions concerning the subject matter taken up, including, among others: the category of creative business, creativity and the features and skills of modern cultural institutions. In the practical layer, the observations and conclusions formulated are aimed at showing the possibilities of cooperation between cultural institutions and creative businesses. The originality of the article lies in deepening and updating the knowledge of cooperation between creative enterprises and cultural institutions and assessing the progressive changes in the phenomenon under study.

The article consists of several parts. A brief introduction is followed by an explanation of the theoretical aspects concerning creative businesses and the attributes of modern cultural institutions. In the next part of the article, selected examples of good practices of cooperation between cultural institutions and representatives of creative businesses are analyzed and evaluated, treating them as a model leading to desirable changes in the activities of cultural institutions. The last part of the article contains the main conclusions resulting from the presented arguments and the presented examples of practice.

The article was developed based on a critical analysis of the literature on the subject, which included secondary material (including internet sources), as well as research findings based on case study (so-called good practice) and observation methods.

2. Literature review

Based on a review of the scientific literature, an analysis was made of the relevant concepts for the research area undertaken. Their problematic scope includes the category of creative business, cultural institutions, and forms of their cooperation.

2.1. The category of creative business and its theoretical basis

The category of creative business is variously analyzed and explained in the literature. However, there is no doubt that the concept of creativity is at the core of its understanding. The beginning of contemporary reflections on creativity dates back to the middle of the twentieth century, when an article appeared J.P. Guilford (1950) under the telling title „Creativity”.

The author assumed that every human being has creative potential, while recognizing that the concept of creativity is closely related to the term creativity. The quoted statement can be considered to coincide with definitions found in the English-language literature, according to

which the equivalent of creativity is the phrase „creativity”, translated as both „creativity” and „creativeness” (Bajer et al., 2010; Wolf, 2014; Kwan, Leung, Liou, 2018, Kochereva, 2019). This situation confirms that the essence of the two concepts is similar, which is why they are relatively often treated as synonyms. This study also adopts this view.

Creativity can be analysed from the point of view of various areas of human activity. When referring to the cultural sphere, the term is most often associated with ingenuity, the ability to think creatively or to create something "new" - so-called artistic creativity (Namyślak, 2016; Curuțiu-Zoicaș, 2019; Szostak, Sułkowski, 2021).

The type of artistic creativity is distinguished by, among others, the report of the United Nations Conference on Trade and Development (UNCTAD, 2008), which presents the place of the concept of creativity in the modern economy in an operationalized manner, where, in addition to the type of creativity mentioned, three other types of creativity are specified – see fig. 1.

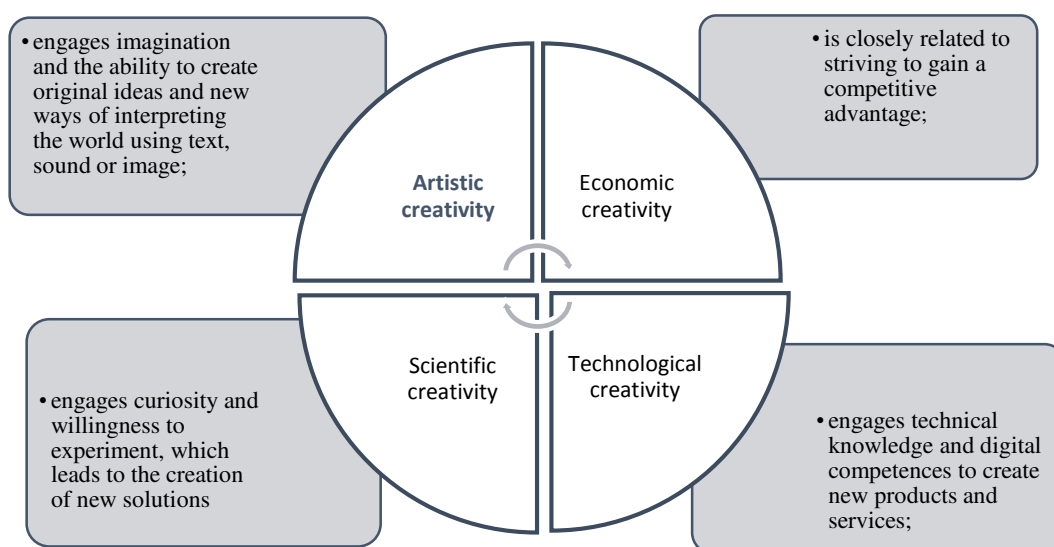


Figure 1. Types of creativity in the modern economy according to UCTAD.

Source: on based (UNCTAD, 2008).

The term creative business is closely linked to the concept of the creative sector, which can be defined in both narrow and broad terms. Definitions formulated in the narrow view of the creative sector indicate that it encompasses products and services that connect to cultural, artistic and entertainment value. These activities include, but are not limited to: books, magazine publications, visual art (painting, sculpture), performing arts (theatre, opera, concerts, dance), recordings, cinema and television films, fashion, toys and computer games (Caves, 2000; Flew, 2002; Throsby, 2010; Sobocińska, 2016).

In turn, the broad understanding of the creative sector is clarified, among other things, by the objectives of the EU Creative Europe program, which indicate that the term creative sector should be understood as: "an ecosystem comprising public bodies, cultural institutions, NGOs, creators, as well as businesses, start-ups and sole traders" (Ministry of Culture and National Heritage, 2022, p. 7). This approach forms the basis of the considerations presented

in this article, which show that cultural institutions are an important actor related to the activities of the creative industries.

According to the UNSCAD report (2008), the main areas of creative businesses in the cultural sector include four - see fig. 2.

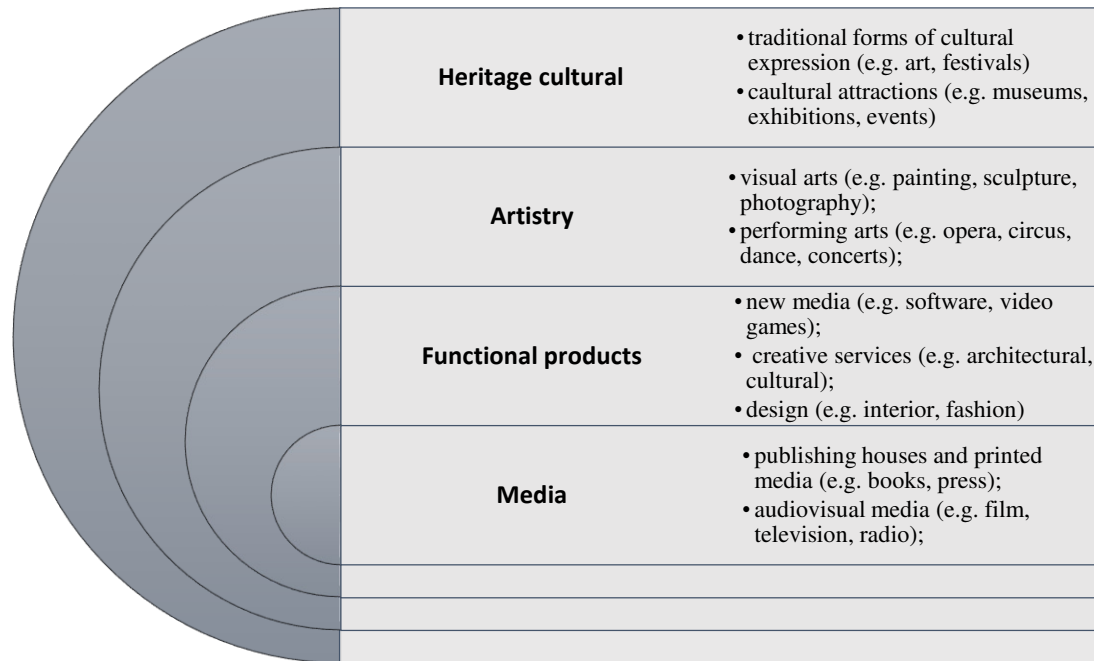


Figure 2. Creative business areas in the cultural sector.

Source: based on (UNCTAD, 2008).

The cultural creative businesses identified by UNCTAD (2008) relate to four key areas of activity. The first of these is formed by cultural heritage. This area brings together all cultural aspects, from historical, anthropological, ethnic, and aesthetic to social. The second area of creative businesses is the arts. Its works inspired by heritage, cultural identity and symbolic meaning create unique value from the point of view of market activities. The next area of creative businesses, on the other hand, is formed by the media; their main task is to produce creative content to communicate with a large audience. The last area is formed by the so-called functional products, which are more demand-driven and oriented towards their specific services, which are: design, new media, and creative services (Throsby, 2010; Sobocińska, 2016).

In the academic literature represented, among others, by Söndermann et al. (2009), Lewandowski (2013); Kosińska (2020) and many other authors, there are three types of sectors representing creative businesses in the cultural area: public, private, and non-profit. Figure 3 shows the three-sector model of creative businesses specific to the cultural area.

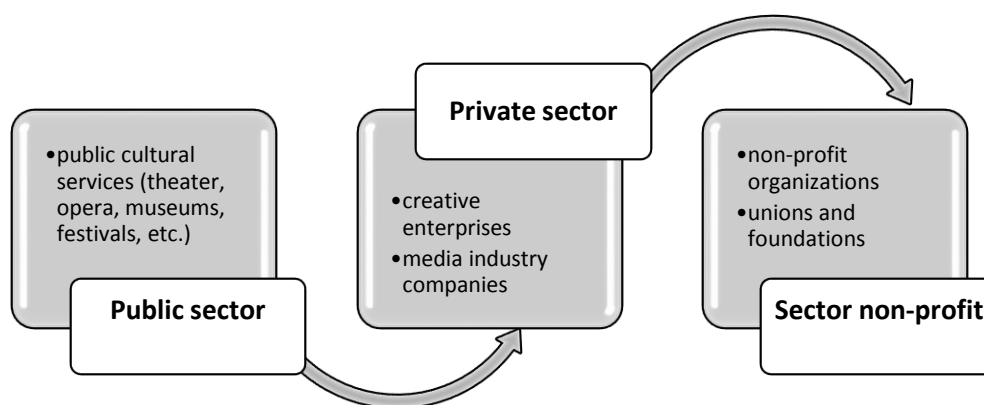


Figure 3. A model of three creative business sectors in the sphere of culture.

Source: on based (Söndermann et. al., 2009, p. 20; Kosińska, 2020).

Even though creative individuals are found in the private sector, their creative activities are not limited to it. Manifestations of these activities can also be found in the public sector (thanks to theatres, opera houses, cinemas, museums, or libraries), but also in the non-profit sector, within which there are various organizations, associations or community foundations, whose aim may be, for example, to promote cultural heritage.

The article assumes that the term creative business means: "an activity having its origin in individual creativity, skill and talent, with the potential to create wealth and create work through generation and exploration of intellectual property" (Flew, 2002, p. 183). The essence of the definition presented is captured in Figure 4.

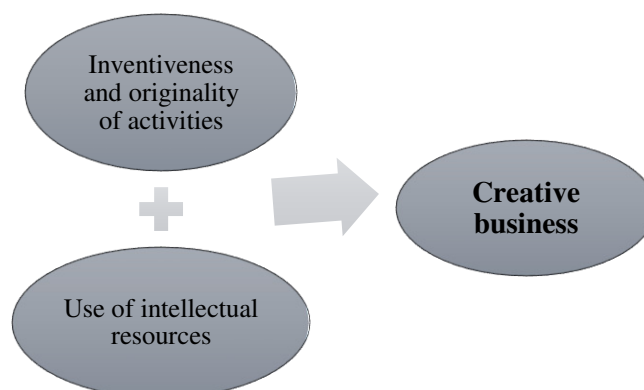


Figure 4. Creative business and its development base in the institutional sector culture.

Source: on based (Flew, 2002).

It follows from the above that the foundations for the creation, but also the functioning, of creative businesses in the cultural institutions sector are, first and foremost, ingenuity and originality of activities using intellectual resources. Culture is undoubtedly one such area.

2.2. New skills of cultural institutions in terms of forms and types of cooperation

Ingram (2016) emphasizes that cultural institutions, as a result of changes in their environment, are currently undergoing significant transformations. One of the key trends

emerging in their environment is the development of a knowledge-based economy, which means that the basis of market activities should be, above all, the wise and skillful use of knowledge available on the market. The development of the assumptions of this economy makes it necessary for actors in the cultural sector to become "intelligent" and oriented towards the skillful creation and management of knowledge (Gračanin, Kalac Jovanović, 2015; Falencikowski, Latzke, 2017).

In view of the above, cultural institutions develop their activities and accompanying strategies in an economy that requires them to make active efforts to acquire the necessary knowledge and then use it effectively in the competitive struggle (Kowalik, 2017).

The study assumes that a cultural institution defined as 'intelligent' operates in accordance with the requirements of the concept of knowledge economy and innovation. Innovation consists of the systematic (continuous) generation and implementation of all manifestations of innovation (novelty), based on the resources of modern communication technologies, reacting dynamically to important changes in the environment (Tidd, Bessant, 2009).

Creating innovation in „smart” organizations depends on a few essential skills. A summary of key skills in relation to a „smart” cultural institution is presented in Fig. 5.

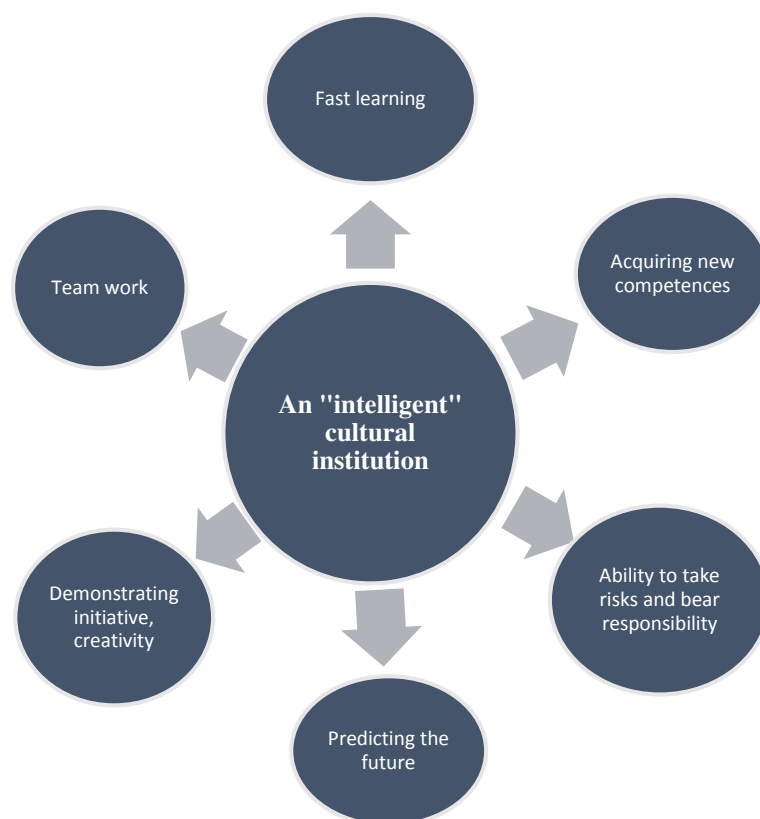


Figure 5. Key skills of an "intelligent" cultural institution necessary for creating innovation.

Source: own study on based (Lozano, 2019).

He skills listed above should be seen as desirable for modern cultural institutions, which are made up of creative and innovative people with specialized knowledge. The phenomenon of "cyberculture", developed as part of the development of the knowledge economy, requires cultural institutions to be able to synergize the three thematic areas of art, science and technology, as well as to use digital media to create a new model of culture based on the synergy of what is "online" with what is "offline" (Zawojski, 2018).

The new skills of cultural institutions contribute to the development of new forms of cooperation not only with representatives of creative businesses, but also with employees and clients. Their manifestations include creative training, artistic interventions (activities of artists within companies and the use of the potential of culture to influence the development of the respective entity), joint implementation of projects (so-called partnerships), the use of the value of art in influencing creativity and its role in employee development (Lewandowska, 2015).

One of the important factors favoring the development of cooperation between cultural institutions and representatives of creative businesses is the size of the entities, or more precisely the dominance of very small cultural entities, including those often operating as sole proprietors (Kosińska, 2020). This factor makes them too weak to gather the resources necessary for their functioning in the cultural sector on their own. Therefore, various forms of cooperation based on partnership and joint implementation of different types of cultural projects are being promoted among them. According to Lenart-Gansiniec (2016), access to the partner's resources and competences (including knowledge skills and experience), and learning from each other, are key benefits of the collaborative model analyses.

A second important factor is that cooperation with other actors (representatives of creative businesses) gives them access to new ideas, technologies, and talent, as well as the possibility to quickly validate their own ideas with a high degree of flexibility of action (Krapieński, Szultka, 2014).

This is why cooperation between cultural institutions and creative businesses is conducive to the creation of beneficial relationships based on which, on the one hand, new sources of funding are obtained and, on the other, valuable business knowledge is derived.

3. Examples of cooperation between cultural institutions and creative businesses based on good practice

3.1. Research methodology

In order to identify the phenomenon under study, qualitative research was carried out in the nature of a diagnosis. Their aim was to find an answer to the question: *What is the essence of cooperation between creative businesses and cultural institutions, which are increasingly*

improving their competences in search of real opportunities for effective and competitive development in the cultural sector?

This objective determined the choice of a research method in the form of a case study, which consisted of analyzing and evaluating examples of good practice in the selected research area. In view of the above, the research methodology used in the article refers to the methodological canon of the management sciences including qualitative research methodology with the inclusion of scientific case studies. The application of this methodology made it possible to describe the entities studied and to identify their operating practices.

3.2. Good practice I - „Silesian Cluster of Culture, Tourism and Recreation”

The cluster under analysis brings together entities providing services in the field of culture, tourism, and recreation, as well as in the field of tourism, consulting, promotion, and marketing. The cluster was created in 2013 as part of a project co-financed by the European Union from the European Regional Development Fund as part of the Regional Operational Program of the Silesian Voivodeship for 2007-2013. Its main goal is to effectively use the environmental and cultural potential of Upper Silesia, increase the tourist and recreational attractiveness of the region and promote the cultural assets of the voivodeship.

The Silesian Voivodeship is an area with an unusually rich cultural heritage, both tangible (castles, landowners' residences, palace, and park complexes) and intangible (the traditional Silesian dialect). It is a significant theatre and music center. It has a very well-developed cinema network. It has numerous galleries, open-air museums and over fifty museums. What particularly distinguishes the voivodeship both nationally and internationally are the places associated with its industrial heritage - the tradition of mining, metallurgy, power generation, railways, or the food industry. Today, subjected to successive revitalization, they are being made available to the inhabitants as dynamically developing centers of culture and tourism with a unique offer.

Functionally, the described cluster is based on the cooperation of various entities providing services in the field of culture (including cultural institutions, museums, associations), tourism, and recreation, with the cooperation of industries related to tourism services, as well as the R&D sphere, business environment institutions and universities. The basis of their cooperation is the transfer of knowledge, technology, and innovative solutions.

Among the activities carried out by the cluster, it is important to note the participation in 2013 in the Technology and Services for Concerts, Events and Congresses Fair and the TOUR-SALON Fair of Regions and Tourist Products. Participation in this event provided an excellent opportunity to present the services offered by the cluster. In addition, the cluster organized a series of conferences entitled. In addition, the cluster organized a series of conferences entitled "The role of the brand of recreational products in the development of the region" and "The role of the brand of cultural products in the development of the region". During such meetings, topics discussed included the dissemination of cultural heritage, tourism product management

and promotion, tourism funding in the new 2014-2020 perspective and the very idea of clustering.

The cluster's key strengths include: a good resource base, resulting from the attractiveness of the region, the combination of activities of diverse entities and well-defined goals that will allow for its effective development.

It is assumed that with the development of the cluster, the effectiveness of its functioning will translate, among other things, into an improvement of the economic situation of the region, an increase in tourist traffic based on the unique landscape, natural and anthropogenic values, as well as tradition and folklore characteristic of the region, though, among other things the joint implementation of cultural, tourist and recreational undertakings and projects, creation of a joint, comprehensive offer of cluster participants, organization of meetings, conferences, creation of a platform for communication and coordination of activities in the cultural, tourist and recreational sectors, increasing the capacity for innovation of cluster members and standardization of the customer service process (Kwiecień, 2016).

3.3. Good practice II – „Birmingham a creative metropolis”

The English city of Birmingham, located in the metropolitan county of the West Midlands, was once a thriving industrial center, but in recent years has relied on the development of creative businesses and promotion through culture. The effect of the scale of the partnerships undertaken has translated into the success of creative businesses in this English city.

In fact, a cultural partnership initiative called the Birmingham Cultural Partnership has been established in Birmingham, represented by a group of individuals who support the cultural interests of the city. Its aim is to help engage local people in cultural participation and integration through artistic activities, while at the same time promoting the city and improving its image through culture and using it as a tool to strengthen the city economically. To this end, a special fund has also been set up to support these tasks.

For the purpose of conscious development and promotion of culture in the described city, four programs have been developed under the name: *The Working Neighborhoods Fund Commissioning Program*. Three of them pursued goals related to the promotion of the city through culture. They were:

- a) International Partnership Program – a project mainly financing international visits of local artists dedicated to various branches of art,
- b-c) Emerging Festivals Fund Festivals Challenge Fund – a project that helps organize artistic festivals of various genres.

Thanks to the program „*The Working Neighborhoods Fund Commissioning*”, as many as 45 projects were completed in Birmingham for a total amount of 424,325 thousand £. The projects were also financed from many additional funds, for example by other funding agencies or partners, sponsorship, ticket sales, as well as from the funds of cooperating organizations. By supporting artistic initiatives, cooperation and exchange between cultural

entities, various ideas for promoting the town through culture were implemented. One of them was a concert tour of the band "Ex Cathedra" along with workshops, closely related to the promotional campaign and activities in Birmingham, which contributed to the promotion of the city in the United States. The concerts received good reviews in the press (including the „New York Times”) and among social media users.

Birmingham, although neither became the European Capital of Culture nor won the City of Culture competition, managed to achieve success based on the cooperation of culture and art entities (including music) with creative businesses. Thanks to the implementation of program activities, positive social and economic effects were noticed, creative businesses strengthened, the local community became more integrated, an increased inflow of tourists was observed, and Birmingham's reputation improved.

There was much more positive media coverage of the city. The interest of cultural sector employees in the city as an attractive place to work was aroused. At the same time, the influence of the presence of culture on attracting young people, also for permanent settlement, was observed (Szlachta, 2014, p. 70).

3.4. Good practice III – „Cooperation of cultural entities with creative businesses the need to build the digital presence of Polish institution culture”

The reality in which cultural institutions currently operate in Poland is characterized by, as already mentioned in the article, the growing importance of the Internet, new information and communication technologies and the assumptions of the knowledge-based economy (Reformat, 2017). This situation means that joint ventures undertaken by cultural entities and creative businesses in the form of design studios specializing in creating comprehensive web and mobile solutions (portals, applications, etc.) are becoming more and more common.

The result of the above work are modern online services, such as: *Polona*, *Cyfrowa Zachęta* [*Digital Incentive*] or *Żydowska Warszawa* [*Jewish Warsaw*]. Interactive and multimedia-enriched portals are one of the important benefits that cultural institutions derive from cooperation with professional teams of graphic designers and programmers. In tab. 1 presents examples of several projects jointly implemented on a partnership basis by representatives of both sectors.

Table 1.

Selected examples of projects based on partnership cooperation between cultural institutions and creative businesses

Name project	Basic project information	Main tasks and project goal
„Polona”	<ul style="list-style-type: none"> - digital repository service of the National Library - contractors: POLONA/2 million - programming and configuration works: LaboratoryEE, Bitnoise, and Neubloc Poland - implementation: company 	<ul style="list-style-type: none"> - presentation and dissemination of library collections (books, old prints, manuscripts, graphics, maps, sheet music, photographs, leaflets, posters and postcards) on the website: www.polona.pl; - sharing not only your own collections, but also those of other institutions

	Neubloc Polish Graphics: company Huncwot	<ul style="list-style-type: none"> - digitization of collections using new technologies, allowing for obtaining the highest quality; - enabling users to create their own collections, work with an active text layer (OCR), add notes and bookmarks to objects
„Cyfrowa Zachęta” [„Digital Incentive”]	- website of the National Gallery of Art	<ul style="list-style-type: none"> - broad dissemination of information about the current offer of the Gallery - presentation of the institution's digital collection; - business card and digital repository of the National Gallery of Art
„Żydowska Warszawa” [“Jewish Warsaw”]	- multimedia online guide prepared by the POLIN Museum of the History of Polish Jews in cooperation with numerous experts	- presentation of the Polish capital through the prism of the history of its Jewish inhabitants on the website: www.warsze.polin.pl
„Warsaw Rising”	- portal of the Warsaw Uprising Museum created in cooperation with the company Bright Media	- popularization and interactive dissemination of the history of the Warsaw Uprising in the form of exhibitions created under curatorial supervision
„Wirtualne Muzea Małopolski” [„Virtual Museums of Małopolska”]	- project created by the Małopolska Institute of Culture in Krakow in partnership with the Department of Economic Development of the Marshal's Office of the Voivodeship. Małopolska, in consultation with museums from the region	<ul style="list-style-type: none"> - preservation of the cultural heritage of Małopolska in digital form; - digitization of museum collections and creation of the Regional Digitization Workshop; - making a collection of approximately 1000 digitized exhibits from 39 museums in Lesser Poland available to a wide audience on the Internet

Source: Prepared based on the analysis of the websites of the mentioned projects.

The examples of good practices presented above in the field of cooperation between cultural institutions and creative businesses confirm the innovative direction of development of these entities, based on new skills, potential and possibilities of using modern digital technologies. At its core is the paradigm of developing a knowledge-based economy, the development of new information and communication technologies, and the digitization and making cultural resources available to the widest possible audience. The examples of cooperation between cultural institutions and creative businesses shown confirm an open approach to the changing needs and expectations of cultural sector participants in terms of communication and ways of interacting with its resources.

They are an important source of information about the activities of cultural institutions in the field of digitization of resources and new forms of making them available (such as virtual museums, digital libraries, electronic archives, etc.). This offer is created with contemporary recipients of broadly understood culture in mind - representing the knowledge-based information society.

4. Conclusions

The aim of the article was to recognize the essence of cooperation between creative businesses and cultural institutions, which are increasingly improving their skills, looking for real opportunities for effective and competitive development in the cultural sector. This goal was complemented by the identification of examples of good practice in this research area. The presented practices were selected from a group of many described both in the literature on the subject and in economic practice, guided by the belief that they can constitute a motivation for activities and a model for various entities in the cultural sector.

Cooperation of cultural institutions with creative businesses requires new skills and competences from the analyzed entities, which enable the implementation of creative initiatives and activities to increase innovation in the cultural sector. It was established that their scope concerns full-scale sharing of culture, activating the audience, as well as generating knowledge and information in the field of broadly understood culture.

This situation is confirmed by the presented examples of cooperation between cultural institutions and creative business entities, which indicate that entering into a form of partnership brings significant benefits. From the point of view of cultural institutions, the partnership is based on the benefits resulting from the potential of the cultural sector in terms of creative development and learning based on valuable business knowledge.

At the same time, it should be emphasized that cooperation between cultural institutions and creative businesses indicates the need to integrate the activities of various entities supporting the development of the cultural sector. As a result of this cooperation, a new quality of products and services offered by cultural institutions is created, which confirms its beneficial impact on the development of these entities.

In conclusion, it is worth highlighting the key practical implications arising from cooperation between cultural institutions and creative businesses. Among these, a key one is cultural education in a new engaging and environmentally friendly form, representing the development potential of cities in line with the assumptions of a knowledge-based economy. Cooperation between cultural institutions and creative businesses also makes it possible to combine technological innovations, stimulate creativity, build an attractive climate, and concentrate talent, becoming an important factor in socio-economic development. Hence, establishing cooperation with representatives of various creative businesses is extremely profitable for cultural institutions.

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DIFFERENCES IN THE FINANCIAL SITUATION OF LAND COUNTIES IN POLAND DEPENDING ON THEIR POPULATION DENSITY

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Purpose: The aim of the article is to identify and assess the differences in the financial situation of counties in Poland, i.e., counties units of local government without cities with counties rights, depending on their population density.

Design/methodology/approach: The article identifies and assesses the differences in the financial situation of counties in Poland, i.e., powiat local government units without cities with powiat rights, depending on their population density. The empirical material used in the article concerns all land counties in Poland, i.e. powiat local government units without cities with powiat rights. The numerical data come from the Central Statistical Office (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using the comparative analysis. Moreover, the following measures of descriptive statistics were used to analyse the data: dynamics index, mean, and coefficient of variation. Additionally, a point assessment of all diagnostic features illustrating the financial situation in separate groups of land counties depending on their population density against the background of all land counties in Poland for the years 2020-2022, which is a new approach to the research problem discussed in the article.

Findings: Analysis of the statistical data confirmed the research hypothesis put forward in the article, which assumes that population density is an important factor shaping the financial situation of land counties in Poland, with the group of counties with the lowest population density having a better situation in this respect and the group with the lowest population density having the worst situation in group of counties with the highest population density.

Originality/value: The originality of the work lies in the author's approach to the analysis of the undertaken research issues and the point assessment of the financial situation in separate groups of land counties depending on their population density against the background of all land counties in Poland for the years 2020-2022. The work may be useful and is addressed primarily to politicians at the central level, as well as to local government officials responsible for public local government finances, as well as for creating the conditions, opportunities, and directions of local socio-economic development of powiat local government units and other decision-makers implementing local development policy in Poland.

Keywords: financial situation, land countiess in Poland, population density.

Category of the paper: research paper.

1. Introduction

The issue of regional and local development in the context of socio-economic growth and development processes is important not only for building social prosperity, but also for maintaining competitive advantages of enterprises, regional and local economies and the national economy. This also translates into the social and political situation, as well as the development of financial flows, investments, and the settlement network. From the point of view of society and economy as well as the socio-economic development of the country, regional and local disproportions are particularly important in this respect, and are common in countries with market economies, regardless of their location, history, culture or level of development. It should be added that the scale of these disproportions in individual countries varies, and their consequences for societies and economies are of different importance and significance. Therefore, reducing them is a priority and a subject of interest for both the entire European Union and its individual member states, including Poland. One of the priorities of the European Union's cohesion policy is to support development in a way that should lead to reducing development disproportions between Member States, their regions, and local communities. Its effect is to increase the competitiveness of the regional and to local economy and improve the quality of life of residents. In this context, the territorial approach in the process of improving cohesion, understood as the geographical space and its inhabitants, is increasingly emphasised (Polverari, Bachtler, 2005; Lambregts, Janssen-Jansen, Haran, 2008; Czudec, Majka, Zając, 2018; Miś, Zając, 2020; Kraska, Kot, 2021).

Local government is a key institution responsible for the implementation of many tasks aimed at meeting the needs of primary importance for residents, as well as creating socio-economic development in the regional and local system. The effectiveness of the implementation of tasks by local government units is largely dependent on effective financial management, and their implementation is guaranteed by adequate economic potential. Therefore, the quality of the local government finance system, considered as a set of institutions, legal norms, and tools defining the principles of local government financial management and used to conduct it, is important in this respect (Grzebyk, Sołtysiak, Stec, Zając, 2020; Kata, Czudec, Zając, Zawora, 2022).

The financial management of local government units is a complex process, carried out with respect to legislative requirements within the local government budget. Ensuring the efficient and proper operation of this specific economy, which consists primarily of cash and property resources, requires strict compliance with many legal acts, standards, and budget principles. As part of the financial management of local government units, various public tasks and financial operations are carried out relating to individual departments of public finances, and various legal and financial methods and instruments are used (Sołtyk, 2017; Sołtysiak, 2017; Sołtysiak, Suraj, 2018).

The financial management of local government units involves collecting income and revenues as well as making expenses and expenditures in order to perform their own and commissioned tasks, which determines their development and competitiveness and ensures the fulfilment of the current and future needs of residents. When assessing the income side of the budget of local government units, it is important to examine the state and changes in the level of income, its dynamics and structure, as well as spatial differentiation. However, the analysis and assessment of the expenditure side of the budget allows us to determine to what extent financial resources are allocated to solving current problems, and to what extent they are allocated to the promotion, investment, and development of local government units and to improving and increasing their competitiveness (Błachut, Cierpień-Wolan, Czudec, Kata, 2018; Grzebyk, Sołtysiak, Stec, Zajac, 2020; Kata, Czudec, Zajac, Zawora, 2022, Sołtysiak, Zajac, 2023).

Investment expenditure in the financial management of local government units, in addition to their own income, is an important factor characterising their development possibilities. The wealth of these individuals clearly affects their investment opportunities. Entities with higher budget revenues per capita usually also have greater investment opportunities. In addition, a larger share of own revenues in total budget revenues allows local governments to use financial resources more freely, and thus creates the opportunity to allocate larger amounts for investments. This is also important from the point of view of the issue of income independence of local government units, understood as providing them with their own sources of income and free disposal of these funds. It should be added that the financial situation of local government units and the possibilities of implementing investment projects are of key importance for their development. Our financial resources constitute the foundation for the functioning of local government units and determine the implementation of all tasks, including those of an investment nature. However, the implementation of investments, especially those aimed at meeting the needs of residents and improving their existence and quality of life, also has a positive impact on the improvement and increase in the competitiveness of local government units (Kokot-Stępień, 2017; Dziemianowicz, Kargol-Wasiluk, Bołtomiuk, 2018; Czudec, 2021; Szolno-Koguc, 2021).

The financial management of the public sector units, including the local government units, should support rational spending of public funds and making appropriate decisions about the management of these funds. The basic goal in the financial management process should be to maximise the benefits from available resources and minimise losses and risks related to the activities undertaken, which especially applies to development projects, where benefits and costs are usually spread over time. Financial management should therefore focus on:

- shaping the amount and structure of budget revenues and determining the methods and sources of their acquisition,
- shaping the capital and property structure that guarantees maintaining economic and financial balance,

- allocating available financial resources,
- shaping the size and structure of expenses in connection with the current and investment activities carried out,
- influencing the level of risk accompanying the decisions made,
- monitoring and forecasting the financial and property situation,
- current assessment of the financial and property situation of the local government enabling the assessment of compliance of the course of current, investment and financial activities with the adopted assumptions,
- assessing the impact of external conditions on investment and financial decisions,
- formulating conclusions and recommendations regarding running a business,
- setting a financing strategy.

A properly managed entity should, in the long term, develop the so-called "good indicators", i.e. those that prove its development. Particularly noteworthy is the concept of the financial situation of a local government unit, interpreted as the ability of the local government to balance recurring expenditure needs with recurring sources of income, while simultaneously implementing tasks resulting from legal provisions that are intended to further increase income and maximise public utility for its residents (Mrówczyńska-Kamińska, Kucharczyk, Średzińska, 2011; Adamczyk, Dawidowicz, 2016; Kowalska, Możyłowski, Śmietanka, 2019; Kata, Czudec, Zając, Zawora, 2022; Ociepa-Kicińska, Gorzałczyńska-Koczkodaj, Brzozowska, Pluskota, 2022).

When defining the financial situation of a local government unit, the following are most often emphasised: the possibility of financing services on a continuous basis, the comprehensiveness of healthy finances, the ability to repay liabilities, and maintaining the current level of services while maintaining resistance to the risk of changes occurring over time. It seems that the most accurate interpretation is the financial situation of a local government unit, referring to its ability to meet its financial obligations and maintain services provided to the local community (Dylewski, Filipiak, Gorzałczyńska-Koczkodaj, 2011; Wiśniewski, 2011; Kopyściański, Rólczyński, 2014; Zawora, 2015; Adamczyk, Dawidowicz, 2016; Kotowska, 2016; Natrini, Taufiq Ritonga, 2017; Ociepa-Kicińska, Gorzałczyńska-Koczkodaj, Brzozowska, Pluskota, 2022).

The financial situation of a local government unit is its financial condition in a specific period of time, resulting from its income and its structure, expenses and their structure, the degree of use of repayable funds, activity and effectiveness in obtaining extra-budgetary funds, as well as the efficiency of management of financial and material resources. Local authorities should care about the good financial situation of a given territorial unit, as it is an element of its competitiveness. In addition, it is evidenced, among other things, the ability to perform tasks, achieve budget balance, as well as increase assets and to implement and satisfy the needs of residents. Additionally, the good financial situation of local government

units and the stability of the public services they provide to residents undoubtedly have a clear and positive impact on broadly understood socio-economic development, not only in the scale of a given local environment or region, but even in the entire country. Among a number of various conditions shaping the financial management of a local government unit, including its financial situation, the most general categories include exogenous, endogenous, and mixed conditions. Moreover, certain common categories can be distinguished, which include: social, economic, environmental, and spatial, as well as institutional, legal, and political conditions. However, to a large extent, the economy and financial situation of a local government unit are shaped by socio-demographic factors, especially such as: population number and its changes over time and population density, and higher population density may lead to a weakening of the financial situation in these units. Moreover, the catalogue of such factors is sometimes expanded to include events whose effects cannot be predicted and which may fundamentally change the economic situation and the operating conditions of local government units. An event in 2020 was the emergence of the coronavirus pandemic. It should be added that the analysis of the financial situation of a local government unit provides information about its current and future property and financial situation, and also allows to determine its possibilities and development prospects (Ossowska, Ziemińska, 2010; Zawora, 2015; Pedro Rodríguez Bolívar, Navarro Galera, Alcaide Muñoz, Deseada López Subires, 2016; Świrski, 2016; Bień, 2017; Standar, 2017; Stanny, Strzelczyk, 2018; Wójtowicz, 2018; Grzebyk, Sołtysiak, Stec, Zając, 2020; Czudec, 2021; Zawora, 2023).

2. Research aim, empirical material, and research methods

The aim of the article is to identify and assess the differences in the financial situation of counties in Poland, i.e., counties units of local government without cities with counties rights, depending on their population density.

The article presents a research hypothesis that assumes that population density is quite an important factor shaping the financial situation of land counties in Poland, with the group of counties with the lowest population density having a better situation in this respect, and the worst situation in the group of counties with the highest population density.

The empirical material used in the article concerns all land counties in Poland, i.e. powiat local government units without cities with powiat rights. The numerical data come from the Central Statistical Office (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using the comparative analysis. Moreover, the following measures of descriptive statistics were used to analyse the data: dynamics index, mean, and coefficient of variation.

In order to achieve the aim of the work, that is, identify and assess the diversification of the financial situation of land counties in Poland, that is, territorial self-government units of counties without cities with county rights, depending on their population density, the following diagnostic features were analysed to illustrate it in the years 2020-2022:

- total revenues of land counties budgets per capita (PLN);
- own revenues of land counties budgets per capita (PLN);
- share of own revenues in the total revenues of local county budgets (%);
- total expenditure of land counties budgets per capita (PLN);
- investment expenditure of land counties budgets per capita (PLN);
- share of investment expenditure in total expenditure of the budgets of land counties (%).

For the purposes of the analysis, the article distinguishes three groups of counties depending on their population density, i.e.:

- I. land counties with the lowest population density (up to 70 people per 1 km²);
- II. land counties with an average population density (70 to 130 people per 1 km²);
- III. land counties with the highest population density (130 people and more per 1 km²).

Additionally, the article provides a point assessment of all diagnostic characteristics that illustrates the financial situation in separate groups of land counties depending on their population density against the background of all land counties in Poland for the years 2020-2022. Individual diagnostic characteristics were compared with the average for all land counties, which was taken as 100 points, and their advantage or underweight was assessed accordingly in the designated groups of these counties. Then, all points were summed and the average was calculated (Figure 1). It should be noted that this is a new approach to the analysis of the research issues discussed in the article.

3. Results

In the territorial division of Poland, there are 314 land counties, i.e., poviats local government units without cities with county rights, among which the largest group are land counties with the lowest population density, i.e., up to 70 people per 1 km² (134 units, which is 42.7% overall). Next, this applies to the group of land counties with an average population density, i.e. 70 to 130 people per 1 km² (116 units, which is 36.9% of the total), while the least numerous is the group of land counties with the highest population density, i.e. 130 people and more per 1 km² (64 units, which is 20.4% of the total) (Table 1).

The data in Table 1 show that in land counties in Poland, the average value of total budget revenues per capita increased in the years 2020-2022, and this also applies to all their groups depending on population density. However, in the years under study, there is variation in the average value of total income of the budgets of land counties per capita between separate groups

of these counties depending on their population density. It is definitely the highest in the group of land counties with the lowest population density. However, it is clearly the lowest in the group of land counties with the highest population density. In turn, the differentiation of this feature between individual counties in Poland in 2020-2022 is small, and this also applies to all their groups depending on population density.

Despite the fact that in landed counties in Poland, the average value of total budget revenues per capita increased in the years 2020-2022, the dynamics of this phenomenon is rather small and there are no major differences in this respect between separate groups of counties depending on their density. Additionally, the differentiation of this characteristic between individual land counties in Poland in the examined years is very small, and is the smallest in the group of land counties with the highest population density, i.e. this group of counties is the most homogeneous in this respect (Table 1).

Table 1.

Total revenues of land counties budgets per capita in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020- 2022	Dynamics, year 2020 = 100
	2020	2021	2022		
Total land counties (N = 314)					
Mean	1 426,8	1 487,7	1 639,0	1 517,8	115,4
Coefficient of variation V (%)	21,0	19,8	21,7	20,1	11,0
Land counties with the lowest population density (up to 70 people per 1 km ² – N = 134)					
Mean	1 565,7	1 623,4	1 814,9	1 668,0	116,8
Coefficient of variation V (%)	19,4	19,1	19,8	18,4	12,3
Land counties with average population density (70 to 130 people per 1 km ² – N = 116)					
Mean	1 371,7	1 430,0	1 567,0	1 456,3	114,9
Coefficient of variation V (%)	18,9	16,2	18,8	17,1	11,2
Land counties with the highest population density (130 people and more per 1 km ² – N = 64)					
Mean	1 236,1	1 308,1	1 400,9	1 315,0	113,5
Coefficient of variation V (%)	17,4	17,8	18,3	17,3	6,8

Source: Central Statistical Office in Warsaw.

Table 2.

Own revenues of land counties budgets per capita in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020- 2022	Dynamics, year 2020 = 100
	2020	2021	2022		
Total land counties					
Mean	546,4	531,9	623,6	567,3	115,9
Coefficient of variation V (%)	23,7	24,8	26,8	22,6	19,0
Land counties with the lowest population density					
Mean	561,7	534,0	663,9	586,5	120,5
Coefficient of variation V (%)	25,5	28,6	30,3	25,2	21,2
Land counties with average population density					
Mean	523,8	517,1	595,5	545,5	115,4
Coefficient of variation V (%)	21,5	21,0	21,7	19,3	17,5
Land counties with the highest population density					
Mean	555,3	554,3	590,0	566,5	107,2
Coefficient of variation V (%)	22,3	22,0	22,3	20,8	12,2

Source: Central Statistical Office in Warsaw.

Analysing the data in Table 2, it should be stated that the average value of own income of the budgets of land counties per capita in Poland increased slightly in the years 2020-2022, and this also applies to all their groups depending on population density. It should be added that there are no major differences in terms of the average value of own income of the counties' budgets per capita between their groups depending on population density. However, the differences in this characteristic between individual counties in Poland in the examined years are small, and this also applies to all their groups depending on population density (Table 2).

The growth dynamics of the the average value of own income of the budgets of land counties per capita in Poland in 2020-2022 is rather low, with the highest growth rate in the group of land counties with the lowest population density, and the lowest in the group of land counties with the highest population density. The variation in this characteristic between individual land counties in Poland in 2020-2022 is also small, but it is the smallest in the group of counties with the highest population density, so this group of counties is the most homogeneous in this respect (Table 2).

Table 3.

Share of own revenues in the total revenues of the budgets of land counties in Poland in 2020-2022 (%)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Total land counties				
Mean	39,2	36,5	38,7	38,1
Coefficient of variation V (%)	23,8	24,6	21,6	22,2
Land counties with the lowest population density				
Mean	36,2	33,2	36,7	35,4
Coefficient of variation V (%)	21,1	23,7	20,2	19,9
Land counties with average population density				
Mean	38,9	36,7	38,5	38,1
Coefficient of variation V (%)	21,5	22,2	19,5	20,0
Land counties with the highest population density				
Mean	45,9	43,1	43,0	44,0
Coefficient of variation V (%)	23,7	21,3	23,3	22,2

Source: Central Statistical Office in Warsaw.

The data in Table 3 show that, on average, in land counties in Poland, the share of own revenues in total budget revenues remains at a similar level in 2020-2022. There are no major differences in this regard between the groups of land counties depending on their population density, and the group of land counties with the highest population density has the highest average in this respect in the years examined. However, on average, the lowest share of own revenues in total budget revenues occurs in the group of land counties with the lowest population density.

Furthermore, it should be noted that the differentiation of this feature between individual land counties in Poland in 2020-2022 is small, and this also applies to all their groups depending on the density of the population (Table 3).

The data in Table 4 shows that the average value of total budget expenditure per capita in land counties in Poland increased in the years 2020-2022 and this applies to all their groups depending on population density. However, the average value of the analysed budget expenditure varies between specific groups of counties depending on their population density. It is the highest in the group of land counties with the lowest population density, and the lowest in the group of land counties with the highest population density. However, the differences in this characteristic between individual counties in Poland in 2020-2022 are small, and this applies to all their groups depending on population density.

Table 4.

Total expenditure of the budgets of land counties per capita in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020-2022	Dynamics, year 2020 = 100
	2020	2021	2022		
Total land counties					
Mean	1 336,3	1 414,3	1 663,4	1 471,3	125,9
Coefficient of variation V (%)	22,9	21,3	21,4	20,8	12,8
Land counties with the lowest population density					
Mean	1 468,8	1 548,2	1 821,4	1 612,8	125,8
Coefficient of variation V (%)	21,9	20,4	20,2	19,4	14,9
Land counties with average population density					
Mean	1 290,5	1 354,8	1 596,5	1 413,9	124,8
Coefficient of variation V (%)	19,7	17,9	18,7	17,8	11,7
Land counties with the highest population density					
Mean	1 141,6	1 241,6	1 453,8	1 279,0	128,3
Coefficient of variation V (%)	19,7	19,3	18,4	18,4	9,6

Source: Central Statistical Office in Warsaw.

The growth dynamics of the average value of total expenditures of counties budgets per capita in Poland in 2020-2022 is small, and there are no major differences in this respect between their groups depending on population density. However, the variation in this characteristic between individual land counties in Poland in the years examined is very small, but it is the smallest in the group of land counties with the highest population density, i.e., this group of counties is the most homogeneous in this respect (Table 4).

Table 5.

Investment expenditure of the budgets of land counties per capita in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020-2022	Dynamics, year 2020 = 100
	2020	2021	2022		
Total land counties					
Mean	215,9	219,0	317,9	250,9	196,7
Coefficient of variation V (%)	69,2	57,1	62,3	51,5	82,8
Land counties with the lowest population density					
Mean	256,1	258,6	371,3	295,3	193,5
Coefficient of variation V (%)	71,0	58,1	65,1	52,6	78,6
Land counties with average population density					
Mean	205,5	194,9	294,7	231,7	199,3
Coefficient of variation V (%)	60,9	50,5	53,3	43,8	86,9
Land counties with the highest population density					
Mean	150,6	179,8	248,2	192,9	198,6
Coefficient of variation V (%)	44,9	44,8	47,9	36,3	84,6

Source: Central Statistical Office in Warsaw.

The data in Table 5 show that the average value of investment expenditure of counties budgets per capita in Poland increased in the years 2020-2022 and this applies to all their groups depending on population density. However, there is variation in the average value of the analysed budget expenditure between separate groups of land counties, depending on their population density. Because it is the highest in the group of counties with the lowest population density and the lowest in the group of counties with the highest population density. In turn, the differentiation of this feature between individual land counties in Poland in the years 2020-2022 is large, and it is the smallest in the group of counties with the highest population density, i.e., this group of counties is the most homogeneous in this respect.

The dynamics of growth in the average value of investment expenditure of the budgets of land counties per capita in Poland in the years 2020-2022 is high and there are no major differences in this respect between their groups depending on population density. The diversity of this characteristic between individual counties in Poland in the examined years is also large and applies to all their groups depending on the density of the population (Table 5).

Analysing the data in Table 6, it should be stated that, on average, in land counties in Poland, the share of investment expenditure in total budget expenditure increased slightly in the years 2020-2022 and this applies to all their groups depending on population density. Moreover, the share of investment expenditure in total budget expenditure varies slightly between the separate groups of counties, with the highest share in the group of land counties with the lowest population density and the lowest in the group of land counties with the highest population density.

In turn, the differentiation of this feature between individual land counties in Poland in 2020-2022 is large, but it is the smallest in the group of counties with the highest population density, i.e. this group of counties is the most homogeneous in this respect (Table 6).

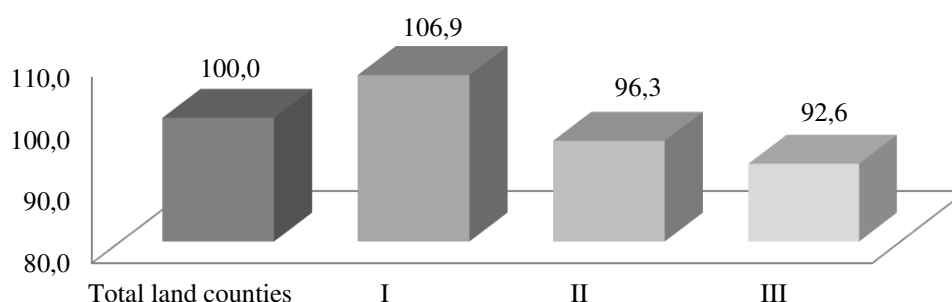
Table 6.

Share of investment expenditure in total expenditure of the budgets of land counties in Poland in 2020-2022 (%)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Total land counties				
Mean	15,8	15,4	18,9	16,7
Coefficient of variation V (%)	55,5	48,8	51,5	44,6
Land counties with the lowest population density				
Mean	17,1	16,6	20,2	18,0
Coefficient of variation V (%)	58,3	51,8	56,2	48,1
Land counties with average population density				
Mean	15,7	14,5	18,4	16,2
Coefficient of variation V (%)	53,6	46,5	46,6	41,4
Land counties with the highest population density				
Mean	13,3	14,7	17,1	15,0
Coefficient of variation V (%)	43,6	41,8	44,5	36,6

Source: Central Statistical Office in Warsaw.

Figure 1 presents the results of the point assessment of all diagnostic features that illustrate the financial situation in separate groups of land counties depending on their population density against the background of all land counties in Poland for the years 2020-2022. On this basis, it can be concluded that the land counties in Poland are diverse in terms of their financial situation. A better financial situation compared to all land counties in Poland occurs in the group of land counties with the lowest population density, and the worst situation in this respect is in the group of land counties with the highest population density.



Explanations: I - land counties with the lowest population density; II - land counties with average population density; III - land counties with the highest population density.

Figure 1. Point assessment of the financial situation in separate groups of land counties depending on their population density compared to all land counties in Poland for the years 2020-2022 (land counties in total = 100.0 points).

Source: Own study.

The analysis of the collected statistical data carried out in the article therefore confirms the research hypothesis, which assumes that population density is a quite important factor shaping the financial situation of land counties in Poland, with the group of counties with the lowest population density having a better situation in this respect, and the group of counties with the lowest population density having the worst situation. It is in the group of counties with the highest population density.

4. Summary and conclusions

The analysis of the collected statistical data carried out in the article shows that:

- ✓ in land counties in Poland, the average value of total budget revenues per capita increased in the years 2020-2022 and this applies to all their groups depending on population density. However, the dynamics of this phenomenon is low and its differences between individual counties in Poland in the analysed years are very small. However, the separate groups of land counties, depending on their population density, differ in terms of the average value of total budget revenues per capita. The highest average value of these incomes in the examined years is recorded in the group of

counties with the lowest population density, while the lowest is in the group of counties with the highest population density. In turn, the differentiation of this feature between individual counties in Poland in 2020-2022 is small, and this applies to all their groups depending on population density;

- ✓ the average value of own revenues of counties budgets per capita in Poland increased slightly in the years 2020-2022 and this applies to all their groups depending on population density. Therefore, both the dynamics of this phenomenon and its differences between individual counties in Poland in 2020-2022 are small. Moreover, there are no major differences in terms of the average value of own income of the budgets of land counties per capita between their groups depending on population density, and the differences in this feature between individual counties are small;
- ✓ on average, in land counties in Poland, the share of own income in total budget revenues remains at a similar level in 2020-2022 and there are no large differences in this respect between their groups depending on population density, and the differentiation of this feature between individual counties is little;
- ✓ in land counties in Poland, the average value of total budget expenditure per capita increased in the years 2020-2022 and this applies to all their groups depending on population density. However, the dynamics of this phenomenon is low and its differences between individual counties are very small. However, the separated groups of land counties, depending on their population density, differ in terms of the average value of total budget expenditure per capita, with the highest value in the group of counties with the lowest population density and the lowest in the group of counties with the highest population density. However, the differences in this feature between individual counties are small, and this applies to all their groups depending on population density;
- ✓ the average value of investment expenditures of land counties budgets per capita in Poland increased in the years 2020-2022, and the dynamics and differentiation of this phenomenon between counties are large and there are no major differences in this respect between separate groups of counties depending on their population density. However, the average value of the analysed budget expenditure, however, varies between the separate groups of counties, with the highest in the group of counties with the lowest population density and the lowest in the group of counties with the highest population density. Moreover, the differentiation of this characteristic between individual land counties in Poland in 2020-2022 is large;
- ✓ on average, in land counties in Poland, the share of investment expenditure in total budget expenditure increased slightly in the years 2020-2022 and this applies to all their groups depending on population density. Moreover, the share of investment expenditure in total budget expenditure varies slightly between the separate groups of counties, but this feature varies significantly between individual counties.

Moreover, the analysis of statistical data carried out in the article and the point assessment made in it regarding the financial situation in separate groups of land counties depending on their population density compared to all land counties in Poland confirmed the research hypothesis.

Therefore, population density is an important factor shaping the financial situation of land counties in Poland, with the group of counties with the lowest population density having a better situation in this respect, and the group of counties with the highest population density having the worst situation.

The results of the the analysis of statistical data presented in the article provide important and up-to-date information on the financial situation of land countiess in Poland. It may be useful both for politicians at the central level and for local government officials responsible for public local government finances, as well as for creating the conditions, opportunities, and directions of local socio-economic development of powiat local government units and for other decision-makers implementing local development policy in Poland.

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DIFFERENCES IN THE LOCAL RESIDENTIAL REAL ESTATE MARKET IN POLAND DEPENDING ON POPULATION DENSITY

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Purpose: The aim of the article is to identify and assess the diversification of the situation in the local residential real estate market in Poland, i.e., in poviats, i.e. in poviats local government units without cities with poviats rights, depending on their population density.

Design/methodology/approach: The article identifies and assesses the diversification of the situation in the local residential real estate market in Poland, i.e., in poviats, i.e. in poviats local government units without cities with poviats rights, depending on their population density. The empirical material used in the article concerns all land poviats in Poland, i.e. poviats local government units without cities with poviats rights. The numerical data comes from the Central Statistical Office in Warsaw (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using the comparative analysis. Moreover, the following measures of descriptive statistics were used to analyse the data: dynamics index, mean, and coefficient of variation. Additionally, a point assessment of all diagnostic features illustrating the situation in the local residential real estate market in Poland, i.e., in separate groups of land poviats depending on their population density against the background of all land poviats, which is a new approach to the research problem discussed in the article.

Findings: The statistical data confirmed the research hypothesis put forward in the article, assuming that population density is an important factor shaping the situation in the local residential real estate market in Poland, with the situation being better in rural poviats with lower population density and the worst in rural poviats with lower population density, the highest population density.

Originality/value: The originality of the work lies in the author's approach to the analysis of the undertaken research issues and a point-by-point assessment of the situation on the local residential real estate market in Poland, i.e., in separate groups of land poviats depending on their population density compared to all land poviats. The work may be useful and is addressed primarily to central-level politicians and local government officials responsible for the conditions, opportunities, and directions of local socioeconomic development of poviats local government units, as well as to other decision-makers implementing local development policy in Poland.

Keywords: residential real estate market, land districts in Poland, population density.

Category of the paper: research paper.

1. Introduction

The issue of regional and local development in the context of socioeconomic growth and development processes is important not only for building social prosperity, but also for maintaining competitive advantages of enterprises, regional and local economies, and the national economy. This also translates into the social and political situation, as well as the development of financial flows, investments, and the settlement network. From the point of view of society and economy as well as the socioeconomic development of the country, regional and local disproportions are particularly important in this respect and are common in countries with market economies, regardless of their location, history, culture, or level of development. It should be added that the scale of these disproportions in individual countries varies, and their consequences for societies and economies are of different importance. Therefore, reducing them is a priority and a subject of interest for both the entire European Union and its individual member states (Kraska, Kot, 2021).

The real estate market is a very important field for research and considerations both in the sphere of science, business, and social and economic policy, as well as regional and local policy. Regardless of the understanding and importance of the real estate market, it is a complex and interdisciplinary area of research, often going beyond mainstream economics. The research methods used in this area and the analysis of publications indicate that the real estate market is still a current and important research area, still in the development phase (Borowska, Domańska, 2016).

The housing market is one of the major segments of the real estate market and is very important socially. Today, as housing assets, related construction, and mortgage receivables increase, in addition to purely consumer and social functions, the importance of the housing sector as a factor of economic growth and stability of the financial sector increases. However, due to the impact of the housing sector on the economy, its functioning and development are important issues in the cognitive and application aspect (Allen, Carletti, 2011; Zaremba, 2011; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

The real estate market is in a permanent imbalance, characterized by periodic excess of demand or supply, and the basic cause of this phenomenon is related to its specific nature. As a rule, the imbalance in the real estate market has a structural basis, and consumers (households) and investors are aware that the property they want is in many cases the so-called rare good that can only be purchased at a specific time and under the conditions currently dictated by the market. It should be added that real estate can not only meet the consumption needs of, e.g., households but can also be a relatively safe form of investing their capital, which means that the residential real estate market is related to the capital market in terms of demand (Belniak, 2008).

The development of the residential real estate market depends on a number of diverse but closely related factors. These include primarily: sociodemographic, economic, legal, financial, institutional, and political conditions. These factors mean that the real estate market is subject to constant changes and the relationship between it and its environment is a feedback loop. However, the real estate market is characterised by its specificity related to its features, including the real estate of the product offered, i.e., its close connection with a specific location, its physical features, lack of substitutes, high capital intensity and durability, individual nature, and confidentiality of the transaction. All this means that we are dealing with a diversity of supply and uniqueness of individual transaction items that are unparalleled in other markets. It should be added that a given, specific environment, e.g. local, and its specific features and conditions may either favor the development of this market, limit it, or even inhibit it. It is worth paying special attention to the sociodemographic environment of the real estate market, especially in relation to the housing market. Demographic conditions play a key role in shaping the real estate market, especially at the local level (including: changes in population, population density, natural increase, migration balance, percentage of the working-age population). This regularity applies in particular to long time horizons, as demographic changes are rarely sudden. This is a favourable situation from the point of view of investment activities, because demographic trends are widely analysed, thanks to which it is possible to predict with considerable accuracy the impact of demographic factors on this market in the future. The development of the real estate market is therefore largely dependent on the current and future demographic situation (Łaszek, 2006; Belniak, 2001, 2008; Foryś, 2010; Gołąbeska, 2011; Zaremba, 2011; Klusek, 2016; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

A very important participant in the residential real estate market is the household, which is an economic entity, separated in the economic sense on the basis of personal property and making decisions regarding consumption and investment based on its own preferences and existing objective constraints (i.e. price and income). The basis for the development of households are decisions regarding the choice of level and field of education, the choice of place of work and residence, and how to spend the money earned. Each household strives to spend its income in such a way as to achieve the greatest possible utility from the purchased goods and services in accordance with its own preferences, and when making decisions, it is guided by both subjective factors (i.e., traditions, preferences, habits, etc.) and objective factors (i.e., the amount of wages, pensions, interest, prices, taxes, etc.). The consequences of decisions made by households are, on the one hand, a specific amount of demand for goods and services, and, on the other hand, the size and structure of supply. Therefore, households are the basic units of the sphere of consumption which, having money, material resources and the time and work of their members, finance the purchases of goods and services, produce items of consumption and services, and organize the processes of consumption and investment (Zalega, 2007; Kośny, 2013; Grzybowska, 2014; Kozera, Stanisławska, Głowicka-Wołoszyn, 2016; Bywalec, 2017, 2020; Kata, Nowak, Leszczyńska, Kowal, Sebastianka, 2021).

An important factor shaping the situation on the residential real estate market may be the financial situation of households, i.e., their financial situation and the state of their material resources, which inform about the family's wealth and largely influence the level, quality and conditions of its life. The financial situation of a household is therefore determined by both its assets and the level of income, and the impact of these two elements on the economic behaviour of households may be not only substitutive but also complementary, when low income is compensated by previously accumulated assets. In turn, the decisions that households make in the sphere of consumption depend not only on their financial situation or conditions on the market of goods and services, but also on state policy or the economic condition of the country. Through the tools that the state uses to stimulate socioeconomic growth and development and to improve the living conditions of citizens within the framework of social and economic policy, it also influences the level and structure of household consumption. This applies primarily to fiscal and monetary policy, as well as income, price, and public expenditure policy. However, not only the state's policy but also its condition, in terms of the level and pace of economic growth and development, influences the decisions of entities in the sphere of consumption. Citizens of highly developed countries generally enjoy a higher standard of living than citizens of developing countries. However, the higher the economic growth rate, the faster private consumption grows and the standard of living of citizens improves. Moreover, one of the most important processes affecting the contemporary world economy and, therefore, individual national economies is globalization. Increased flows of goods, services, labour, and capital, which are manifestations of globalisation processes, largely determine the condition of modern economies, which translates into contemporary consumption patterns. For this reason, the concept of globalisation of consumption appears in the literature on the subject, which means the spread of identical or very similar consumption patterns, i.e., the so-called homogenization of consumption on a transnational scale, as well as the creation of the so-called global consumer culture. This is manifested in the greater availability of foreign goods, which means a greater variety of goods on the domestic market, and thus great opportunities to meet the consumption needs of households. Increased competition on the domestic market also influences the behaviour of domestic producers, which often results in lower prices of goods and services. It is also worth noting that increased flows, especially of goods, services, capital, and people, contribute to the diffusion of information, ideas, and culture, which has a huge impact on changes in consumption patterns. This leads to the emergence of transnational market segments that include homogeneous groups of consumers on a transnational or even global scale. This means that a group of consumers in one country has similar preferences, properties, and characteristics as the corresponding segment in another country. In the case of the global segment, these are recipients (consumers, clients) waiting for the same (global) product all over the world, which may also be of great importance and influence the situation on the residential real estate market (Choroś-Mrozowska, Clowes, 2018; Kata, Nowak, Leszczyńska, Kowal, Sebastianka, 2021).

The analysis of the domestic housing market indicates a low state of housing resources in Poland. The housing situation in the country is one of the worst in Europe. Despite a dynamic increase in the number of apartments put into use and one of the highest gross value added generated by the construction sector, Poland is still characterised by a housing deficit. It is noted that the Polish housing policy is characterised by a tendency towards increased development in terms of quantity, while at the same time insufficient concentration on improving the quality and availability of the housing fabric. One of the main problems of the housing sector remains the insufficient stock of social housing, excluded from the "market game" and intended for less wealthy households. Currently, the main "actor" on the market remains the development sector, for which apartments remain an investment with a calculable profit rate. The result is that the overwhelming and growing number of apartments remains an investment of private capital. More and more apartments are being commoditised, but the pace of growth of the stock of affordable apartments is not sufficient. Another problem is the low diversity of forms of meeting housing needs available on the market, including the shrinking cooperative and co-housing sector, and the negligible share of senior and supported housing. Government housing programmes are addressed to households that meet specific criteria, which, in addition to financial criteria, also include the conditions of specific marital status (e.g. marriage) or having children, which excludes most Poles from social housing in the so-called "housing gap" and about 70% of citizens who do not have the creditworthiness to purchase a flat. However, these programs should be treated and assessed positively, because they contribute to improving the housing situation of at least some of the least affluent Poles. However, national housing policy appears to be social rather than social in nature. It seems to be true to say that the priority in the development of the housing fabric in Poland should be the accessible, non-market sector, developed in various forms of support and responding to the needs of the widest possible group of recipients. Young people (25-34 years old) entering the labor market are particularly vulnerable to housing exclusion and, without public housing support, are forced to live in overcrowded apartments shared with family or rented on the market. The Polish housing situation differs significantly from the housing situation in other Western European countries, where a policy is implemented that focuses on creating opportunities to meet the housing needs of a wide group of citizens through various types of instruments and forms (ownership and spatial). Moreover, the price of apartments in Poland remains a significant challenge, as it is increasing at a very fast pace, much higher than the average price increase in European Union countries. Therefore, the financial availability of housing is decreasing and the number of citizens burdened with housing costs is constantly increasing. The quality of the housing fabric in Poland also remains a problem, as it differs from that of the European Union countries. This is visible primarily in the low standard of apartments, which are characterised by significant overcrowding and a relatively small area. The sources of the difficult situation on the residential real estate market in Poland seem to be primarily: too low a share of expenditure allocated to housing development, as well as macroeconomic conditions, including high

inflation and the socioeconomic situation related to the war on the eastern border of our country (Samorek, Cichocki, 2023).

In turn, the systemic causes of the condition of Polish housing include: isolated and uncoordinated action of real estate market actors, fragmentary operation of sectors directly related to housing, insufficient support or failure to use the possibilities of conducting an effective housing policy by local governments, the overwhelming share of the development industry in the market structure primary housing, and insufficient evaluation of housing programmes and policies, including at the local level, that is, poviats and municipal level (Muzioł-Węclawowicz, Nowak, 2018; Samorek, Cichocki, 2023).

2. Research aim, empirical material, and research methods

The aim of the article is to identify and assess the diversification of the situation in the local residential real estate market in Poland, i.e., in poviats, i.e. in poviats local government units without cities with poviats rights, depending on their population density.

The article hypothetically assumes that population density is an important factor shaping the situation on the local residential real estate market in Poland, and that the situation is better in rural poviats with lower population density and the worst in rural poviats with the highest population density.

The empirical material used in the article concerns all land poviats in Poland, i.e. poviats local government units without cities with poviats rights. The numerical data comes from the Central Statistical Office in Warsaw (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using comparative analysis. Furthermore, the following descriptive statistics were used to analyse the data: dynamics index, mean, and coefficient of variation.

To achieve the aim of the work, that is, to identify and assess the diversification of the situation in the local residential real estate market in Poland, that is, in poviats, i.e. in poviats local government units without cities with poviats rights, depending on their population density, the following diagnostic features were analysed illustrating:

- average number of residential premises sold as part of market transactions in 2020-2022 (dynamics) - stimulator;
- average value of residential premises sold as part of market transactions in 2020-2022 (dynamics) - stimulant;
- average usable area of a residential property sold as part of market transactions in 2020-2022 (m²) - stimulant;

- average price of residential premises sold as part of market transactions in 2020-2022 (PLN) - a destimulant;
- average price per 1 m² of residential premises sold as part of market transactions in 2020-2022 (PLN) - a destimulant.

The article distinguishes three groups of land poviats depending on their population density, i.e.:

- I. land poviats with the lowest population density (up to 70 people per 1 km²);
- II. land poviats with average population density (70 to 130 people per 1 km²);
- III. land poviats with the highest population density (130 people and more per 1 km²).

Additionally, the article contains a point assessment of all diagnostic features illustrating the situation on the local residential real estate market in Poland, that is, in separate groups of land poviats depending on their population density against the background of all land poviats. Individual diagnostic characteristics were compared with the average for all land poviats, which was taken as 100 points, and their advantage or underweight was assessed accordingly in the designated groups of these poviats. Then all points were summed up and the average was calculated (Figure 1).

3. Results

In the territorial division of Poland, there are 314 land poviats, i.e., poviat local government units without cities with county rights, among which the largest group are land poviats with the lowest population density, i.e., up to 70 people per 1 km² (134 units, which is 42.7% overall). Next, this applies to the group of rural poviats with an average population density, ie 70 to 130 people per 1 km² (116 units, which is 36.9% of the total), while the least numerous is the group of rural poviats with the highest population density, ie 130 people and more per 1 km² (64 units, which is 20.4% of the total) (Table 1).

The data in Table 1 show that in rural districts in Poland, the average number of residential premises sold as part of market transactions increased in 2020-2022, with the highest number in 2021. However, there is a great variation in this respect between separate groups of land poviats, depending on their population density. The group of land poviats with the highest population density has the highest average number of residential premises sold as part of market transactions in 2020-2022 and it is clearly the lowest in the group of land poviats with the lowest population density. It should be added that, as in the case of all rural districts in Poland, also in all their groups depending on population density, the average number of residential premises sold as part of market transactions was the highest in 2021.

However, the diversity of this characteristic between individual districts in Poland in 2020-2022 is very large. This also applies to all separate groups of land poviats depending on their population density, with the greatest variation in this characteristic between individual land poviats in the years examined in the group of poviats with the highest population density (Table 1).

Table 1.

Average number of residential premises sold as part of market transactions in rural districts in Poland in 2020-2022

Specification	Years			Dynamics, year 2020 = 100
	2020	2021	2022	
Total land poviats (N = 314)				
Mean	253,0	307,6	284,2	137,7
Coefficient of variation V (%)	144,5	129,4	120,6	60,8
Land poviats with average population density (70 to 130 people per 1 km ² – N = 116)				
Mean	153,7	180,1	177,1	132,7
Coefficient of variation V (%)	91,9	95,9	100,9	61,7
Land poviats with average population density (70 to 130 people per 1 km ² – N = 116)				
Mean	216,8	277,3	257,6	149,3
Coefficient of variation V (%)	93,7	99,7	87,8	65,9
Land poviats with the highest population density (130 people and more per 1 km ² – N = 64)				
Mean	526,3	629,4	556,8	127,1
Coefficient of variation V (%)	127,1	105,7	101,9	40,2

Source: Central Statistical Office in Warsaw.

In turn, the dynamics of the average number of residential premises sold as part of market transactions in the years 2020-2022 in landed poviats in Poland is large and positive, but differs in individual groups of these poviats, depending on their population density. It is definitely the highest in the group of rural poviats with average population density, and the lowest in the group of rural poviats with the highest population density. However, in the group of land poviats with the lowest population density, it is closest to the average for all land poviats in Poland (Table 1).

The variation in this characteristic between individual land poviats in Poland in 2020-2022 is large, but is the smallest in the group of land poviats with the highest population density, that is, this group of poviats is the most homogeneous in this respect (Table 1).

The data in Table 2 show that in rural districts in Poland, the average value of residential properties sold as part of market transactions increased in 2020-2022. However, there is a great variation in this respect between separate groups of land poviats, depending on their population density. The group of land poviats with the highest population density has the highest average value of residential premises sold as part of market transactions in 2020-2022, and it is clearly the lowest in the group of land poviats with the lowest population density.

The differentiation of this characteristic between individual districts in Poland in 2020-2022 is very large, and this also applies to all their groups according to population density (Table 2).

The dynamics of the average value of residential buildings sold as part of market transactions in 2020-2022 in rural districts in Poland is very high and positive. It should be noted, however, it varies in individual groups of land poviats, depending on their population density. Because it is definitely the highest in the group of rural poviats with average population density and the lowest in the group of rural poviats with the highest population density. However, in the group of land poviats with the lowest population density, it is closest to the average for all land poviats in Poland (Table 2).

In turn, the diversity of this feature between individual land poviats in Poland in 2020-2022 is large, and is the smallest in the group of land poviats with the highest population density, i.e. this group of poviats is the most homogeneous in this respect (Table 2).

Table 2.

Average value of residential premises sold as part of market transactions in rural districts in Poland in 2020-2022 (PLN)

Specification	Years			Dynamics, year 2020 = 100
	2020	2021	2022	
Total land poviats				
Mean	60 931 803,1	82 228 677,0	85 525 123,6	181,8
Coefficient of variation V (%)	203,8	179,4	165,6	69,9
Land countries with the lowest population density				
Mean	29 425 945,5	37 357 294,9	43 808 264,0	179,1
Coefficient of variation V (%)	120,4	119,3	140,1	81,3
Land countries with average population density				
Mean	44 158 616,9	65 807 311,3	69 082 650,1	195,1
Coefficient of variation V (%)	103,1	130,8	112,6	66,1
Land countries with the highest population density				
Mean	157 298 592,3	205 941 858,4	202 671 781,9	163,4
Coefficient of variation V (%)	153,3	128,5	123,4	41,0

Source: Central Statistical Office in Warsaw.

Table 3.

Average usable area of a residential premises sold as part of market transactions in rural districts in Poland in 2020-2022 (m²)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Total land poviats				
Mean	53,8	54,5	53,4	53,9
Coefficient of variation V (%)	14,7	13,3	13,3	11,5
Land countries with the lowest population density				
Mean	52,7	53,1	51,9	52,5
Coefficient of variation V (%)	16,7	13,1	13,3	9,8
Land countries with average population density				
Mean	53,7	54,4	53,2	53,7
Coefficient of variation V (%)	10,7	11,2	10,4	9,9
Land countries with the highest population density				
Mean	56,4	57,4	57,2	57,0
Coefficient of variation V (%)	15,7	15,2	15,2	14,7

Source: Central Statistical Office in Warsaw.

Based on the data in Table 3, it should be stated that in rural districts in Poland, the average usable area of residential premises sold as part of market transactions remains at a similar level in the years 2020-2022. There are no major differences in this respect between the designated groups of land poviats depending on their population density, and the group of land poviats with the highest population density has the largest average usable area of residential premises sold as part of market transactions in the years examined.

Additionally, it should be noted that the differentiation of this feature between individual land districts in Poland in 2020-2022 is small, and this also applies to all their groups depending on population density (Table 3).

The data in Table 4 shows that the average price of residential buildings sold as part of market transactions in rural districts in Poland increased in the years 2020-2022, and this also applies to all their groups depending on the density of the population. However, the average price of residential premises sold as part of market transactions in 2020-2022 is clearly differentiated between specific groups of land poviats depending on their population density. It is definitely the highest in the group of rural poviats with the highest population density and clearly the lowest in the group of rural poviats with the lowest population density. In turn, in the group of land poviats with an average population density, it is most similar to the average for all land poviats in Poland.

Table 4.

Average price of residential premises sold as part of market transactions in rural districts in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Total land poviats				
Mean	193 321,6	216 630,0	247 228,0	219 059,9
Coefficient of variation V (%)	34,0	32,7	32,2	31,7
Land countries with the lowest population density				
Mean	169 483,1	187 894,9	216 488,0	191 288,7
Coefficient of variation V (%)	30,3	26,7	28,0	25,3
Land countries with average population density				
Mean	191 854,7	217 036,8	246 811,2	218 567,6
Coefficient of variation V (%)	24,2	23,6	22,5	22,3
Land countries with the highest population density				
Mean	245 892,5	276 056,8	312 345,1	278 098,1
Coefficient of variation V (%)	36,3	35,2	34,7	35,1

Source: Central Statistical Office in Warsaw.

The diversity of this feature between individual districts in Poland in 2020-2022 is quite large. However, it is the smallest in the group of land poviats with average population density, that is, this group of poviats is the most homogeneous in this respect, and then it also applies to the group of land poviats with the lowest population density (Table 4).

The data in Table 5 show that the average price per 1 m² of residential buildings sold as part of market transactions in rural districts in Poland increased in the years 2020-2022, and this also applies to all their groups depending on the density of the population. However,

the average price per 1 m² of residential premises sold as part of market transactions in 2020-2022 is clearly differentiated between specific groups of land poviats depending on their population density. It is definitely the highest in the group of rural poviats with the highest population density and clearly the lowest in the group of rural poviats with the lowest population density. In turn, in the group of land poviats with an average population density, it is more similar to the average for all land poviats in Poland.

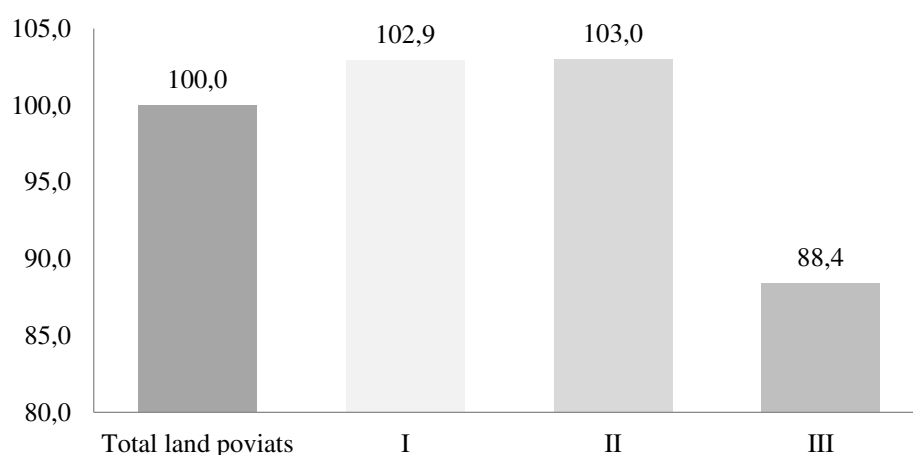
Table 5.

Average price per 1 m² of residential premises sold as part of market transactions in rural districts in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Total land poviats				
Mean	3 564,7	3 956,0	4 595,4	4 038,7
Coefficient of variation V (%)	29,2	26,9	27,8	26,8
Land countries with the lowest population density				
Mean	3 208,2	3 555,6	4 177,2	3 647,0
Coefficient of variation V (%)	30,7	26,8	31,0	27,7
Land countries with average population density				
Mean	3 572,2	3 988,5	4 648,1	4 069,6
Coefficient of variation V (%)	21,2	20,3	21,3	19,8
Land countries with the highest population density				
Mean	4 297,6	4 735,3	5 375,4	4 802,8
Coefficient of variation V (%)	28,2	26,1	24,9	25,9

Source: Central Statistical Office in Warsaw.

However, the variation in this characteristic between individual land poviats in Poland in 2020-2022 is quite large, and is the smallest in the group of land poviats with average population density, i.e., this group of poviats is the most homogeneous in this respect (Table 5).



Explanations: I - land poviats with the lowest population density; II - land poviats with average population density; III - land poviats with the highest population density.

Figure 1. Score assessment of the situation on the local residential real estate market in Poland, i.e. in separate groups of land poviats depending on their population density compared to all land poviats (total land poviats = 100.0 points).

Source: Own study.

Figure 1 presents the results of the point assessment on the situation on the local residential real estate market in Poland, ie, in separate groups of land poviats depending on their population density compared to all land poviats. On this basis, it can be observed that the land poviats in Poland are diverse in terms of the situation in the residential real estate market. A better situation in this respect, compared to all land poviats in Poland, occurs in the group of land poviats with the average and the lowest population density, and the worst situation occurs in the group of land poviats with the highest population density.

Therefore, this confirms the research hypothesis put forward in the article, assuming that population density is an important factor shaping the situation on the local residential real estate market in Poland, and this situation is better in rural poviats with lower population density and the worst in rural poviats with the highest population density.

4. Summary and conclusions

Districts constitute a very important local residential real estate market in Poland, and at the same time worthy of in-depth and comprehensive analysis. The analysis of the collected statistical data carried out in the article shows that:

- in land poviats in Poland, the average number and value of residential premises sold as part of market transactions increased in the years 2020-2022, but there is, however, great diversity in this respect between the separate groups of these poviats depending on their population density. The group of rural poviats with the highest population density has the highest average number and value of residential premises sold as part of market transactions in the researched years, while the lowest is in the group of rural poviats with the lowest population density. However, the differentiation of this feature between individual districts in Poland in the years 2020-2022 is very large and this applies to all their groups depending on population density;
- the growth dynamics of the average number and value of residential buildings sold as part of market transactions in rural districts in Poland in 2020-2022 is successively large and very large, but differs in separate groups of these districts depending on their population density. By far the highest growth dynamics in the average number and value of residential premises sold as part of market transactions in the analysed years is recorded in the group of rural poviats with average population density and the lowest in the group of rural poviats with the highest population density. In turn, in the group of land poviats with the lowest population density, they are more similar to the average for all land poviats in Poland. However, the differentiation of this feature between individual land poviats in Poland in the years 2020-2022 is large, and it is the smallest

in the group of land poviats with the highest population density, that is, this group of poviats is the most homogeneous in this respect;

- in land poviats in Poland, the average usable area of a residential property sold as part of market transactions remains at a similar level in 2020-2022, and the differences in this characteristic between individual poviats are small, and this also applies to all their groups depending on population density, with the largest average usable area of a residential premises sold as part of market transactions in the analysed years in the group of rural poviats with the highest population density;
- the average price in total and per 1 m² of residential premises sold as part of market transactions in rural districts in Poland increased in 2020-2022, and this also applies to all their groups depending on population density. However, these prices are clearly differentiated between specific groups of land poviats depending on their population density. They are definitely the highest in the group of rural poviats with the highest population density and clearly the lowest in the group of rural poviats with the lowest population density. In turn, in the group of land poviats with an average population density, they are most similar to the average for all land poviats in Poland. However, the differences in these characteristics between individual land poviats in Poland in 2020-2022 are quite large, with the smallest differences in the group of land poviats with average population density, i.e., this group of poviats is the most homogeneous in this respect.

Moreover, the analysis of statistical data carried out in the article and the point assessment made in it regarding the situation on the local residential real estate market in Poland, i.e., in separate groups of land poviats depending on their population density compared to all land poviats, confirmed the research hypothesis.

Therefore, population density is an important factor shaping the situation on the local residential real estate market in Poland, and the situation is better in rural poviats with lower population density and the worst in rural poviats with the highest population density.

Therefore, a higher population density improves the economic situation in the local residential real estate market in Poland, but also results in higher prices for these properties, which is not such a positive phenomenon, especially for customers.

The results of the statistical data presented in the article provide important and up-to-date information on the situation on the local residential real estate market in Poland. It may be useful both for politicians at the central level and for local government officials, especially responsible for the conditions, opportunities, and directions of local socio-economic development of poviat local government units, as well as for other decision-makers implementing local development policy in Poland.

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SITUATION ON THE RESIDENTIAL REAL ESTATE MARKET IN CITIES WITH COUNTY RIGHTS IN POLAND

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Purpose: The aim of the article is to identify and assess the situation on the residential real estate market in cities with county rights in Poland.

Design/methodology/approach: The article identifies and assesses the situation on the residential real estate market in cities with county rights in Poland. The empirical material of the article concerns all cities with county rights in Poland. The numerical data comes from the Central Statistical Office in Warsaw (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using the comparative analysis. Moreover, the following measures of descriptive statistics were used to analyze the data: dynamics index, mean and coefficient of variation. Additionally, a point assessment was made of all diagnostic features illustrating the situation on the residential real estate market in separate groups of cities with county rights in Poland against the background of all such cities, which is a new approach to the research problem discussed in the article.

Findings: The analysis of statistical data confirmed the research hypothesis, which assumes that the number of inhabitants is an important factor shaping the situation on the residential real estate market in cities with county rights in Poland, and this situation is better in cities with fewer inhabitants, and the worst in cities with the largest number of inhabitants.

Originality/value: The originality of the work lies in the approach to the analysis of the research issues undertaken. A point assessment of all diagnostic features illustrating the situation in the residential real estate market in separate groups of cities with county rights in Poland against the background of all such cities. The work may be useful and is addressed primarily to politicians at the central level, as well as to local government officials responsible for the conditions, possibilities and directions of local socio-economic development of cities with county rights, as well as to other decision-makers implementing urban development policy in Poland.

Keywords: residential real estate market, cities with county rights in Poland, number of inhabitants.

Category of the paper: research paper.

1. Introduction

Cities with county rights in Poland are local government units with a unique influence on supra-local and even regional development because they are where the potentials, activities, and entities deciding on its course are concentrated. The measure of a city's strength is primarily its ability to shape its development in terms of quality, i.e., to generate new solutions and new processes characterised by innovation and creativity. The pace and nature of the development of modern cities are determined equally by the ability to use unconventional potentials to achieve breakthrough ideas, as well as the skills and competences of functioning in various cooperation networks. It should be added that strong cities usually become real centres of socio-economic development, which is reflected in their attributes such as:

- high attractiveness of the city for entities looking for conditions for the implementation of unconventional, innovative projects,
- significant share in the economic structure of the city of companies creating local and supralocal cooperation networks around us, including those involving entities transferring intellectual values to the economy,
- the presence of numerous potential partner entities in the city enabling enterprises to outsource functions and, as a consequence, specialise their own activities and constantly strengthen leading strategic competences,
- extensive relationships connecting business entities with local government institutions, scientific, research and development, educational institutions, and civic sector entities,
- extensive relationships connecting business entities with local government institutions, scientific, research and development, educational institutions, and civic sector entities (Wrana, 2013).

One of the main criteria for assessing the effectiveness of actions undertaken by city governments is the ability to compete. Winning the competition for a significant investor, the location of an important institution, a prestigious event, or for new residents is a tangible and often spectacular, testimony to the success of the policy implemented by local government authorities. Competition is also a process that motivates various entities to increase the effectiveness of their own activities or implement innovations. Competition between cities leads to their own strengthening and to the strengthening of the regional structure. However, nowadays the importance of cooperation as a competence that determines the importance of the city and its development possibilities is becoming more and more visible. Therefore, nowadays one of the most important factors determining the development of a city is its social potential, which is usually identified by:

- an efficient leader, able to formulate a long-term vision of the development of a given local system, who is able to gather the local elite around him,
- the local elite, gathering the most active and creative actors,

- functioning of local institutions stabilising the actions of the leader and dynamizing local development,
- activity of the local community getting involved in projects initiated by local government authorities or initiating development themselves,
- tendency of local governments towards inter-municipal cooperation,
- and small and medium-sized enterprises strengthening the local entrepreneurship fabric.

Attributing a key role to the above-mentioned factors in the city's development process results from many reasons, but the most important of them lies in the statement that the way of using the values and resources of the local environment ultimately always remains the responsibility of the human factor, which, through its actions, can either create a development factor out of them or a barrier that limits it (Wrana, 2013; Tuziak, 2014; Kulawiak, 2016).

The residential real estate market is a current and very important area for research and considerations both in the sphere of science, business, and social and economic policy, as well as regional and local policy. Today, the importance of the housing sector is increasing as a factor of economic growth and stability of the financial sector. However, due to the impact of this sector on the economy, its functioning and further development are important issues in the cognitive and application aspect (Allen, Carletti, 2011; Zaremba, 2011; Borowska, Domańska, 2016; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

The development of the residential real estate market depends on a number of diverse but closely related factors. These include primarily: sociodemographic, economic, legal, financial, institutional, and political conditions. These factors mean that the real estate market is subject to constant changes and the relationship between it and its environment is a feedback loop. It should be added that a given, specific local environment, e.g., a city, and its specific features and conditions may either favor the development of this market, limit it, or even inhibit it. It is worth paying special attention to the socio-demographic environment of the real estate market, especially in relation to the housing market. Demographic conditions play a key role in shaping the real estate market, especially at the local level (i.e., among others: the number of population (residents) and its changes over time, population density, natural increase, migration balance, percentage of the working-age population). The development of the real estate market is therefore largely dependent on the current and future demographic situation (Łaszek, 2006; Belniak, 2001, 2008; Foryś, 2010; Gołąbeska, 2011; Zaremba, 2011; Kłusek, 2016; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

A very important participant in the residential real estate market is the household, which is an economic entity, separated in the economic sense on the basis of personal property and making decisions regarding consumption and investment based on its own preferences and existing objective constraints (i.e. price and income). The basis for the development of households are decisions regarding the choice of level and field of education, the choice of place of work and residence, and how to spend the money earned. Each household strives to spend its income in such a way as to achieve the greatest possible utility from the purchased

goods and services in accordance with its own preferences, and when making decisions, it is guided by both subjective factors (i.e., traditions, preferences, habits, etc.) and objective factors (i.e., traditions, preferences, habits, etc.) i.e., the amount of wages, pensions, interest, prices, taxes, etc.). The consequences of decisions made by households are, on the one hand, a specific amount of demand for goods and services, and, on the other hand, the size and structure of supply. Therefore, households are the basic units of the sphere of consumption, which, having money, material resources, and the time and work of their members, finance the purchases of goods and services, produce items of consumption, and services, and organise the processes of consumption and investment (Zalega, 2007; Kośny, 2013; Grzybowska, 2014; Kozera, Stanisławska, Głowicka-Wołoszyn, 2016; Bywalec, 2017, 2020; Kata, Nowak, Leszczyńska, Kowal, Sebastianka, 2021).

An important factor shaping the situation on the residential real estate market may be the financial situation of households, i.e., their financial situation and the state of their material resources, which inform about the family's wealth and largely influence the level, quality and conditions of its life. The financial situation of a household is therefore determined by both its assets and the level of income, and the impact of these two elements on the economic behaviour of households may be not only substitutive but also complementary, when low income is compensated by previously accumulated assets (Choroś-Mrozowska, Clowes, 2018; Kata, Nowak, Leszczyńska, Kowal, Sebastianka, 2021).

Additionally, in the residential real estate market, an important factor influencing the choices made by consumers and households is the fact that this market is imperfect, with poor flow of information, local, where choices are made on the basis of individual adjustment of the characteristics of the apartment to the buyer's preferences. The imperfect functioning of the housing market makes it very difficult to perfectly match the structure of supply to the structure of demand, resulting in a certain ambiguity in the valuation of individual characteristics and the always individual nature of the transaction. Unlike homogeneous goods, we are dealing not with one point of balance but with their entire area. When considering the consumption choices of households, we consider the consumption of a stream of services. The basic consumer choices are decisions about the amount of housing consumption and the choice of the form of this consumption between ownership and a flat for rent (Augustyniak, Łaszek, Olszewski, Waszczuk, 2013; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

The decision-making process and the buyer's preferences influence the condition of the housing market. Consumer behaviour on the market is neither a simple phenomenon nor isolated from other elements and manifestations of individual lives. A person's specific behaviour on the market is the resultant or result of the influence of many determinants. Without recognising these determinants and the directions and ways of their impact, it is not possible to thoroughly understand consumer behaviour. Consumer behaviour in the housing market, as in other markets, is influenced by many factors. They can be divided into four main groups, i.e. personal, cultural, social, and psychological. The strength of these factors is closely related

to the specificity of houses and apartments as specific consumer products and the nature of the Polish real estate market, as well as, in a broader sense, to the processes of globalisation and transformations within European culture (Kotler, 1994; Kieźel, 2000; Rozborska, 2011; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

When purchasing an apartment, buyers pay special attention to the price of the property, which is usually the main factor determining their choice. The location of the property is also important. Residential properties are permanently assigned to specific places in space, which means that they are immobile. Immobility means that the proximity of elements of the environment (closest neighbourhood), as well as the location in terms of other objects or socioeconomic phenomena (location) are an integral part of the analysed apartment, just like the physical (nonspatial) features of the property. Environmental factors are the external components of a home. Unlike the internal (physical) features of the apartment, real estate users do not have exclusive rights to consume elements of the environment. The environment can generate both positive and negative effects. The positives include proximity to social and technical infrastructure, availability of various types of services, and a diversified and prosperous labour market. However, the negative ones include: annoying noise, environmental pollution, or high crime rate in the vicinity of the property. The determinants of real estate features may therefore be the benefits of agglomeration resulting from the accumulation of a large group of people, business units, and institutions in a small area, and thus extensive infrastructure (Domański, 2002; Polko, 2005; Czornik, 2008; Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

The buyer's decision-making process in the residential real estate market involves prudent and rational decisions, the course of which varies greatly depending on the characteristics of the consumer, the type of product, or the environment. Segmenting buyers and understanding the impact of individual factors is an essential area of research at the local, regional, and national levels. Due to the variability of the environment, especially the conditions related to location, which is a limited good, research must be updated and verified in market realities. Therefore, important determinants of purchasing behaviour in the residential real estate market are factors related to the characteristics of buyers and the conditions of the microenvironment (Grzybowska-Brzezińska, Kuberska, Wojarska, 2017).

Residential property management is a complex process that involves making decisions both tactical and strategic. To ensure the implementation of tasks, real estate owners must adapt their services to technological pressure and to the dynamically changing market and customer requirements, often results in the implementation of various innovations that improve and increase the efficiency of management, especially of public housing resources (Kabus, Dziadkiewicz, 2023).

As research shows, social innovations play an important role in the residential real estate market (especially municipal ones), manifested, among others, by organizing social campaigns, involving residents in the management of municipal resources, informing residents about events

taking place in the surroundings, supporting culture, art, and sports, activities related to health protection by promoting health-promoting attitudes, using local resources to create e.g. support centres, business incubators and counseling, as well as supporting employee volunteering for the local community. These activities contribute primarily to improving the quality of life of residents of municipal properties. Therefore, it is worth focussing on developing social innovations that are really important and expected by residents of municipal resources. Moreover, it is important because the issue of social responsibility and participation of residents in the management of municipal resources is current (Kabus, Dziadkiewicz, 2022).

Analysis of the housing market in Poland indicates a low level of housing resources. The housing situation in the country is one of the worst in Europe. Despite a dynamic increase in the number of apartments put into use and one of the highest gross value added generated by the construction sector, Poland is still characterised by a housing deficit. The reasons for this state of affairs should be sought, among others, in:

- local and uncoordinated action of real estate market actors,
- fragmentary operation of sectors directly related to housing,
- insufficient support or failure to use the possibilities of conducting an effective housing policy by local government units, including cities with legal rights poviat,
- the dominant share of the development industry in the structure of the primary housing market,
- and insufficient evaluation of housing programmes and policies, both at the national, regional, and local level (Muzioł-Węclawowicz, Nowak, 2018; Samorek, Cichocki, 2023).

Due to the above, it is necessary to take actions in many fields, forcing the intensified development of a comprehensive housing policy aimed at improving the resource in terms of quantity, quality, and accessibility. It is necessary to develop the social housing sector, contributing to improving the housing needs of less wealthy citizens. Social housing policy directly shapes the living environment and determines the quality of life. We should look for housing policy instruments focused on the effective increase in the ability to meet the housing needs of that part of society that is unable to meet them on their own. Support instruments should be intended primarily for people in the so-called rent gap and those without creditworthiness. The solution would be the development of accessible housing, including social, social and rental housing. It is also necessary to develop ecological construction, including passive and zero-emission buildings. Environmentally friendly solutions can be implemented in all phases of the building life cycle, including the stage of modernisation and renovation. The issue of energy saving, the use of environmentally friendly building materials, thermal modernisation, and supporting the sustainable revitalisation of housing resources are important. In addition, it is important to improve the standard of housing, including in terms of equipment and size of apartments, counteracting the progressive commoditisation of apartments

and focusing on increasing the number of apartments that are affordable for residents and at the same time meet their real needs and expectations (Samorek, Cichocki, 2023).

2. Research aim, empirical material, and research methods

The aim of the article is to identify and assess the situation on the residential real estate market in cities with county rights in Poland.

The article hypothetically assumes that the number of inhabitants is an important factor shaping the situation on the residential real estate market in cities with county rights in Poland, with the situation being better in cities with fewer inhabitants and the worst in cities with the largest number of inhabitants.

The empirical material of the article concerns all cities with county rights in Poland. The numerical data comes from the Central Statistical Office in Warsaw (Local Data Bank), and the time scope of the research covers the years 2020-2022. The collected and organised empirical material was prepared in tabular and graphic form, using the comparative analysis. Moreover, the following measures of descriptive statistics were used to analyse the data: dynamics index, mean, and coefficient of variation.

To identify and assess the situation on the residential real estate market in cities with county rights in Poland, the following diagnostic features that illustrate it were analysed:

- average number of residential premises sold as part of market transactions in 2020-2022 (dynamics) - stimulant;
- average value of residential premises sold as part of market transactions in 2020-2022 (dynamics) - stimulant;
- average usable area of a residential premises sold as part of market transactions in 2020-2022 (m²) - stimulant;
- average price of residential premises sold as part of market transactions in 2020-2022 (PLN) - destimulant;
- average price per 1 m² of residential premises sold as part of market transactions in 2020-2022 (PLN) - destimulant.

The article distinguishes three groups of cities with county rights for analysis, depending on the number of inhabitants, i.e.:

- I – cities with a population of up to 100,000;
- II – cities with 100-200 thousand inhabitants;
- III – cities with 200,000 inhabitants and more.

Furthermore, the article contains a point assessment of all diagnostic features that illustrates the situation on the residential real estate market in separate groups of cities with county rights in Poland against the background of all such cities. Individual diagnostic characteristics were

compared with the average for all cities with county rights in Poland, which was taken as 100 points, and their advantage or underweight was accordingly assessed in the designated groups of such cities. Then all points were summed up and the average was calculated (Figure 1). It should be emphasised that this is a new approach to the research problem discussed in the article.

3. Results

In the territorial division of Poland, there are 66 cities with county rights, among which the largest group are cities with the smallest number of inhabitants, i.e. up to 100,000 (29 units, which is 43.9% of the total). Next, this applies to the group of cities with 100-200 thousand inhabitants (23 units, representing 34.9% of the total). However, the group of cities with the largest number of inhabitants, i.e. 200,000, is the least numerous and more (14 units, which is 21.2% of the total) (Table 1).

The data in Table 1 shows that in cities with county rights in Poland, the average number of residential premises sold as part of market transactions increased in 2020-2022, with the highest number in 2021. However, there is a great variation in this respect between separate groups of cities with county rights, depending on the number of inhabitants. The group of cities with the largest number of inhabitants, i.e. 200,000, has by far the highest average number of residential premises sold as part of market transactions in 2020-2022 and more, and it is clearly the lowest in the group of cities with the smallest number of inhabitants, i.e. up to 100,000. It should be added that, as in the case of all cities with county rights in Poland, also in all their groups depending on the number of inhabitants, the average number of residential premises sold as part of market transactions was the highest in 2021.

Table 1.

Average number of residential premises sold as part of market transactions in cities with county rights in Poland in 2020-2022

Specification	Years			Dynamics, year 2020 = 100
	2020	2021	2022	
Cities with county rights in total (N = 66)				
Mean	1 844,4	2 278,4	2 096,9	110,8
Coefficient of variation V (%)	179,0	173,6	186,7	29,2
Cities with a population of up to 100,000 (N = 29)				
Mean	440,3	540,0	470,1	115,8
Coefficient of variation V (%)	56,2	54,1	47,6	28,0
Cities with 100-200 thousand inhabitants (N = 23)				
Mean	1 269,9	1 441,9	1 273,1	103,0
Coefficient of variation V (%)	59,7	56,9	55,8	18,4
Cities with 200,000 inhabitants and more (N = 14)				
Mean	5 650,9	7 193,9	6 766,0	112,7
Coefficient of variation V (%)	100,1	89,9	98,1	41,1

Source: Central Statistical Office in Warsaw.

However, the differentiation of this feature between individual cities with district rights in Poland in 2020-2022 is very large, and it is clearly smaller in groups of cities with fewer inhabitants, i.e., these separated groups of cities are the most homogeneous in this respect (Table 1).

In turn, the dynamics of the average number of residential premises sold as part of market transactions in the years 2020-2022 in cities with county rights in Poland is rather small and positive, but differs in individual groups of these cities, depending on the number of inhabitants. It is clearly the lowest in the group of cities with 100-200 thousand inhabitants (Table 1).

The differentiation of this feature between individual cities with county rights in Poland in 2020-2022 is quite large, but it is the smallest in the group of cities with 100-200 thousand inhabitants, i.e., this separate group of cities is the most homogeneous in this respect (Table 1).

The data in Table 2 show that in cities with county rights in Poland, the average value of residential premises sold as part of market transactions increased in 2020-2022. However, there is a great diversity in this respect between separate groups of cities with county rights, depending on the number of inhabitants. The group of cities with the largest number of inhabitants, i.e., 200,000, has by far the highest average value of residential premises sold as part of market transactions in 2020-2022. and more, and it is clearly the lowest in the group of cities with the smallest number of inhabitants, i.e. up to 100,000.

Table 2.

Average value of residential premises sold as part of market transactions in cities with county rights in Poland in 2020-2022 (PLN)

Specification	Years			Dynamics, year 2020 = 100
	2020	2021	2022	
Cities with county rights in total				
Mean	660 742 134,1	916 427 572,0	952 370 847,2	140,6
Coefficient of variation V (%)	254,3	235,0	254,3	31,7
Cities with a population of up to 100,000				
Mean	105 663 367,8	149 566 964,8	140 118 521,7	148,2
Coefficient of variation V (%)	70,1	73,9	58,3	31,6
Cities with 100-200 thousand inhabitants				
Mean	309 626 934,1	393 572 370,6	387 813 237,5	132,4
Coefficient of variation V (%)	78,6	77,9	72,0	20,0
Cities with 200,000 inhabitants and more				
Mean	2 362 300 607,1	3 326 554 146,1	3 522 055 479,5	137,8
Coefficient of variation V (%)	132,4	114,9	125,7	44,1

Source: Central Statistical Office in Warsaw.

The differentiation of this feature between individual cities with county rights in Poland in 2020-2022 is, in turn, very large, but it is clearly smaller in groups of cities with fewer inhabitants, that is, these separated groups of cities are the most homogeneous in this respect (Table 2).

The dynamics of the average value of residential buildings sold as part of market transactions in the years 2020-2022 in cities with district rights in Poland is large and positive, but slightly differentiated in individual groups of these cities depending on the number of inhabitants. It is the highest in the group of cities with the smallest number of inhabitants, i.e. up to 100,000, and the lowest in the group of cities with 100-200,000 inhabitants. However, in the group of cities with the highest number of inhabitants, i.e. 200 thousand and more, it is closest to the average for all cities with county rights in Poland (Table 2).

In turn, the differentiation of this feature between individual cities with district rights in Poland in the years 2020-2022 is quite large, and it is the smallest in the group of cities with 100-200 thousand inhabitants, i.e., this separate group of cities is the most homogeneous in this respect (Table 2).

Table 3.

Average usable area of a residential premises sold as part of market transactions in cities with county rights in Poland in 2020-2022 (m²)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Cities with county rights in total				
Mean	53,0	53,2	52,5	52,9
Coefficient of variation V (%)	7,3	6,3	6,2	5,8
Cities with a population of up to 100,000				
Mean	53,0	53,7	52,6	53,1
Coefficient of variation V (%)	6,6	7,5	7,2	6,3
Cities with 100-200 thousand inhabitants				
Mean	52,1	52,5	52,2	52,3
Coefficient of variation V (%)	4,9	5,0	5,4	4,9
Cities with 200,000 inhabitants and more				
Mean	54,2	53,2	52,8	53,4
Coefficient of variation V (%)	10,9	5,1	5,1	6,4

Source: Central Statistical Office in Warsaw.

In cities with county rights in Poland, the average usable area of residential premises sold as part of market transactions remains at a similar level in 2020-2022. There are no major differences in this regard between the groups of these cities depending on the number of inhabitants (Table 3).

It should be added that the differences in this feature between individual cities with county rights in Poland in the years 2020-2022 are small or even negligible, and this also applies to all their groups depending on the number of inhabitants (Table 3).

The data in Table 4 shows that the average price of residential properties sold as part of market transactions in cities with county rights in Poland increased in the years 2020-2022, and this also applies to all their groups depending on the number of inhabitants. However, the average price of residential premises sold as part of market transactions in 2020-2022 is clearly differentiated between separate groups of cities with county rights depending on the number of inhabitants. It is definitely the highest in the group of cities with the largest number of inhabitants, i.e., 200,000 and more. However, in the remaining groups of cities, it is lower and more similar to the average for all cities with county rights in Poland.

Table 4.

Average price of residential premises sold as part of market transactions in cities with county rights in Poland in 2020-2022 (PLN)

Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Cities with county rights in total				
Mean	258 081,6	293 109,9	323 787,5	291 659,7
Coefficient of variation V (%)	40,0	43,4	39,7	40,8
Cities with a population of up to 100,000				
Mean	235 829,3	274 276,1	300 206,6	270 104,0
Coefficient of variation V (%)	45,8	54,0	47,6	49,0
Cities with 100-200 thousand inhabitants				
Mean	225 295,5	255 567,8	287 105,1	255 989,5
Coefficient of variation V (%)	24,3	22,6	21,5	22,6
Cities with 200,000 inhabitants and more				
Mean	355 696,6	391 117,5	430 277,3	392 363,8
Coefficient of variation V (%)	27,2	29,5	28,8	28,4

Source: Central Statistical Office in Warsaw.

However, the differences in this characteristic between individual cities with county rights in Poland in 2020-2022 are quite large. However, it is highest in the group of cities with the smallest number of inhabitants, i.e., up to 100,000, i.e. this group of cities is the most diverse in this respect (Table 4).

Table 5.

Average price per 1 m² of residential premises sold as part of market transactions in cities with county rights in Poland in 2020-2022 (PLN)

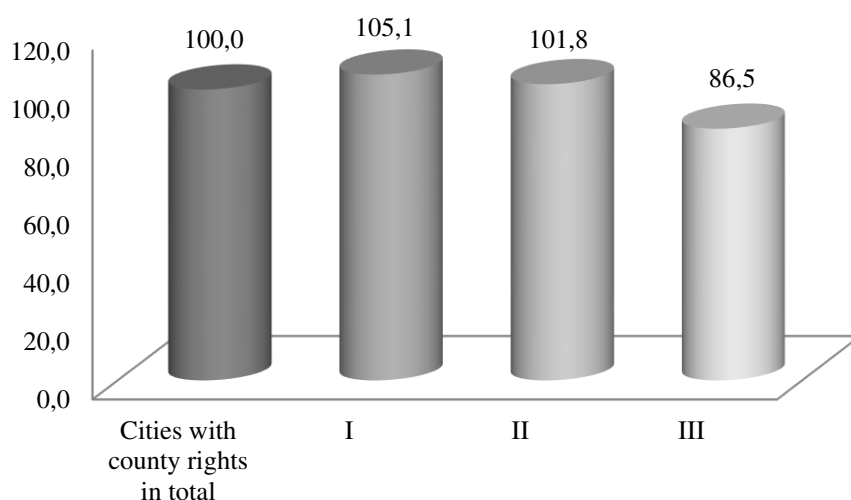
Specification	Years			Average for years 2020-2022
	2020	2021	2022	
Cities with county rights in total				
Mean	4 838,2	5 456,6	6 121,3	5 472,0
Coefficient of variation V (%)	36,0	36,6	35,0	35,7
Cities with a population of up to 100,000				
Mean	4 413,2	5 027,4	5 664,2	5 034,9
Coefficient of variation V (%)	40,2	42,8	40,7	41,1
Cities with 100-200 thousand inhabitants				
Mean	4 306,4	4 851,3	5 471,3	4 876,3
Coefficient of variation V (%)	22,2	20,1	19,0	20,2
Cities with 200,000 inhabitants and more				
Mean	6 554,5	7 296,9	8 089,5	7 313,6
Coefficient of variation V (%)	24,8	25,3	25,0	25,0

Source: Central Statistical Office in Warsaw.

The data in Table 5 show that the average price per 1 m² of residential premises sold as part of market transactions in cities with county rights in Poland increased in the years 2020-2022, and this also applies to all their groups depending on the number of inhabitants. However, the average price per 1 m² of residential premises sold as part of market transactions in 2020-2022 is clearly differentiated between separate groups of cities with county rights depending on the number of inhabitants. It is definitely the highest in the group of cities with the largest number of inhabitants, i.e., 200,000 and more. However, in the remaining groups of cities, it is lower and closest to the average for all cities with county rights in Poland.

The variation in this feature between individual cities with county rights in Poland in 2020-2022 is quite large. However, it is highest in the group of cities with the smallest number of inhabitants, that is, up to 100,000, i.e., this group of cities is the most diverse in this respect (Table 5).

Figure 1 presents the results of the point assessment on the situation on the residential real estate market in separate groups of cities with county rights in Poland compared to all such cities. It should be noted that the cities with county rights in Poland are diverse in terms of the situation on the residential real estate market. A better situation in this respect compared to all cities with county rights in Poland occurs in the group of cities with the smallest number of inhabitants, i.e. up to 100,000 and in the group of cities with 100-200 thousand inhabitants. However, the worst situation on the residential real estate market is in the group of cities with the largest number of inhabitants, i.e. 200,000 and more.



Explanations: I – cities with a population of up to 100,000; II – cities with 100-200 thousand inhabitants; III – cities with 200,000 inhabitants and more.

Figure 1. Point evaluation of the situation on the residential real estate market in separate groups of cities with county rights in Poland compared to all of these cities (cities with county rights in total = 100.0 points).

Source: Own study.

Therefore, this confirms the research hypothesis put forward in the article, assuming that the number of inhabitants is an important factor shaping the situation on the residential real estate market in cities with county rights in Poland, and this situation is better in cities with fewer inhabitants and the worst in cities with the largest number of inhabitants.

4. Summary and conclusions

The analysis of the collected statistical data carried out in the article shows that:

- In cities with county rights in Poland, the average number and value of residential premises sold as part of market transactions increased in the years 2020-2022; however, there is a clear differentiation in this respect between separate groups of these cities depending on the number of inhabitants. The group of cities with the largest number of inhabitants, i.e., 200,000, has the highest average number and value of residential premises sold as part of market transactions in the years examined. and more, and the lowest are in the group of cities with the smallest number of inhabitants, i.e. up to 100,000. In turn, the differentiation of these features between individual cities with county rights in Poland in 2020-2022 is very large, but it is clearly smaller in groups of cities with fewer inhabitants, i.e. these separate groups of cities are the most homogeneous in this respect;
- The growth dynamics of the average number and value of residential premises sold as part of market transactions in cities with district rights in Poland in 2020-2022 is successively small and large. However, the discussed dynamics indicators vary in specific groups of cities with poviats rights depending on the number of inhabitants, and the lowest are in the group of cities with 100-200 thousand inhabitants. However, the differences in these characteristics between individual cities with county rights in Poland in 2020-2022 are quite large. However, it is the smallest in the group of cities with 100-200 thousand inhabitants, i.e. this separate group of cities with county rights is the most homogeneous in this respect;
- The average usable area of a residential premises sold as part of market transactions in cities with district rights in Poland remains at a similar level in the years 2020-2022 and there are no major differences in this respect between their groups depending on the number of inhabitants. Moreover, the differentiation of this feature between individual cities with county rights in the years examined is small, or even negligible, and this applies to all separate groups of these cities;
- in cities with county rights in Poland, the average price in total and per 1 m² of residential premises sold as part of market transactions increased in 2020-2022. However, these prices are clearly differentiated between specific groups of cities depending on the number of inhabitants. They are definitely the highest in the group of cities with the largest number of inhabitants, i.e. 200,000 and more, and in other separate groups of cities, are lower and most similar to the averages for all cities with county rights in Poland. The differentiation of these features between individual cities with county rights in Poland in 2020-2022 is quite large, and it is greatest in the group of cities with the smallest number of inhabitants, i.e. up to 100,000, i.e. this group of cities is the most diverse in this regard.

Moreover, the analysis of statistical data allows us to confirm the research hypothesis put forward in the article, assuming that the number of inhabitants is an important factor shaping the situation on the residential real estate market in cities with county rights in Poland, and this situation is better in cities with fewer inhabitants, and the worst it is in the cities with the largest number of inhabitants.

It should be added that the results of the statistical data analysis presented in the article provide important and up-to-date knowledge that may be useful primarily for central-level politicians and local government officials responsible for the conditions, possibilities and directions of local socio-economic development of cities with poviata rights, as well as for other decision-makers implementing urban development policy in Poland. At the same time, this justifies the need to continue similar research and analysis.

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VERIFICATION OF THE IMPACT OF SELECTED MACROECONOMIC ISSUES ON THE FORMATION OF THE WIG20 INDEX

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Purpose: The aim of the article was to assess the impact of selected macroeconomic variables on the WIG20 stock index.

Design/methodology/approach: The study included the following macroeconomic indicators: GDP, inflation and industrial production. The analysis included a Pearson linear correlation test and a Granger causality test. The study was based on quarterly data for the period from January 2000 to June 2023.

Findings: The research results suggest that the inflation rate does not have a significant impact on changes in the WIG20 index, which is confirmed by correlation analysis and causality tests. The industrial production index and the GDP index have a moderate impact on changes in the stock exchange index.

Research limitations/implications: The study used only selected macroeconomic variables affecting the value of the WIG20 index. It should also be noted that the study was based on statistical data on a quarterly basis, where the possibility of more accurate data could allow for more detailed results.

Practical implications: The conducted research can help investors make decisions by providing information on the relationship between selected macroeconomic factors and the stock market. The obtained results of correlation and causality allow us to understand how individual indicators, such as industrial production or GDP, may influence the behavior of the WIG20 stock exchange index.

Originality/value: This research allows for understanding the relationship between macroeconomic factors and the stock market, especially in the context of the Polish capital market. The study allows to re-analyze the impact of selected macroeconomic indicators on the stock market index for a new and broader research period.

Keywords: stock market, macroeconomics, investments.

Category of the paper: Research paper.

Introduction

The stock market is seen as an indicator of the state of a country's economy. Stock market changes reflect different stages of the economic cycle, where changes in the stock market may confirm the relationship between the country's economic factors and stock market events. The WIG20 index is one of the important indicators on the Polish capital market, which plays a key role in assessing the country's economic dynamics. As a collection of the twenty largest and most liquid companies listed on the Warsaw Stock Exchange, it is an important point of reference for investors, stakeholders and analysts. This index serves as an indicator of the overall direction of the stock market in Poland, reflecting the general trend (upward or downward) of listed companies. Proper analysis of the index is a crucial tool for both individual investors, who use it in the investment decision-making process, and for financial institutions and investment funds, which utilize it in portfolio management. Additionally, the WIG20 index plays a significant role in international economic relations, as one of the key indicators reflecting the condition of the Polish economy. Changes in its value may impact the perception of Poland as a destination for foreign investment.

In the literature on financial markets, there are numerous descriptions of relationships indicating a close connection between the state of the capital market (especially the stock market) and the real economy. Many researchers have conducted studies on the relationship between macroeconomic indicators and stock market indices, and the results of these analyses have often been diverse. Empirical research conducted by M. Celej did not demonstrate a significant relationship between macroeconomic factors and stock prices of companies listed on the Warsaw Stock Exchange (Celej, 2014). J. Przybył, in his considerations on investments in capital markets with varying growth rates, arrived at similar conclusions. In his analyses, he found that there is no long-term relationship between GDP growth and stock returns (Przybył, year of report retrieval 2024). It is worth mentioning the study by Gajdek and Pietraszewski, who conducted an analysis of the relationship between the capital market and GDP growth in 11 countries of Central and Eastern Europe. Their findings indicate that the degree of dependence is not straightforward, with countries with less advanced capital markets showing a strong and positive correlation, while those with more developed capital markets exhibit no correlation or even a negative impact (Gajdka, Pietraszewski, 2014). Similarly, M. Radke presented a similar view, conducting an analysis of the relationship between economic growth and the capital market for 20 European countries. In the conducted analyses, he noticed that changes in stock market index values mostly correlate positively with GDP, although this correlation is low or moderate (Radke, 2021). This topic was also addressed by E. Widz, who suggests that there is a positive but moderate correlation between changes in the main stock market indices of the Warsaw Stock Exchange and changes in GDP in Poland. It appears that changes in stock market indices precede changes in GDP, although in the case of significant

changes in GDP, a stronger correlation is observed along with simultaneous changes in indices (Widz, 2016). Similar observations were made in analyses by another research team, where changes in the WIG index and GDP occurred practically simultaneously or with a slight quarterly delay (Brzeszczyński et al., 2009). The authors noted that if these relationships remain stable in the future, it can be assumed that the improvement in economic conditions will coexist with improvements in the stock market. Continuing this argument, it can be hypothesized that the existence of a solid correlation between economic trends and the stock market will allow investors and market analysts to use information about changes in GDP to forecast market direction, and vice versa.

In terms of macroeconomic indicators, the issue of the impact of inflation on the stock market is often discussed. According to the Polish Language Dictionary, inflation is defined as *a progressive decrease in the purchasing power of money and the associated increase in prices, caused by the circulation of too much money relative to the goods introduced* (PWM, 2024). Inflation, which signifies an increase in the prices of goods and services, theoretically can result in an increase in nominal company incomes, which in turn can affect the increase in the value of their stocks. However, high inflation primarily leads to negative effects, where (in the case of companies) price increases can raise business costs, leading to a decrease in their profit margins. High inflation also leads to an increase in interest rates, aimed at curbing price increases by restraining demand. The rise in interest rates may negatively impact stock prices, as higher loan costs can reduce firm profits and decrease the attractiveness of stock investments. In a study conducted by G. Adams and his team on the impact of inflation on stock prices, it was found that unexpected increases in both the PPI and CPI indices lead to a decrease in stock prices (Adams et al., 2004). A. Humpe and P. Macmillan examined how macroeconomic variables can explain long-term movements in the stock markets of the USA and Japan. Based on their research, it was found that in the case of the United States, there is a negative relationship between stock prices and the long-term high interest rate (resulting from inflation) (Humpe, Macmillan, 2007). As described by P. Fiszeder and S. Rowiński, the results of most empirical studies in the global literature suggest that inflation typically leads to a short-term decline in stock prices. The delayed effects of inflation on current increases in the WIG index are also negative, although not statistically significant (Fiszeder, Rowiński, 2012). The authors also noted that the relationship between economic activity and market sentiment on stock markets is quite complex because the stock market serves as an economic indicator. On the other hand, market sentiment can influence economic activity through wealth and investment effects. In the case of the European stock market, it is worth mentioning the study by P. Chodnicka-Jaworska and K. Niewińska, which focused on identifying macroeconomic factors affecting the banking sector in Europe. According to the analysis, high interest rates and the level of inflation have a favorable impact on bank stock returns (Chodnicka-Jaworska, Niewińska, 2016). Furthermore, the obtained results clearly demonstrated the significant

influence of elements such as: GDP growth rate, short-term and long-term market rate, and changes in the producer price index.

The widely discussed issue also includes the aspect of interdependence between industrial production and the stock market index. Industrial production can be seen as one of the key indicators of economic conditions, and its changes can significantly affect investor sentiment and asset valuation in financial markets. T. Chiang and X. Chen in their research pointed out that an increase in stock profits or market value positively contributes to industrial production growth (Chiang, Chen, 2017). They conducted their studies for 20 international markets (excluding the Polish market). Similar research results were obtained by another group of researchers, who determined that current changes in stock prices positively influence industrial production, but the pace of industrial production does not have a short-term impact on the Indian stock market (Sahu, Bandopadhyay, 2020). A different opinion on this matter is held by A. Bhattacharjee and J. Das, where it was found that inflation, interest rates, gold prices, and industrial production do not have a significant impact on the stock market (the study focused on the Indian stock market) (Bhattacharjee, Das, 2021).

It is worth noting that the majority of studies mentioned in the literature review analyzed relationships based on specific time series. The stock market is often perceived as an indicator that can predict future economic reality, and therefore it can influence various economic indicators. Information from the stock market affects social moods, which directly impacts the pace of consumption and domestic demand. Literature analysis suggests that a re-evaluation of the impact of macroeconomic factors on the main WIG20 stock index is necessary. This is motivated by the lack of clear conclusions from previous empirical research on these relationships. Through further empirical studies (for a new research period), it will be possible to establish more precise dependencies and better understand the dynamics of the stock market. This, in turn, will enable investors to make rational and accurate investment decisions, contributing to more efficient capital utilization in the financial market. Therefore, this article aims to empirically assess the impact of selected national macroeconomic variables on the examined WIG20 stock index.

Research methodology

The study focused on an attempt to assess the interdependence of selected macroeconomic indicators on the WIG20 stock exchange index. The study included the following macroeconomic indicators: GDP, inflation and industrial production. In the first step of the study, appropriate statistical data were downloaded, available on the website: biznesradar.pl (historical values of the WIG20 index) and bankier.pl (selected macroeconomic data). The research period included data from the beginning of January 2000 to June 2023.

In connection with the implementation of the research goal, a research methodology was formulated, the graphical visualization of which is presented in Figure 1.

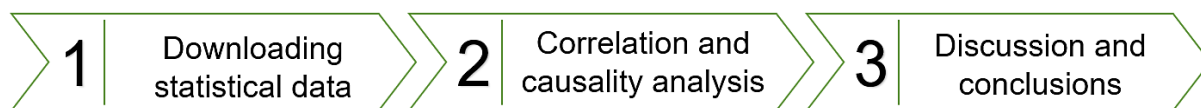


Figure 1. Research methodology.

Source: own study.

As part of the second step of the analysis, the linear correlation and Granger causality of selected macroeconomic indicators with the WIG20 index were examined. In the case of interdependence, the Pearson linear correlation formula was used (Aczel, Sounderpandian, 2009):

$$\hat{r} = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}}$$

Correlation scores range from -1 to 1, where numbers close to 1 indicate a strong linear relationship and numbers close to 0 indicate no such relationship. Negative values indicate that an increase in variable X results in a decrease in variable Y, while positive values mean that an increase in X leads to an increase in Y. We interpret the correlation obtained as follows (Kafle, 2019):

- $0 < r < 0.4$ – low correlation;
- $0.4 \leq r < 0.7$ – medium correlation;
- $0.7 \leq r < 1$ – high correlation;
- $r = 1$ – completely positive correlation.

To deepen the analysis of the relationship, it was also examined whether variable X (representing macroeconomic indicators) exerts a causal influence on variable Y (WIG20 index) through Granger causality analysis. In this case, we characterize the calculations as follows (Granger, 1969):

$$Y_t = a_0 + \sum_{i=1}^p a_{y_i} Y_{t-i} + \sum_{i=1}^p a_{x_i} X_{t-i} + \varepsilon Y_t$$

$$X_t = \beta_0 + \sum_{i=1}^p \beta_{x_i} X_{t-i} + \sum_{i=1}^p \beta_{y_i} Y_{t-i} + \varepsilon X_t$$

where:

Y_t, X_t – research variables;

a_0, β_0 – free word;

p – row of delays.

Results

Comparing information on quarterly changes in macroeconomic indicators (year-on-year basis) with the WIG20 index allows us to observe whether there is a general relationship between changes in the values of these indicators and the overall trend in the WIG20 index. Table 1 presents the results of the correlation analysis, where the relationships between macroeconomic indicators and the point value of the WIG20 were examined.

Table 1.

Results of the correlation analysis between selected macroeconomic indicators and the point value of the WIG20 index

	Inflation rate (y/y)	Industrial production index (y/y)	GDP indicator (y/y)	WIG20
Inflation rate (y/y)	1.00	-0.02	0.04	-0.19
Industrial production index (y/y)	-0.02	1.00	0.53	0.19
GDP indicator (y/y)	0.04	0.53	1.00	0.46
WIG20	-0.19	0.19	0.46	1.00

Source: own study.

The correlation coefficient between the WIG20 index and the GDP indicator is 0.46, indicating a moderate positive relationship between these two variables. Such a result suggests that when GDP increases, there is a higher likelihood that the WIG20 index will also increase, although this relationship is not very strong. Investors may be optimistic about the prospects of companies during economic growth periods, which can lead to an increase in stock prices on the stock exchange. The correlation coefficient between the WIG20 index and the inflation indicator is -0.19, indicating a weak negative relationship between these two variables. This result suggests that there is some inverse relationship in the behavior of the WIG20 index concerning changes in the inflation rate. However, this relationship is weak, which may mean that changes in inflation are just one of many factors influencing the behavior of stock markets. A weak correlation with the stock index was also observed in the case of the industrial production index, which was 0.19.

When examining the interdependence of such variables, it is advantageous to compare indicators to the percentage growth of the WIG20, allowing for an assessment of the economic growth rate relative to the pace of stock market growth. The results of such an analysis have been presented in Table 2.

Table 2.

Results of the correlation analysis between selected macroeconomic indicators and the percentage change in the point value of the WIG20 index year to year

	Inflation rate (y/y)	Industrial production index (y/y)	GDP indicator (y/y)	Change WIG20 index (y/y)
Inflation rate (y/y)	1.00	-0.02	0.04	-0.13
Industrial production index (y/y)	-0.02	1.00	0.53	0.52
GDP indicator (y/y)	0.04	0.53	1.00	0.40
Change WIG20 index (y/y)	-0.13	0.52	0.40	1.00

Source: own study.

Analyzing the percentage change of the WIG20 concerning the same indicators, we observe similar trends, albeit with varying strengths of relationships. The negative correlation of the WIG20 percentage change to inflation (-0.13) suggests a potential decrease in the WIG20 value in response to inflationary growth, although this relationship is weaker than in the calculations from Table 1. Similarly, concerning the change in the GDP indicator, its correlation with the WIG20 decreased from 0.46 to 0.40, remaining interpreted as a moderate dependency. Conversely, there was an increase in the positive correlation of the WIG20 percentage change to the industrial production change (rising from 0.19 to 0.52). This implies that the growth in industrial production may correlate with the increase in the WIG20 value, which can be interpreted as a positive signal for stock market investors. However, it is essential to remember that correlation does not necessarily imply causation, and other factors may influence stock price movements on the stock market.

In the causality analysis, the focus was on a lag of 2, where the Granger test considered a maximum lag of two units of the chosen time (i.e., two quarters). The results of the Granger causality tests have been presented in Table 3.

Table 3.

The results of Granger causality for individual indicators on the year-on-year change of the WIG20 index and the point-wise change of the WIG20 index

	CAUSALITY OF THE INDICATOR ON THE INDEX					
	Inflation rate (y/y)		Industrial production index (y/y)		GDP indicator (y/y)	
	F	p-value	F	p-value	F	p-value
CHANGE WIG20 INDEX (Y/Y)	0.25	0.78	4.95	0.01	4.22	0.02
WIG20	0.60	0.54	2.41	0.09	2.36	0.10

Source: own study.

The causality test results suggest a significant relationship between the industrial production index and the year-on-year change in WIG20. With a p-value of 0.01, there is a very small probability that this relationship occurred by chance. Similarly, for the GDP indicator, where the p-value was determined to be 0.02. This indicates a strong basis for rejecting the hypothesis of no causality. Consequently, it can be inferred that changes in the industrial production index and changes in GDP may influence changes in WIG20 on a year-on-year basis. Different results were obtained when analyzing the causality of indicators directly on the

point change of the WIG20 index. In this case, none of the variables achieved a p-value less than 0.05. Regarding the industrial production index, the p-value was obtained at 0.09, meaning there is about a 9 percent chance that the observed relationship could have occurred by chance. This result is not sufficiently convincing to reject the hypothesis of no causality between the industrial production index and WIG20.

Conclusions

The conducted research has shown a varied impact of selected macroeconomic factors on the WIG20 stock index. The results of correlation and causality analysis have helped identify which of the proposed variables should be considered in potential investments. The research findings suggest that the inflation index does not have a significant influence on changes in the WIG20 index, as confirmed by correlation analysis and causality testing. The industrial production index and GDP indicator have a moderate impact on changes in the stock index. A similar opinion was expressed by (Fiszeder, Rowiński, 2012) and (Bhattacharjee, Das, 2021). Satisfactory results were obtained in terms of the causality and correlation of these indicators in attempting to assess their impact on the value of the WIG20 index, albeit in a year-on-year percentage basis. The research results are consistent with the results of other researchers cited in the introduction (Brzeszczyński et al., 2009; Widz, 2016; Chiang, Chen, 2017; Sahu, Bandopadhyay, 2020; Radke, 2021). The final conclusions from the research suggest that considering the industrial production and GDP indicators may be significant in investment decision-making, while the inflation indicator may have less importance for changes in prices in the stock market. Like all studies, this one also has certain limitations. Firstly, only selected macroeconomic variables influencing the value of the WIG20 index were used in the study. Secondly, it should be noted that the study relied on quarterly statistical data, where the possibility of more precise data could lead to more detailed results. Thirdly, the study focused solely on the relationship between macroeconomic variables and the WIG20 index without considering potential non-linear relationships or interactions among variables, which could provide further insights into the dynamics of the stock market. Additionally, the study did not account for external factors such as geopolitical events or regulatory changes, which could also influence stock market movements independently of the selected macroeconomic indicators.

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PROFESSIONAL COMPETENCE OF MILITARY COMMANDERS IN THE AREA OF EFFECTIVE MANAGEMENT OF HUMAN RESOURCES IN COMBAT CONDITIONS

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Purpose: The main objective of the research is to identify the research gap in the identification of the latest experiences in management of competence of military commanders in the context of resource management on the modern battlefield.

Design/methodology/approach: The research presented in this paper is based on an analysis of the literature on the subject, a critical review of selected areas of management competence of military commanders and the applied interview technique. The literature study took into account secondary sources, which were research communications in the subject area as well. Using methods of logical deduction and requesting, conclusions and recommendations were generated. Combining several research methods resulted in obtaining a broader context of the studied phenomenon and ensured a higher quality of the conducted research.

Findings: As a result of the research, a gap was identified in the process of preparation of military commanders in military universities carried out so far. By means of deduction and logical inference, the value-forming and mobilization competencies recognized by experts as essential for managing the compact organizational structure of subordinate soldiers during combat in current operations were systematized. Changes in the contemporary security environment necessitate the development of a new, tailored model for the preparation of the modern military commander. The proposals presented are an open set - they should be constantly monitored and cyclically updated.

Research limitations/implications: Research interests have been limited to the conclusions of the current Russian-Ukrainian conflict, as the most similar in specificity, complexity and actors to the existing threats in relation to Poland.

Practical implications: The recommendation developed on the basis of the conducted research is the identified need to develop value-creating and mobilization competencies as important in managing military personnel during combat. The practical result of the research is a proposal to train military commanders in these areas as the main training in a military academy or training center.

Originality/value: Based on the research conducted, the article proposes original system solutions for managing the development of military commanders' competence in relation to the challenges and threats facing them on the future battlefield.

Keywords: professional competence, military personnel, human resource management.

Category of the paper: research paper.

1. Introduction

Process of security destabilisation already underway before 2022 has resulted in an increase in military and non-military threats, as well as demands and expectations placed on internal and external security services. Soldiers, policemen and officers, as well as other specialized services, faced new challenges based on the purpose of the service, as well as their responsibility for the state, society and its citizens. Leaving aside obvious aspects such as the level of training of personnel and equipping them with state-of-the-art means of influence, the very process of their preparation also becomes important, supplementing it with competencies previously overlooked or treated with less attention. The values that determine a state's defense capabilities are also changing. War theory researchers have long constate that *a war is a field of uncertainty; three-quarters of what warfare is based on is covered by a fog of greater or lesser uncertainty* (Clausewitz, 2022, p. 65). Contemporary researchers, on the other hand, emphasize that *contemporary and future conflicts will require the ability to produce, distribute and use innovative solutions. The battlefield has thus become a multifaceted and complex* (Szulc, 2004, p. 231).

The professional competence of military personnel has been discussed in the literature for a long time, although the greatest interest has been in recent years. However, they have not been defined in a clear and generally accepted way. Researchers working in this area are asking whether they are some general professional traits revealed in different work situations, or whether they encompass many other specific, sometimes unrelated skills. Regardless of the resolution of this dispute, the essence is to improve and shape the professional competence of military commanders to such an extent that they are able to fulfill their statutory tasks related to the area of state security in the context of multifaceted and multidimensional threats.

The research on the competence of professional military commanders in light of recent experience was inspired by observations and exchange of experiences with Ukrainian soldiers and citizens after the beginning of the aggression of the Russian Federation. The choice of this subject matter was dictated by completely new challenges in terms of the forms and methods that Ukrainian commanders faced in the battle. Morower there were interests in the evolution of these competencies and the requirements for soldiers in a new threat situation, as well as the author's own professional experience. The research inquiry was directed at determining the importance of military discipline in the task force, the role of leadership and building morale in soldiers, as part of the development of management competencies of tactical level commanders, as one of the determinants of success in the command process. Based on this, a research gap has been identified in the lack of up-to-date knowledge of the key competencies of tactical level commanders vis-à-vis the methods used by Russian troops in combat. From this, a research question was formulated as to what management competencies are most relevant on the current battlefield? The main purpose of this publication is the cognitive function of identifying

capabilities in the area of management competence of military commanders in light of recent experience. In order to achieve the main research goal, the research was conducted using such methods, techniques and research tools as critical analysis of the literature, individual partially categorized interview, secondary research and logical deduction. The research was conducted by limiting itself to the currently largest armed conflict in Ukraine in terms of its scale, location in relation to Poland, and effects on the victims and the region as a whole.

2. Literature review

The issue of competence is definitely an interdisciplinary concept with its connotations in many fields of science. This term can be understood as a set of knowledge, skills and qualities that allow you to effectively perform tasks and effectively achieve your own goals in the context of the strategic objectives of the organization. Defined in this way, competencies can be referred both to a job position and to the person performing the work in the position. However, in today's labor market, competencies have a broader dimension, as they are complemented by general knowledge, employee experience and human resource specialized knowledge. They then give the organization a new competitive advantage in the market (Swanson, 2023, p. 277). In the literature, approaches to defining competence refer to different approaches: the term "competence" - is a functional approach, refers to the ability to achieve minimum standards of set goals, and "competency" - a behavioral approach, refers to the behavior of the employee that enable him to achieve high performance at work (Szczepańska-Woszczyna, 2016, p. 50).

An interesting division of professional competencies into two main groups that include social competencies in their set can be found in the publication of Filipowicz:

- core competencies, within which he details:
 - cognitive competence - broadening of horizons, ability to learn, creativity;
 - social competence - contacts with superiors and other employees;
 - personal competence - commitment, perseverance;
- executive competence:
 - business competence - business orientation, industry knowledge, diagnosing customer needs, sales techniques;
 - corporate competence - identification with the company, customer focus, openness to change, ethics and values, organizational agility and professional knowledge;
 - managerial competence - team building, caring for subordinates, delegating, motivating, leading, organizing, planning, process and project management, strategic thinking and change management (Filipowicz, 2016, pp. 37-39).

However, there is an emerging view among many researchers in this context that professional competence should be considered in relation to the employee's personality. Thus, in the British and Scandinavian model, the prevailing conviction is that the professional competence of employees should be considered independently of the permanent structures of their personality. Such elements as mental predispositions or personality traits are not included in these sets of competencies. A slightly different approach in this setting is proposed by the American interpretation, where the dominant approach has become person-oriented (e.g., behavioral event interviews). The purpose of such analysis is to identify those characteristics that make it possible to distinguish individuals with above-average performance from others. Thus, competencies in this approach include skills, knowledge, personal characteristics and behavioral (Kupczyk, Stor, 2017, p. 10).

A characteristic motive for the effective functioning of modern organizations and the community more broadly is professionalization, which is inextricably linked to the need for high levels of competence. And so while these have applied to specific professions for a long time, much higher expectations are placed on them nowadays, as a result of the increasing importance they are playing (Oleksyn, 2018, p. 12). This is clearly evident in a military organization, whose peculiarity lies in the need for management personnel - i.e., commanders - to acquire high competence, and it belongs to the group of learning organizations - in a changing environment, high technology and rapidly increasing expectations of society. The result of the interaction of the above elements should be an effective and unwavering command, especially in a hierarchical arrangement that delegates tasks and competencies to contractors.

Command is a distinctive form of directing human resources in the army and should be perceived as a special form of leadership in which the military's characteristic principle of one-man decision-making and responsibility for its consequences applies. Some researchers understand *command* as the process by which a commander, within the framework of the authority he possesses, makes decisions with a particular rigor of enforceability, which are intended to achieve the desired goal using the forces and means at his disposal (Posobieć, Prusiński, 2012, p. 6). Doctrinal documents indicate that command is the process by which a commander imposes his will and intentions on his subordinates and by which, assisted by his staff, he plans, organizes, coordinates and directs the actions of his subordinate troops through the use of standard operating procedures and all available means of communicating information (DD/3.2.5, 2007, p. 8). Others still argue that it is the deliberate activity of the commander and his command institutions, which must be carried out within the framework of a clearly defined command system that ensures high combat readiness and proper preparation of troops to best achieve the goal of a battle, combat, operation (Michniak, 2008, p. 40). However, given the purpose of this study, it is necessary to identify the competencies that commanders should be equipped with in order to effectively and efficiently manage personnel and subordinate structures in the area of forming team integrity and discipline, as elements that support

command in achieving goals and fulfilling tasks. To this end, based on his research, the author has developed a model of the profile of a military commander as a team leader and manager, which are shown in Figure 1.

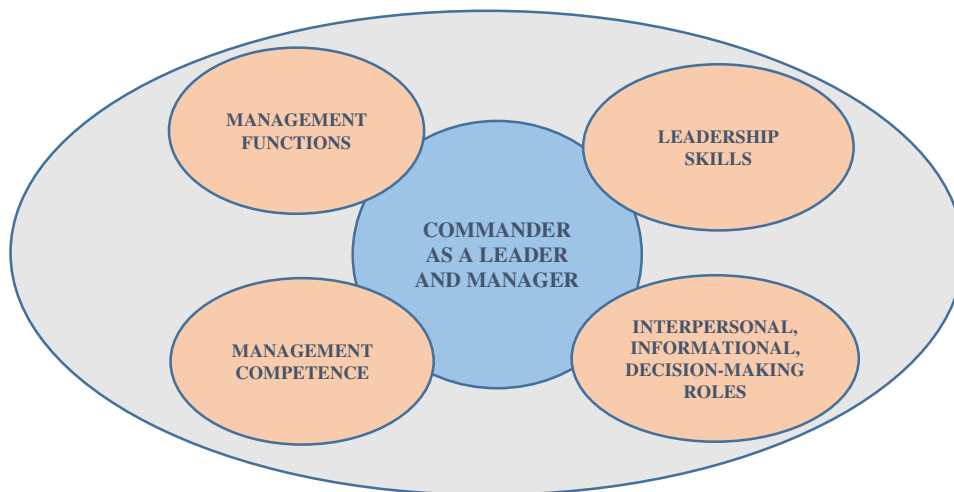


Figure 1. Components of the profile of the commander as a leader and manager.

Source: the author's study.

Looking for competency models in the uniformed forces in the literature, an interesting proposal was presented by Piotrowski, identifying three subsets among the managerial competencies of commanders, additionally defining their current and desired levels and the resulting competency gap. According to him, the managerial competencies of commanders form the following collections:

- a) professional competence;
- b) social competence;
- c) business competence (Piotrowski, 2019, pp. 133-134).

The above proposal for the management competence of commanders, in connection with the performance of their professional duties (command proces), is shown in Figure 2.

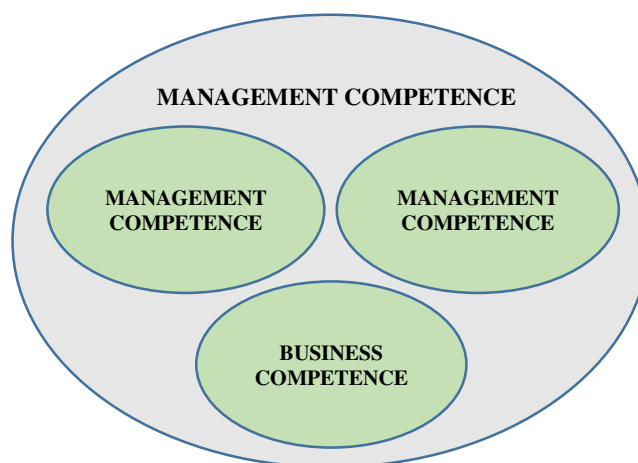


Figure 2. Management competence of military commanders.

Adapted from: Piotrowski, 2019.

In the field of management competence of military commanders, the highest percentage was assigned to professional competence 47.5%, social competence 35.0% and entrepreneurial competence 17.5%. In the component of professional competencies of commanders, the highest rank was assigned to command knowledge, education appropriate to the function, foresight and planning skills, and management knowledge. In the component of social competence, the highest rank was given to leadership, personal qualities, work experience, building good relationships and teamwork. In the component of business competence, these are readiness and willingness to act, commitment to their tasks, commitment to the tasks of subordinates. A profile of key competencies of commanders is presented, which includes such elements as:

- a) command knowledge;
- b) management knowledge;
- c) foresight and planning skills;
- d) problem-solving and decision-making skills;
- e) skills in organizing activities;
- f) building positive relationships and teamwork;
- g) leadership;
- h) professional experience;
- i) readiness to act (Piotrowski, 2019, pp. 138-147).

Complementing the listed elements with the results of available research in the field of command competence, in relation to the new challenges of volatility, uncertainty, complexity and ambiguity, which in the literature has taken the term VUCA (Czainska, Balcerzyk, 2023, p. 279), is reasonable to add to this set of capabilities and skills related to the responsibility of commanders. The importance of decisions taken in combat, related to the lives of subordinate soldiers and the possible loss of valuable military equipment, in addition, the consequences of decisions in relation to the civilian population (definitely more responsibility than the head of a civilian company) cause, in the author's opinion, that this range of competence should be included in the set of command competencies. In this regard the profile of essential competence of commanders, in connection with the performance of their professional duties in the command process, is shown in Figure 3. In addition, a subset of management competence shared by civilian managers and military commanders was identified.

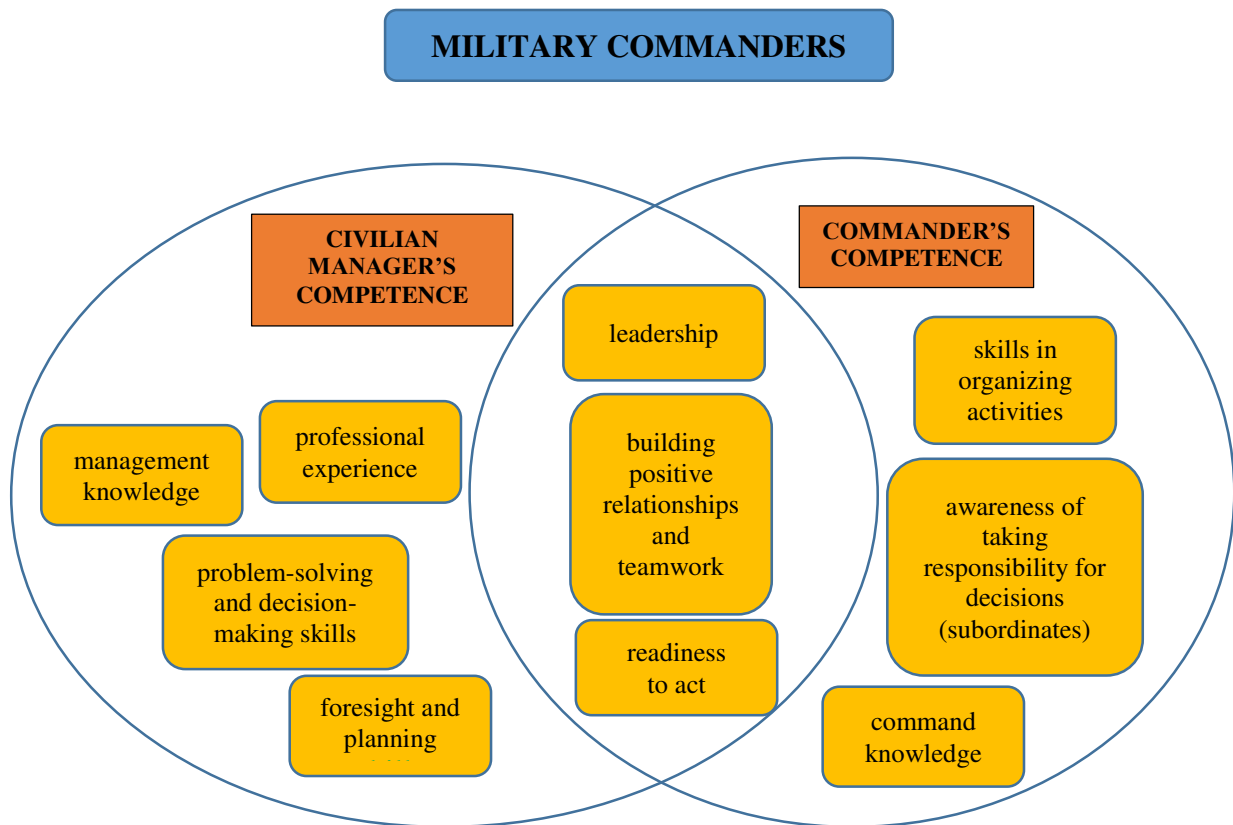


Figure 3. Core competence of military commanders.

Source: the author's study.

Observance of military discipline is considered an imperative for the functioning of active duty military personnel, regardless of rank or duty position. Recently, there have been an increasing number of cases of soldiers coming into conflict with the law, both on and off duty. This may be due to the fact that the size of the army has increased significantly in the recent period from 95,000 soldiers in 2015 to 172,000 in May 2023 (PAP, 2023). Although this is certainly not the only reason. Violations of rules established by military acts and regulations are covered by various types of responsibility. The first is disciplinary responsibility for acts that constitute disciplinary offenses under *Ustawa o obronie Ojczyzny*. Article 353 states that "a violation of military discipline constitutes an act of a soldier consisting of conduct detrimental to the good name or interest of the Armed Forces, culpable exceeding of authority or failure to perform duties arising from legal regulations, including orders and instructions issued by superiors authorized under these regulations". Article 352 of the mentioned law states that "in the case of an act constituting a minor disciplinary offense, the disciplinary superior may refrain from initiating disciplinary proceedings and conduct a disciplinary interview, documented in the form of a note, with the perpetrator of the disciplinary offense". In both cases, the purpose of disciplinary proceedings or conducting a disciplinary interview is to resolve the disciplinary case of the soldier accused of committing a disciplinary offense in the form of a substantive ruling. In the case of insubordination of greater legal gravity, committing an act with the characteristics of a misdemeanor or a felony, the soldier carries

criminal responsibility, listed in the military part of the *Ustawa z dnia 6 czerwca Kodeks karny*. As a result, with the entry into force of the regulations of the *Kodeks karny* - the part relating to the responsibility of soldiers for acts committed, there was a demarcation of disciplinary responsibility from criminal responsibility. On the other hand, however, the above fact can be interpreted as an extension of the soldier's responsibility as a citizen, in connection with the performance of a public function and the fulfillment of the resulting duties, which undoubtedly distinguishes him from a civilian labor market employee, who does not bear part of this responsibility. Another form of responsibility related to the fulfillment of a soldier's official duties, is the social mission of the army as an institution serving citizens - for the purposes of this publication, it has been adopted as social responsibility. Recent world events within international and internal security clearly show that the importance of this type of social responsibility for the security services seems to be crucial. An overview diagram of the responsibility of soldiers, in connection with the performance of their official duties is shown in Figure 4.

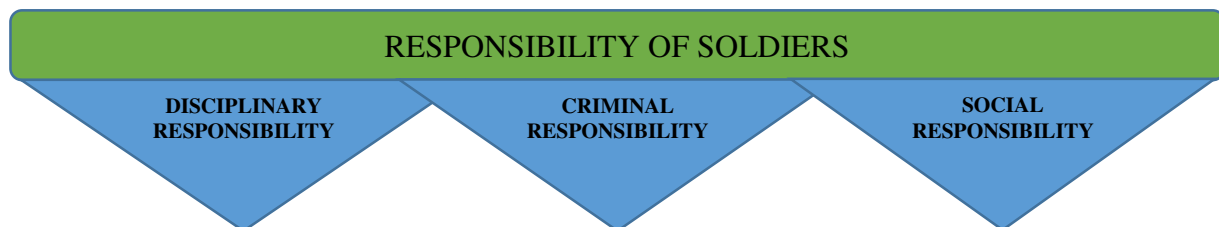


Figure 4. Responsibilities of soldiers in connection with the execution of their official duties.

Source: the author's study.

The above elements should be placed in the area of military discipline as a component of the process of management and command of military personnel, while asking the question - what is the actual purpose of maintaining military discipline and what functions of management (command) it supports or fulfills?

Planning as a function of management is focused on determining the goals of the organization in different time frames (strategic, tactical, operational goals) and developing the best possible (most effective) ways to achieve them. Of particular importance is the establishment of end goals in the organization. as the initial phase to begin planning. With regard to the final goals, intermediate objectives are identified, the methods of proceeding are chosen, the resources needed are identified and the sources of their acquisition are indicated, and the time and place of the anticipated activities are specified. In this way, an operational plan is created which is the final result of planning (Przybyła, 2003, pp. 115-121). In the decision-making process of a military commander, planning is divided into three stages: assessment of the situation, presentation of the intention to act, and development of the action plan and combat order. It is precisely the equivalent of the aforementioned operational plan. The maintenance of executive discipline in this area is enforced by further development of the operational situation, for example, on the battlefield.

Organizing as a function of management involves the formation of the organizational structure, taking into account such aspects as, for example, the division of employee responsibilities (combining various activities, organizing competencies, etc.), defining the hierarchy (separating organizational levels, establishing rules of subordination), organizational formalization (organizational documentation), information ties, procedures of conduct, distribution of decision-making and coordination of activities in time and space. Thus, it includes organizing the organization, integrating the activities occurring in it, and consolidating the rules and procedures in place (Przybyła, Wudarzewski, Koźliński, 1995, pp. 49-121). Formalization and enforceability of executive discipline in this task area is a necessary factor for the smooth and effective functioning of a specific organizational structure (company, battalion, military unit) in terms of the objectives and tasks set.

Motivation (leadership) is a special function. This is because it refers to the desired attitudes and behavior of employees. Motivation is directed, on the one hand, to the recognition of professional and personality qualifications of employees, on the other hand, to the recognition of their needs, aspirations and expectations. On this basis, such a system of influence on employees is developed and such organizational conditions are created that employees engage more fully in the realization of objectives, using and improving their capabilities and qualifications. However, it is important to keep in mind the significant impediments to motivation that arise from the wide variety of qualifications and personalities, the variability of their attitudes and needs, and the limited ability to recognize these elements (Koźliński, Listwan, 1999, pp. 9-13). Following the rules and norms imposed in a military organization should in this case be the result of the commander's influence on the team, flowing from each individual in the team by himself, rather than being an element imposed and held accountable by the governing body. Such conditions increase the efficiency and productivity of the organization, including the military structure.

Control is used by management to check and evaluate whether subordinate organizational structures are performing their tasks, and as a result, allows the detection of irregularities and prevention of adverse phenomena. as a function of management is a special case of evaluation, for which there is a reference in the form of a benchmark. It is a process of comparing facts with benchmarks and drawing conclusions from these comparisons (Kuc, 2009, p. 24). The reference to the role of this function in command as a specific form of management thus seems to be unambiguous - it is a stage following preparation and execution, occupies a larger or smaller time frame, involves the detection of causes of inefficiency (Posobiec, 2013, p. 103). The purpose of control is to improve the quality of command and efficiency in the execution of tasks. The control function is exercised by all commanders, thus verifying the executive discipline of subordinates and correcting or proceeding to create a new operational plan. The place of military discipline in the fulfillment of basic management (command) functions is shown in Figure 5.

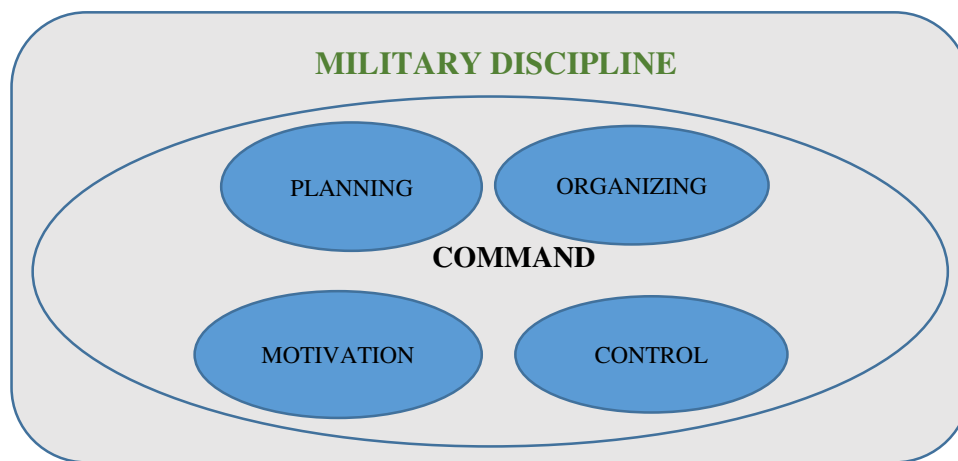


Figure 5. Management functions vs. discipline in the command process.

Source: the author's study.

In conclusion, the creating of discipline in an organization's task force fulfills all the listed management (command) functions. They are carried out by commanders at all levels of command in cycles of organized activities that reflect the command process. Executive discipline, training discipline and military discipline determines the achievement of goals and the realization of tasks at each stage of these cycles, as well as fulfills the mentioned management function.

3. Research methodology

The research was conducted using such methods, techniques and research tools as critical analysis of the literature, individual partially categorized interview, secondary research and logical deduction. The scope was limited to the current largest armed conflict in Ukraine in terms of its scale, location in relation to Poland, and effects on the victims and the region as a whole. The research tool used to conduct the survey among Ukrainian commanders and instructors was a structured interview questionnaire. Sixteen commanders and two instructors directly related to the combat operations of Ukrainian troops in the battle were surveyed using the questionnaire technique. The anonymous interview questionnaire contained 8 questions of various open-ended nature. The questionnaire included optional questions, assuming that not every respondent has enough knowledge to answer all the questions. The following are the results of the study on the identification of key capabilities and competencies of tactical level commanders for success in commanding subordinate task forces.

4. Results

The results of the study show the fundamental importance of leadership and targeting of commanders in leading the team in situations of significant constraints in information, resources, time, and on the other hand under pressure from the enemy and their own soldiers. This confirms the theory of "bounded rationality" in leadership put forward by Simon, which states that it is not possible for a leader to make decisions at an optimal level, but only at a satisfactory level, mainly due to information deficiencies or levels of motivation (Tversky, Kahneman et al., 2000).

In the research process, the author used the interview technique, considering it as enabling to learn about the phenomena occurring in the consciousness of the respondents. Valuable research material obtained during the conducted research by means of an individual interview partially categorized with representatives of the Ukrainian army and Ukrainian experts dealing with security issues, are the conclusions in terms of the desired competencies, capabilities and behaviors of commanders in the process of leadership/command of military personnel, which are as follows:

- essential in battlefield command at the tactical level is maintaining a high level of morale and commitment among subordinate soldiers. During interviews, those interviewed noted a significant increase among soldiers in extreme situations in the level of identification with the team and willingness to make sacrifices. In the case of Ukrainian society, its social stratification and national diversity (according to the official national census of December 5, 2001, Ukraine at that time had a population of 48 457 000 representing 130 nationalities), additionally outlines a significant process of strengthening the national identity of Ukrainian soldiers, the will to strengthen national aspirations, with the further consequence of society developing European and allied aspirations;
- preparation of tactical level commanders should be directed at developing the ability to effectively manage a subdivision during combat operations - the Ukrainian conflict delegates responsibility in combat to lower levels of command - such as squad, platoon, company. The peculiarities of combat operations determined by the impact of the enemy force combat operations to be carried out by small numbers of troops and subunits. As a result, the responsibility for planning, organizing and conducting combat operations comes down to lower-level commanders, in many cases young and inexperienced, although burdened in these situations with considerable responsibility for subordinates and success in combat;

- it is valuable to develop in the process of training commanders the ability to adopt creative and innovative methods of combat - a significant advantage over the enemy is obtained through the ability of commanders to apply innovative equipment solutions and processes for directing combat. Importantly, this applies to modern technologies such as Starlink (this is a system and a constellation of satellites in low Earth orbit. The main purpose is to provide access to telecommunications services, including broadband Internet in areas without infrastructure, for example, in developing countries) or an application using management of reconnaissance information obtained from civilian sources. Also, the use of very simple products or methods known in civilian applications, albeit useful and effective in specific situations of clashing with the enemy, contributes to achieving an advantage in combat;
- important among soldiers is uninterrupted mental and physical resilience - the outstandingly high intensity of operations in adverse living and weather conditions and the difficulty of logistical supply on the front line of combat operations determine the rapid loss of physical capacity over time due to the lack of valuable and regular food, vitamins and minerals. Thus, physical preparation, building the resilience of commanders are again becoming an important part of professional preparation;
- development of leadership competencies and leadership roles by commanders provide a sense of security among fighting soldiers - those interviewed indicated that soldiers feel more secure, show high morale and will to fight in a situation of confident and substantive management by the commander of the team. On the other hand, during the loss of contact with him, there are acts of panic, fleeing, there is information chaos, which is immediately exploited by the enemy;
- important in the context of effectiveness in extremely difficult conditions of conducting combat is the ability to maintain a high level of military discipline in the team - in the stage of increased impact of the enemy, during disparities in equipment resources, information chaos and other factors that have a destabilizing effect on the commander and his subunit, such elements as understanding the purpose of action, trust in the commander and other members of the team, respect for orders and commands, and uninterrupted verbal and non-verbal communication become extremely important. Representatives of the Ukrainian army pointed out that regardless of the level of equipment with modern means of warfare, military training, logistical supplies in the area of operations - it is discipline, morale and willingness to make sacrifices that plays a key role in combat. This area is then the responsibility of the commander, who should be aware of the importance of this element in the process of commanding a human team.

Summarizing the results of the study, it should be stated that the greatest importance in managing the organizational structure of subordinate soldiers during combat in the Ukrainian theater of operations is presented by value-forming competence and mobilization competence. These include the ability to create a vision by the commander, building and sustaining values

(ideas) among soldiers, the ability to mobilize subordinates in the realization of goals, motivating and at the same time maintaining the compactness of the team and forming a high level of executive discipline, the ability to manage combat in a limited area of autonomy, as well as the ability to adapt and create new, non-standard solutions related to robotization and informatization of the modern battlefield. Thus, on the one hand, these are conclusions that previously appeared in separate, individual discussions, as well as completely new ones that should be taken into account in the process of education and training of tactical level commanders in military academies and training centers.

Following up on this research, it becomes rational to prepare training programs and courses for commander candidates in developing the indicated skills and capabilities. In addition, such training should extend to commanders who are already carrying out the tasks of their posts, in the improvement courses dedicated to them.

5. Conclusions

The main purpose of this publication was the cognitive function of identifying capabilities in the area of management competence of military commanders in light of recent experience. The collected research material provided data for the formulation of conclusions regarding the identification of new management competencies of tactical level commanders. As a result of the research, a gap in the hitherto implemented process of preparing future commanders in military universities was identified. By means of deduction and logical inference, the competencies listed in the research results were systematized, identifying value-forming and mobilization competencies as having the greatest importance in managing the organizational structure of subordinate soldiers during combat in the Ukrainian theater of warfare. This is essential in the process of training commanders who will soon be responsible for the security of all citizens. As the results of the research showed, changes in the modern security environment and the imminent threat of warfare necessitate the development of a new, tailored model for the preparation of the modern military commander of the tactical level. The proposals presented are an open set, and should, according to the author, be constantly monitored and periodically updated by the institutions responsible for the process. For there are constant and permanent changes in the conditions in relation to which the commander will carry out management, command and social functions. However, it should be remembered that the activity of every commander is oriented towards the relationship and fulfillment of management functions in relation to another person, more generally to the local community and society as a whole. Adopting such a perspective, the validity of which is confirmed by the experience of the conflict in Ukraine, it is necessary to model the concept of education and training of soldiers in such a way as to strive to equip military personnel with a wide range of competencies,

enabling them to perform during their service not only professional (military) functions, but also social and pedagogical functions. The practical result of the conducted research is the presented proposal for supplementing the competencies of commanders with the listed abilities, which should be taken into account in the process of professional preparation at a military universities or training centers. Unquestionably, research in this area should be continue.

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MASTERING PROJECT MANAGEMENT: THE LEADER-TEAM CONNECTION

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Purpose: The research examines the relationship between transformational leadership, team cohesion, and project objectives' achievement rate in public organizations.

Design/methodology/approach: The survey selected 18 offices in Poland's voivodeship capitals and included all 269 departments and faculties. Directors nominated employees for a questionnaire focusing on projects needing diverse skills. 70 employees (and projects) were selected, with 50 responding to the subsequent survey conducted via computer-assisted telephone interviewing (CATI).

Findings: Understanding and implementing transformational leadership is essential in public administration for fostering team cohesion and project success. Although team cohesion is currently lacking, enhancing communication and collaboration can improve it. Transformational leadership encourages idea generation and team representation, yet its direct impact on project objectives is minimal. Public organizations should invest in leadership development to address project needs and navigate bureaucratic challenges effectively.

Research limitations/implications: Limitations of research include potential self-selection bias among participants and unaccounted external variables like political pressures, funding constraints, and policy changes that could affect the relationship between leadership styles, team cohesion, and project success. Future research should address these factors for a more comprehensive understanding of effective leadership in public administration.

Practical implications: Practical implications suggest investing in leadership development programs to cultivate transformational leadership qualities, fostering team cohesion, and aligning goals with organizational missions. Leaders should prioritize integrity, transparency, and accountability to navigate the unique challenges of the public sector, enhancing project performance through collaborative and supportive team environments.

Social implications: Socially, promoting transformational leadership fosters collaboration and inclusivity within public organizations, enhancing team dynamics and potentially improving service delivery to the public. Encouraging leadership qualities like empowerment and transparency contributes to a more accountable and socially responsible public sector.

Originality/value: This paper contributes by highlighting the significance of transformational leadership in public administration, shedding light on its positive impact on team cohesion and suggesting avenues for organizational improvement in project performance.

Keywords: transformational leadership, public sector innovation, team cohesion.

Category of the paper: Research paper.

1. Introduction

In the dynamic area of innovation within the public sector, distinct from the profit-oriented private sector, the spotlight is on fostering collaborative government and adopting post-bureaucratic organizational structures. Public sector entities, driven by a mission to enhance public services and deliver social value, differ from their private counterparts. This shift has led to the prominence of multidisciplinary teams with complementary skills and high interdependence, addressing the complex challenges faced by public organizations.

In this context, the significance of leadership styles cannot be overstated, as they play a crucial role in influencing organizational effectiveness. The hierarchical structure of the public sector places ethical leadership at the forefront, with leaders serving as vital sources of ethical guidance. Transformational leadership, marked by the ability to inspire and motivate followers toward organizational progress, emerges as a powerful style for achieving institutional targets. Specifically in the area of public service management, transformational leadership aligns organizational goals with community-oriented missions, emphasizing vision, mission, and personalized attention to employees.

This paper deals with the research methodology and findings of a study examining the connections among transformational leadership, team cohesion, and the achievement of project objectives within the framework of project management in public administration. The purpose for this paper is to investigate the relationships among transformational leadership, team cohesion, and project objectives' achievement within the context of project management in public administration. The research, funded by the National Science Center, explores the maturity of local government public administration in implementing solutions related to team self-management processes in Poland. The paper presents three hypotheses and six research questions, with the aim of unraveling the dynamics between leadership styles, team cohesion, and project success. Findings explain the complex interplay of these variables and offer valuable insights for researchers and practitioners in the public sector. This paper makes a significant contribution by emphasizing the importance of transformational leadership within public administration. It illuminates how such leadership positively influences team cohesion and proposes strategies for enhancing organizational performance in project delivery.

2. State of the art

In contrast to the private sector, innovation in the public sector is not driven by the pursuit of profit but rather by the goal of improving public services and delivering value to society (Feltynowski, 2012; Moore, Hartley, 2008; Torfing, Triantafillou, 2016). This shift towards collaborative government and post-bureaucratic organizational structures has led to an increased emphasis on multidisciplinary teams. These teams are characterized by their complementary skills and high interdependence, making them well-suited to tackling the complex challenges faced by public organizations (Van der Voet, Steij, 2021).

In this evolving landscape, the significance of leadership styles comes to the forefront due to their profound impact on organizational effectiveness (Warrick, 1981; Van Eeden et al., 2008; Yahaya, Ebrahim, 2016). Telukdarie (2018) contends that effective leadership involves self-regulation and a natural commitment to correctness for the benefit of the organization (Sosik, Dionne, 1997; Politis, 2001; Skogstad, 2007). Scholars such as Du et al. (2013), Nanjundeswaraswamy and Swamy (2014), and Bag et al. (2021) emphasize a leader's responsibility to cultivate positive relationships with organizational stakeholders, fostering motivation, commitment, and sustainability. Dhamija and Bag (2020) further explore the positive correlation between leadership, organizational commitment, and performance (Dhamija et al., 2023). Ethical leadership gains prominence in the public sector, given its hierarchical structure. Treviño et al. (2005) argue that leaders in public organizations serve as critical sources of ethical guidance due to their influential role within the hierarchical framework. The literature underscores the importance of ethical leadership, referencing authentic leadership (Van Eeden et al., 2008; Munir et al., 2013; Yahaya, Ebrahim, 2016), servant leadership (Brewer, 2010), and transformational leadership (Ali et al., 2015; Ardi et al., 2020) as integral components.

Transformational leadership, characterized by inspiring and motivating followers to contribute to organizational progress (Bass, 1999; Bass et al., 2003; Hill et al., 20212), emerges as a potent style for achieving institutional targets. Regardless of individual demographics, transformational leadership proves effective in organizational strategies related to manpower management, influencing workforce behavior toward adopting transformative, charismatic, and visionary leadership (Saeed et al., 2014; Ali et al., 2015; Novak et al., 2020). Moreover, participative and authoritative leadership styles exhibit positive correlations with interpersonal skills (Bass et al., 2003). A study by Abasilim et al. (2019) reveals a positive relationship between employee commitment and transformational leadership, contrasting with a slightly negative link between commitment and transactional leadership. Role ambiguity and role conflict are identified as detrimental to work performance. Hasan Al Khajeh (2018) finds that charismatic, transactional, and bureaucratic leadership styles negatively impact organizational performance, while transformational, autocratic, and democratic styles have positive effects.

In the specific context of public services management, transformational leadership proves crucial, aligning organizational goals with community-oriented missions. Bass's model of transformational leadership identifies four dimensions, emphasizing vision, mission, and personal attention to employees. Public management research underscores the significance of transformational leadership behaviors, resulting in enhanced individual, group, and organizational performance. Trust in leaders, intrinsic motivation, and team cohesion emerge as mediating variables in the relationship between transformational leadership behaviors and follower behaviors. Transformational leaders, capable of addressing both material and psychological needs, play a pivotal role in fostering teamwork and team performance. While transformational leadership has been linked to enhanced team performance, little research delves into the specific mechanisms by which transformational leaders influence team interaction. Team cohesion, influenced by transformational leaders, becomes a crucial factor in achieving higher perceived performance and satisfaction within teams.

3. Research Methodology

The article results from a research project financed by the National Science Center (Miniatura 5 number: 2021/05/X/HS4/00171). The research project was designed to gain knowledge on the maturity of local government public administration to implement solutions related to team self-management processes in Poland. The selection of units to be surveyed from the general population was complete; consequently, surveys were planned in 18 offices in the capital cities of voivodeships in Poland. The study covered all 269 departments and faculties. In the beginning, the first questionnaire survey was sent to directors or deputy directors of all departments. Their task was to identify a project that required the involvement of a team with various skills, experience, and knowledge, and to select a person from this team to conduct further research. Managers selected a total of 70 employees (and 70 projects) who met the adopted assumptions. Then a second questionnaire survey was sent to them. A total of 50 responses were received. The choice of where to conduct the research is dictated by city offices that are the capitals of voivodeships should implement advanced organizational and functional solutions in their activities. The designed research was quantitative and was carried out using the computer-assisted telephone interviewing (CATI).

In addition to the author's methodologies, leadership and team cohesion scales were used when constructing the survey (Tuckman, Jensen, 1997; Super, 2020; Turaga, 2022). A -2 to 2 scale was used for Leadership and team cohesion-related expressions: -2 = Very Poor, -1 = Poor, 1 = Good, 2 = Very Good. Moreover, A Likert type 1 to 5 scale was used for project objectives' achievement rate-related expression: 1 = 20%, 2 = 40%, 3 = 60%, 4 = 80%, 5 = 100%. In this regard, the main research questions were evaluated using mean, median, and correlation analysis.

The primary research goal for this paper is to investigate the relationships among transformational leadership, team cohesion, and project objectives' achievement within the context of project management in public administration. In contemporary project management, the successful realization of project objectives is of paramount importance for organizations striving for competitiveness and excellence. However, the dynamic nature of projects often demands effective leadership and cohesive teamwork. The interplay between leadership styles, team cohesion, and project success has drawn the attention of researchers and practitioners alike. Three hypotheses and six research questions were formulated (Table 1).

Table 1.
Research questions and hypotheses

Research Questions	Hypotheses
RQ1. To what extent has the project objectives' achievement rate been realized? RQ2. Is there a significant level of team cohesion observed in project management? RQ3. Is transformational leadership adopted as the predominant leadership style during project management? RQ4. Can team cohesion be identified as a determining factor influencing project objectives achievement rate? RQ5. Is there a discernible correlation between leadership style and team cohesion in the project setting? RQ6. Can the leadership style be recognized as a factor potentially affecting the project objectives' achievement rate?	H1: The presence of transformational leadership in project management positively contributes to team cohesion H2: Team cohesion plays a pivotal and statistically significant role in realizing project objectives. H3: The application of a transformational leadership style contributes positively to the achievement of project objectives.

Source: own compilation.

4. Findings

Research Model

The figure 1 visually delineates the investigation's findings on the interplay among Transformational Leadership, Team Cohesion, and Attaining Project Objectives. In our research, we used factor analysis because encompasses diverse multivariate statistical methods with the primary objective of elucidating the underlying structure inherent in a given data matrix (Alpar, 2011). To assess the suitability of the dataset, two distinct methods are employed: the Bartlett test (Bartlett, 1937) and the Kaiser-Meyer-Olkin (KMO) test (Kaiser, 1970). The Bartlett sphericity test provides insights into the presence of a satisfactory level of correlation among variables. If the p-value derived from the Bartlett test is below the 0.05 significance threshold, it signifies a notable relationship among variables, indicating suitability for conducting factor analysis. The KMO value, ranging from 0 to 1, evaluates the sampling adequacy and the appropriateness of inter-variable correlations for factor analysis. A KMO value equal to or exceeding 0.50 is considered acceptable, indicating sufficient sampling adequacy (Durmuş, Yurtkoru, Çinko, 2013; Kalaycı, 2014).

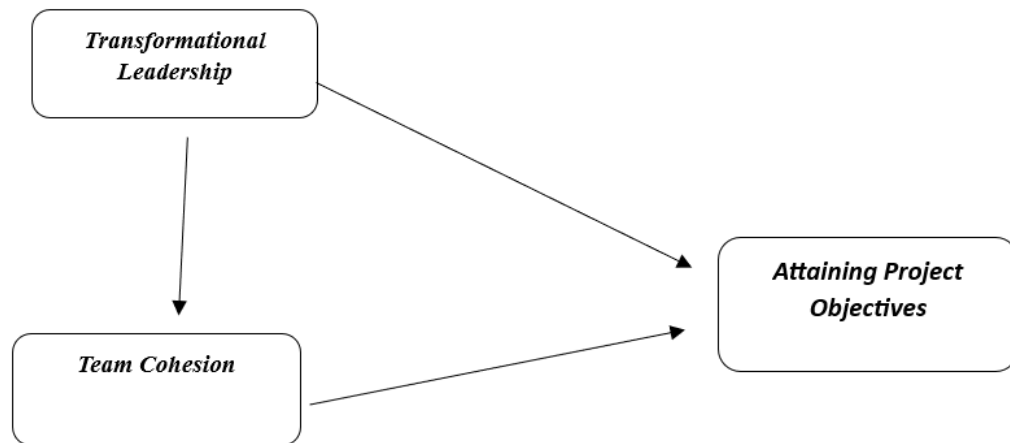


Figure 1. Research Model.

Source: Own prepared.

The gathered data were analysed in two ways: exploratory factor analysis using the principal component analysis method and descriptive statistics using the frequency and correlation analyses (see figure 2 below).

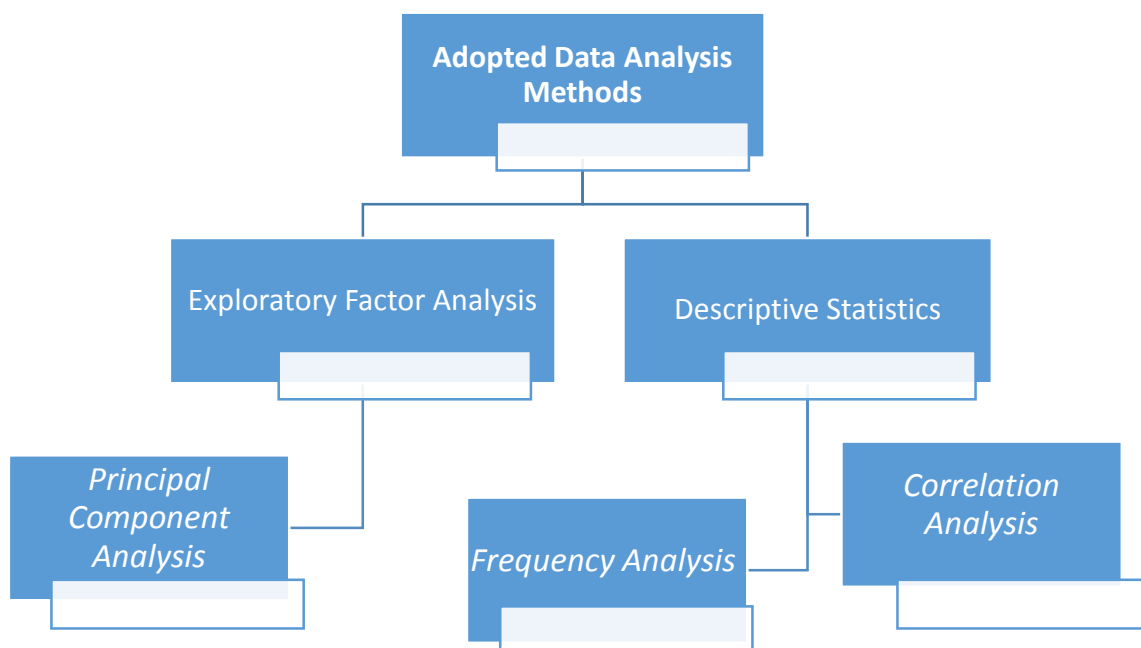


Figure 2. Adopted methods for analysing data obtained from surveys.

Source: own prepared.

5. Results

Exploratory Factor Analyses

In this part, factor analysis will be employed to delineate the underlying structure of the study's data matrix.

Transformational Leadership

The eligibility of the data for factor analysis was assessed through the Kaiser-Meyer-Olkin coefficient and the Bartlett Sphericity test, revealing a KMO value of 0.744 and significant results for the Bartlett Sphericity test ($\chi^2 = 127.480$, $p < 0.001$). Given these outcomes, it was deemed appropriate to proceed with factor analysis for the data about Transformational Leadership construction. To this end, Principal Component Analysis (Pearson, 1901) served as the estimation method, complemented by the Varimax Rotation Method (Kaiser, 1958).

Table 2.

Results of the Exploratory Factor Analysis Related to Transformational Leadership

Corresponding Items	Transformational Leadership
Encouraged employees to come up with their ideas	0.851
Encouraged you to look for better ways of doing things and to come up with your ideas	0.783
He/She was a source of new ideas, thought-provoking; you could learn a lot from him/her	0.747
Encouraged group discussions and implemented solutions adopted by the group	0.741
He/She was a good representative of the interests of the team he was leading towards higher superiors	0.678
Able to defuse tensions and misunderstandings within the team	0.585
Ensured that employees were informed about the goals of the team and their role in the organization	0.504
Total Variance Explained	49.99%

Source: own prepared.

A total of 7 expressions related to the one-dimensional construction in the study were subjected to factor analysis. The analysis revealed the existence of one dimension with an eigenvalue exceeding 1. This dimension accounts for a total variance of 49.99%.

Team Cohesion

The eligibility of the data for factor analysis was assessed through the Kaiser-Meyer-Olkin coefficient and the Bartlett Sphericity test, revealing a KMO value of 0.718 and significant results for the Bartlett Sphericity test ($\chi^2 = 86.533$, $p < 0.001$). Given these outcomes, it was deemed appropriate to proceed with factor analysis for the data about Team Cohesion construction. To this end, Principal Component Analysis (Pearson, 1901) served as the estimation method, complemented by the Varimax Rotation Method (Kaiser, 1958).

Table 3.*Results of the Exploratory Factor Analysis Related to Team Cohesion*

Corresponding Items	Team Cohesion
Most people identified with the group	0.900
There was cooperation and synergy in the work	0.821
Team members willingly and emotionally expressed personal opinions and views	0.782
People expressed similar views on how to achieve the objective	0.769
Total Variance Explained	67.17%

Source: Own prepared.

A total of 4 expressions related to the one-dimensional construction in the study were subjected to factor analysis. The analysis revealed the existence of one dimension with an eigenvalue exceeding 1. This dimension accounts for a total variance of 67.17%.

Table 4.*Reliability of Research Instruments*

Instruments	Cronbach's Alpha Value
Transformational Leadership	0.821
Team Cohesion	0.825

Source: Own prepared.

Upon scrutiny of the Cronbach Alpha values provided above for the instruments utilized in this study, it becomes apparent that each dimension demonstrates reliability in terms of internal consistency. In addition, Attaining Project Objectives has been evaluated regarding independent expression 'In your opinion, to what extent has the project's objective been achieved?'. Therefore, it was excluded from the factor and reliability analyses.

In this part, the main research questions and hypotheses are evaluated in the order presented in Table 1. In the following, the project objectives' achievement is evaluated, and results are presented in Table 5.

Table 5.*Evaluation of project objectives achievement*

Corresponding Item	Mean	Median	Skewness	Kurtosis	Std Dev.
Project Objectives' Achievement	4.40	5.00	-0.79	-0.67	0.72

Source: own prepared.

According to mean and median values (frequency analysis), public organizations' *Project Objectives Achievement* is very high. In other words, public organizations execute a significant portion of the project goals effectively. This finding lets us positively answer research question 1 (*RQ1. To what extent has the project objectives' achievement rate been realized?*) that the project objectives' achievement rate is high in public organizations. In the following, team cohesion is evaluated, and results are presented in Table 6.

Table 6.*Evaluation of the team cohesion*

Corresponding Item	Mean	Median	Skewness	Kurtosis	Std Dev.
<i>Team Cohesion</i>	-0.97	-1.00	1.60	2.97	0.66

Source: own prepared.

The findings show that public organizations' team cohesion is insignificant during project implementation, and there is room for improvement. In this regard, research question 2 (*RQ2. Is there a significant level of team cohesion observed in project management?*) was negatively evaluated. Leadership style is evaluated in the following, and results are presented in Table 7.

Table 7.*Evaluation of the leadership style*

Corresponding Item	Mean	Median	Skewness	Kurtosis	Std Dev.
<i>Transformational Leadership</i>	-1.28	-1.42	1.12	0.61	0.57

Source: own prepared.

The result exhibits that transformational leadership is not the predominant leadership style in public organizations. In this regard, research question 3 (*RQ3. Is transformational leadership adopted as the predominant leadership style during project management?*) was negatively evaluated. In the following, correlation analysis is presented to evaluate the relationship between research variables in Table 5. Tabachnick and Fidell (2013) and George (2011) indicate that If Skewness and Kurtosis's results are between +1.5 and -1.5, it can be concluded that data has normally been distributed. In the study, only the *Team Cohesion* variable is unsuitable for this criterion. In addition, when a small sample size is considered, it is seen that non-parametric tests can be appropriate for the study. Therefore, Spearman correlations have been applied.

Table 8.*Correlation analysis regarding research variables*

Variables	Mean	Median	SD	1.	2.	3.
<i>1. Project Objectives' Achievement</i>	4.40	5.00	0.72			
<i>2. Team Cohesion</i>	-0.97	-1.00	0.66	-0.148		
<i>3. Transformational Leadership</i>	-1.28	-1.42	0.57	-0.142	0.428**	

Note: Spearman's correlation applied, ** $p < 0.01$, $n = 50$.

Source: own prepared.

The findings show that a significant and positive relationship exists between team cohesion and transformational leadership ($r = 0.428$, $p > 0.01$). In addition, no significant relationship exists between other variables. According to correlation analysis results, research question 4 (*RQ4. Can team cohesion be identified as a determining factor influencing project objectives achievement rate?*) has negatively evaluated that team cohesion is not a determining factor influencing project objectives achievement rate. On the other hand, research question 5 (*RQ5. Is there a discernible correlation between leadership style and team cohesion in the*

project setting?) has been positively evaluated that there is a discernible correlation between transformational leadership style and team cohesion in the project setting ($r = 0.428$, $p > 0.01$). Lastly, research question 6 (*RQ6. Can the leadership style be recognized as a factor potentially affecting the project objectives' achievement rate?*) has been negatively evaluated, and there is no significant relationship between leadership style and the project objectives' achievement rate.

As a result, only Hypothesis 1 (*H1: The presence of transformational leadership in project management positively contributes to team cohesion*) has been verified that transformational leadership in project management positively impacts team cohesion. Hypothesis 2 (*H2: Team cohesion plays a pivotal and statistically significant role in realizing project objectives*) and Hypothesis 3 (*H3: The application of a transformational leadership style contributes positively to achieving project objectives*) has been rejected because there is no significant relationship between related variables.

6. Conclusion and discussion

The findings demonstrate the importance of understanding and implementing transformational leadership in order to promote team cohesion and achieve project objectives in public administration. The study used multiple correlation analysis to investigate the complex interplay between leadership styles, team cohesion, and the achievement of project objectives. It was found that team cohesion in public organizations during project implementation is currently insignificant and requires improvement. This indicates that there is a need for organizations to focus on enhancing team cohesion in order to enhance project performance. It can be achieved through fostering open communication, promoting collaboration, and creating a supportive team environment (Levasseur, 2017).

The study reveals no significant relationship between team cohesion and the achievement rate of project objectives. However, when teams have a high level of cohesion characterized by members identifying with the group, cooperating and synergizing at work, and expressing similar views on achieving objectives, they can be more likely to focus on project goals altogether (Kozlowski, Ilgen, 2006, 2018).

Furthermore, the research acknowledged that transformational leadership is not the predominant leadership style in public organizations. This suggests that there may be a gap between the leadership practices in the public sector and the optimal leadership style required for successful project management. The findings revealed that transformational leadership positively contributes to team cohesion. This suggests that when leaders exhibit transformational qualities such as encouraging employees to come up with their own ideas, being a source of new ideas and thought-provoking discussions, and representing the interests

of the team, it fosters a sense of cohesion among team members. This finding aligns with previous research indicating that transformational leadership enhances team dynamics and collaboration. (Sihite et al., 2020; Hapsari et al., 2021). Public organizations should invest in leadership development programs that promote transformational leadership qualities, such as inspiring and motivating employees, fostering empowerment, and aligning goals with the organization's mission.

Additionally, the research highlighted no significant relationship between transformational leadership and the achievement rate of project objectives. In other words, adopting a transformational leadership style neither positively nor negatively contributes to achieving project objectives. However, when leaders employ transformational leadership techniques, it creates an environment that promotes team cohesion. Public organizations should prioritize leadership approaches that value integrity, transparency, and accountability (Herasymiuk et al., 2020). Leaders should also be mindful of the public interest and foster a sense of social responsibility. The unique nature of the public sector requires a tailored approach to project management. Public organizations should consider the specific challenges and dynamics of the public administration context, such as bureaucratic structures, regulatory requirements, and stakeholder involvement. Project management methodologies and practices should be adapted to suit the public sector's needs. However, further research is needed to explore these factors in different contexts and across a larger sample size. This would enrich the understanding of effective leadership strategies and project management practices in the public sector. Participants who volunteered to participate in the study may differ systematically from those who did not participate, leading to potential self-selection bias. Research limitations encompass potential self-selection bias among participants and unaddressed external variables such as political pressures, funding constraints, and policy changes, which could impact the interplay between leadership styles, team cohesion, and project outcomes. Future studies ought to tackle these factors to attain a more holistic grasp of effective leadership within public administration. The study may not have accounted for all relevant external variables or contextual factors that could influence the relationships between leadership styles, team cohesion, and project success. Factors such as external political pressures, funding constraints, or changes in public policy could confound the results and should be considered in future research.

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DIMENSIONS OF EMPLOYEE INVOLVEMENT: DÉBUT NUANCES IN EMPOWERMENT, TEAM ORIENTATION, AND CAPABILITY DEVELOPMENT

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Purpose: This study aims to investigate the nuances of organizational culture and its influence on employee involvement within national and multinational companies. Utilizing established frameworks in organizational behavior and culture, the research explores dimensions such as empowerment, team orientation, and capability development.

Design/methodology/approach: Drawing from Cameron and Quinn's Competing Values Framework (2006) and Denison's model (1990), the study employs statistical analysis to compare mean "Involvement" scores between national and multinational companies. Subsequent analysis delves into the traits of empowerment, team orientation, and capability development. ANOVA is utilized to scrutinize variations in Team Orientation and Capability Development, considering leadership and cultural context.

Findings: Multinational companies exhibit lower mean involvement scores, particularly emphasizing team orientation with slightly higher capability development. ANOVA identifies significant differences in Team Orientation, highlighting leadership's role. Borderline significance in Capability Development warrants further exploration.

Research limitations/implications: The study's scope is limited to national and multinational companies, potentially overlooking nuances in smaller organizations or across diverse industries. Longitudinal studies could provide deeper insights into the evolving nature of organizational culture and involvement.

Practical implications: Tailored interventions are recommended for multinational companies, emphasizing team collaboration and capability development. National companies are advised to address variability in empowerment perceptions for a more consistent organizational culture.

Social implications: Fostering a culture of involvement not only enhances organizational effectiveness but also contributes to employee well-being and satisfaction, ultimately benefiting society by promoting healthier work environments.

Originality/value: This study contributes to the understanding of how organizational culture influences employee involvement across different types of companies, offering insights for

practitioners to foster more engaged and effective workplaces. Additionally, it underscores the importance of considering cultural context and leadership in shaping organizational dynamics.

Keywords: Employee Involvement, Organizational Culture, Organizational Effectiveness, Empowerment, Multinational Companies, Team Orientation, Organizational Behavior.

1. Introduction

Involvement in organizations is a multifaceted concept that lies at the heart of understanding and fostering a dynamic and effective workplace environment. It encompasses the degree to which individuals within an organization actively engage, contribute, and invest their time, energy, and skills in the pursuit of common organizational goals (Katz, Kahn, 1978). The concept of involvement extends beyond mere participation; it involves a deep sense of commitment, dedication, and connection to the organizational mission and values (Mowday, Porter, Steers, 1982). Recognized as a crucial dimension of organizational culture, involvement influences employee motivation, satisfaction, and overall performance (Cameron, Quinn, 2006). In this context, exploring the various facets of involvement, including its sub-dimensions such as empowerment, team orientation, and capability development, becomes essential for comprehending the intricate dynamics that shape organizational success and employee well-being (Denison, 1990). This introduction sets the stage for a comprehensive examination of involvement in organizations, shedding light on its significance, measurement, and impact on both individual and organizational outcomes.

Fostering a Culture of Involvement

Creating a workplace culture centered around involvement demands a strategic and comprehensive approach engaging employees across various dimensions. In this in-depth exploration, it delves into specific strategies and practices to enhance organizational culture through increased involvement, fostering a sense of ownership, commitment, and shared purpose (Vajpayee, Chakraborty, 2017).

Open Communication Channels: Promoting Transparency and Dialogue

Open and transparent communication serves as the foundation for a engaged organizational culture (Katz, Kahn, 1978; Denison, 1990). Creating accessible channels for dialogue fosters an environment where employees feel comfortable sharing their thoughts, concerns, and ideas without hesitation. Whether through regular town hall meetings, digital platforms, or forums, these avenues facilitate two-way communication. Leaders play a crucial role by actively listening to employees, showcasing a dedication to accessibility and transparency. Research indicates that in smaller companies with flattened structures, the promotion of employee

involvement and a positive culture is facilitated through open communication (Vajpayee, Karthick, 2019).

Empowerment: Granting Autonomy and Decision-Making Authority

Empowering employees involves granting them the autonomy to make decisions and contribute to the organization's success (Mowday, Porter, Steers, 1982). Providing clear guidelines and support mechanisms fosters a culture where individuals feel empowered to take initiative. This empowerment not only enhances involvement but also instills a sense of responsibility and accountability (Chakraborty, Vajpayee, 2017).

Participatory Decision-Making: Involving Employees in Key Choices

Involving employees in decision-making processes that impact their work and the organization as a whole is crucial (Cameron, Quinn, 2006; Katz, Kahn, 1978; Vajpayee, Pallavi, Sanghani, 2022). Establishing cross-functional teams to tackle specific challenges or projects ensures a diversity of perspectives. This participatory approach not only leverages the collective intelligence of the workforce but also cultivates a collaborative environment.

Recognition and Rewards: Acknowledging Contributions

Recognizing and rewarding employees for their contributions is integral to an involved culture (Denison, 1990; Mowday et al., 1982). Formal recognition programs, whether through awards, praise, or other incentives, celebrate individual and team achievements. This not only boosts morale but also reinforces the idea that every contribution matters.

Training and Development: Investing in Employee Growth

Investing in employee training and development programs is a proactive way to enhance involvement. These programs not only enhance skills and competencies but also signal a commitment to employee growth (Katz, Kahn, 1978). Opportunities for continuous learning and career advancement contribute to a culture where individuals feel invested in and valued (Chakraborty et al., 2017).

Team Building: Fostering Collaboration and Interpersonal Relationships

Team building is essential for cultivating a collaborative environment. Through activities and initiatives that foster teamwork, employees develop stronger interpersonal relationships (Vajpayee, Chakraborty, 2017; Cameron, Quinn, 2006). This not only enhances the overall workplace atmosphere but also contributes to a culture where individuals feel connected to their colleagues and the organization's mission.

Leadership Involvement: Setting the Tone from the Top

Leaders play a crucial role in influencing the culture of engagement. By actively engaging with employees, being visible, and maintaining accessibility, leaders establish an environment where their approachability and commitment to involvement are evident (Mowday et al., 1982). The involvement of leadership sets the overall tone for the entire organization. In a recent study by Vajpayee and Sanghani (2022), it was observed that incorporating mindfulness philosophy in organizations not only fosters a positive work environment but also contributes to the overall mental well-being of employees.

Shared Values and Mission: Reinforcing Organizational Identity

It is crucial to communicate and reinforce an organization's core values and mission (Denison, 1990). When employees comprehend and align themselves with these fundamental aspects, a collective sense of purpose emerges. This alignment fosters a cohesive organizational culture where everyone collaborates toward shared objectives. Research indicates that aligning societal culture with organizational culture leads to increased job satisfaction and involvement (Vajpayee, Chakraborty, 2017). Similarly, the presence of shared values and mission contributes to a positive transformation in organizational culture (Vajpayee, Sanghani, 2023).

Flexibility and Adaptability: Embracing Change

A culture of involvement should be adaptable and open to change. Encouraging employees to embrace innovation and contribute ideas for process improvement fosters a culture of continuous adaptation (Cameron, Quinn, 2006). This flexibility ensures that the organization can navigate challenges and capitalize on opportunities in a rapidly changing business landscape (Vajpayee, Sanghani, 2023).

Employee Well-being: Prioritizing Health and Balance

Prioritizing employee well-being through wellness programs and support services is essential for an involved culture. When organizations demonstrate a genuine concern for the overall health and well-being of their employees, it contributes to a positive and caring culture.

Continuous Improvement: Cultivating a Learning Organization

Establishing a culture of continuous improvement encourages employees to identify areas for enhancement (Cameron, Quinn, 2006). This proactive approach involves employees in the ongoing process of organizational development, contributing to a culture that values growth and progress.

Measurement and Feedback: Assessing Involvement Initiatives

Implementing mechanisms to measure and assess employee satisfaction, engagement, and the effectiveness of involvement initiatives is crucial (Denison, 1990; Katz, Kahn, 1978). Regular feedback loops allow organizations to refine and improve their involvement strategies over time, ensuring they stay relevant and impactful.

In conclusion, fostering involvement in organizational culture requires a deliberate and sustained effort across various dimensions. By embracing these strategies, organizations can create a workplace where employees feel valued, motivated, and connected to a shared vision. This not only enhances individual well-being but also contributes to a resilient and positive organizational culture that propels the entire workforce toward success.

2. Review of Literature

2.1. Organizational Culture: An Overview

Organizational culture encompasses the shared values, beliefs, and practices that define the identity of a company. Schein (1985) argued that culture is a deeply embedded phenomenon influencing the way individuals perceive, think, and behave within an organization. Numerous studies (Deal, Kennedy, 1982; Hofstede, 1980; Ouchi, 1981) have highlighted the role of culture in shaping organizational processes, decision-making, and overall effectiveness.

2.2. Employee Involvement: Defining the Landscape

Employee involvement refers to the active participation of employees in decision-making processes and the overall functioning of the organization. Studies such as those by Lawler (1986) and Cotton et al. (1988) have emphasized the positive correlation between employee involvement and job satisfaction, organizational commitment, and performance. Additionally, the work of Hackman & Oldham (1980) has contributed to understanding the relationship between job design and employee involvement.

2.3. Impact of Organizational Culture on Employee Involvement

Research suggests a strong interplay between organizational culture and employee involvement. Denison's (1990) model, focusing on organizational culture traits like involvement and adaptability, posits that a strong and positive culture enhances employee commitment and engagement. Studies by Cameron and Quinn (2006) utilizing the Competing Values Framework further corroborate the link between organizational culture and various indicators of employee involvement. Moreover, the work of Deal and Kennedy (1982) explores the impact of culture on employee motivation and performance.

2.4. Empirical Studies on Employee Involvement Initiatives

Empirical studies have explored the effectiveness of specific employee involvement initiatives. A notable example is the work of Lawler (1986), who examined the impact of employee involvement programs on organizational performance. The study found a positive relationship between employee involvement and productivity, affirming the value of such initiatives (Vajpayee et al., 2022). Additionally, research by Goodman & Leyden (1991) provides insights into the outcomes of participative management practices on employee job satisfaction.

2.5. The Role of Leadership in Fostering Involvement

Leadership has been identified as a critical factor in fostering a culture of involvement. Bass and Avolio's (1994) transformational leadership theory emphasizes the role of leaders in inspiring and motivating employees, thereby enhancing their level of involvement. This aligns with studies by Avolio et al. (2004) which highlight the importance of leadership behaviors in creating an environment conducive to employee engagement. Further, the work of House et al. (1996) explores the impact of leadership styles on organizational culture and employee involvement (Vajpayee, Sanghani, 2022).

2.6. Cultural Dimensions and Employee Participation

Hofstede's (1980) cultural dimensions theory has been instrumental in understanding how cultural factors influence employee participation. Studies applying Hofstede's framework (Hofstede, 2001; Bond et al., 1985) have identified cultural dimensions such as power distance and individualism-collectivism as significant determinants of employee involvement practices across different cultures. Additionally, the work of Ronen & Shenkar (1985) delves into the role of cultural differences in shaping management practices and employee involvement strategies (Vajpayee, Sanghani, 2023).

2.7. Challenges and Barriers to Employee Involvement

Despite the numerous benefits associated with employee involvement, studies (Cotton et al., 1988; Lawler, 1992; Wilkinson, 1998) have also identified challenges and barriers. Factors such as resistance to change, lack of communication, and inadequate leadership support can impede the successful implementation of employee involvement initiatives. Additionally, research by Beer et al. (1990) provides insights into the challenges of sustaining employee involvement over time.

2.8. The Impact on Organizational Performance

Research investigating the broader impact of organizational culture and employee involvement on organizational performance is abundant. Studies by Denison (1990) and O'Reilly and Chatman (1996) have found positive correlations between a strong organizational culture, high employee involvement, and improved organizational performance. Furthermore, the work of Kotter & Heskett (1992) explores the long-term impact of corporate culture on organizational success.

2.9. Homogeneous Organizational Culture:

Homogeneous organizational culture, often regarded as a critical dimension in organizational studies, adds depth to the understanding of the interplay between culture and employee involvement. Scholars like Hofstede (1980) and Deal & Kennedy (1982) acknowledge the significance of a shared culture within an organization, emphasizing its role in shaping employee behavior and attitudes. The idea of a homogeneous culture suggests a collective mindset, where employees share common values, beliefs, and practices, fostering a sense of unity and cohesion (Vajpayee et al., 2018a).

The literature on homogeneous organizational culture underscores its potential impact on employee involvement initiatives (Vajpayee, 2018b). A consistent and shared culture can serve as a catalyst for cohesive decision-making and active employee participation. Moreover, studies by Cameron and Quinn (2006) propose that a homogeneous culture, characterized by a strong emphasis on particular cultural traits, can create a stable environment conducive to sustained employee engagement (Vajpayee, Chakraborty, 2017).

Despite the potential benefits, it is essential to recognize the delicate balance required in fostering a homogeneous culture. While it can enhance alignment and collaboration, an overly homogeneous culture may stifle diversity and creativity. Therefore, understanding the nuanced dynamics of homogeneous organizational culture within the broader context of organizational studies contributes to a more comprehensive exploration of its implications on employee involvement and, subsequently, organizational effectiveness.

The literature reviewed here illustrates a complex and interconnected relationship between organizational culture, employee involvement, and organizational outcomes. While many studies highlight the positive impacts of fostering a culture of involvement, challenges and barriers must also be considered. As organizations strive to enhance their cultures, understanding the nuanced dynamics between culture and involvement is crucial for achieving sustained success. Future research should continue to explore emerging trends and their implications for organizational practices.

Need of Research

The need for research in any field, including organizational behavior and management, is paramount to advancing knowledge, addressing emerging challenges, and improving practices. Research provides a systematic and evidence-based approach to understanding complex phenomena, identifying trends, and developing insights that can inform decision-making. In the context of organizational behavior, ongoing research is essential to uncover the intricacies of workplace dynamics, the impact of evolving technologies, and the effectiveness of various management strategies. Furthermore, research helps organizations stay responsive to changing market conditions, societal trends, and employee expectations. By continuously engaging in research endeavors, scholars and practitioners contribute to the refinement of theories, the development of best practices, and the enhancement of organizational effectiveness, ultimately fostering innovation and sustainable growth.

Methods of the Research

Objective of the Research

1. Present the key findings of the research in a clear and concise manner, ensuring accessibility for diverse audiences.
2. Highlight and analyze any observed patterns or trends within the dataset, providing insights into the underlying dynamics.
3. Assess the statistical significance of the results, clearly articulating the significance levels and their implications for the research hypotheses.
4. Contextualize the results by relating them to existing literature and theoretical frameworks, demonstrating their contribution to the field.
5. Align the presentation with the original research objectives, showcasing how each objective has been addressed and what insights have been gained.
6. Conduct a comparative analysis where applicable, exploring variations, similarities, or differences observed in the results.
7. Discuss the practical implications of the findings, addressing how they can inform decision-making, policy development, or practical applications within the studied context.

Sampling Techniques

This study delves into the intricate dynamics of organizational cultures, specifically emphasizing the dimensions of Empowerment, Team Orientation, and Capability Development. The research employs a comprehensive sampling approach, including two multinational and two national companies. Key components such as creative change, customer focus, core values, agreement, coordination, and integration are analyzed within the context of these organizational dimensions. The study underscores the interplay and interconnectedness

of Empowerment, Team Orientation, and Capability Development, providing actionable insights for leaders aiming to foster resilient and effective organizational cultures. The survey research methods utilized contribute to a robust understanding of how these dimensions shape the organizational culture landscape.

3. Results

The Involvement factor was taken in terms of three components that is, empowerment, team orientation and capability development. Each of these was analyzed and compared between the two types of companies (multinational and national).

Table 1.

Mean "Involvement" scores of organizational cultures of the national and multinational companies and the t-value

Company	Mean	SD	t-value
Multinational (N = 70)	4.06	0.40	't' = -2.24 (p < .05)
National (N = 70)	3.89	0.48	

Table 1 presents the mean "Involvement" scores of organizational cultures for both multinational and national companies, along with the corresponding standard deviations (SD) and t-values. The sample size for both multinational and national companies is 70.

Interpretation

The mean "Involvement" score for multinational companies is 4.06, with a standard deviation of 0.40. The t-value is -2.24, and the associated p-value is less than 0.05, indicating that the difference in the mean involvement scores between multinational and national companies is statistically significant.

On the other hand, the mean "Involvement" score for national companies is 3.89, with a slightly higher standard deviation of 0.48.

The negative t-value suggests that the mean involvement score for multinational companies is lower than that of national companies. Since the p-value is less than 0.05, there is evidence to reject the null hypothesis, supporting the conclusion that there is a statistically significant difference in the involvement scores between the two types of companies.

In summary, based on the provided information, it seems that multinational companies have a lower mean involvement score in organizational culture compared to national companies, and this difference is statistically significant at the 0.05 significance level.

Table 2.

Mean of underlying traits of Involvement scores empowerment (E), team orientation (TO), and capability development (CPI) of national and multinational company

COMP		E	TO	CPI
National	Mean	3.81	3.86	3.59
	SD	1.57	.47	.49
Multinational	Mean	3.81	4.05	3.83
	SD	.43	.54	1.03

Interpretation

1. **Empowerment (E):** The mean empowerment scores are the same for both national and multinational companies (3.81). The standard deviation for national companies is higher (1.57) compared to multinational companies (0.43).
2. **Team Orientation (TO):** Multinational companies have a higher mean team orientation score (4.05) compared to national companies (3.86). The standard deviation for team orientation is higher for multinational companies (0.54) compared to national companies (0.47).
3. **Capability Development (CPI):** Multinational companies have a slightly higher mean capability development score (3.83) compared to national companies (3.59). The standard deviation for capability development is higher for multinational companies (1.03) compared to national companies (0.49).

Table 3.

ANOVA Table for sub-dimension of involvement

		Sum of Squares	Df	Mean Square	F	Sig.
ME	Between Groups	2.857E-04	1	2.857E-04	.000	.988
	Within Groups	183.605	138	1.330		
	Total	183.605	139			
MTO	Between Groups	1.245	1	1.245	4.828	.030
	Within Groups	35.571	138	.258		
	Total	36.816	139			
MCPI	Between Groups	2.064	1	2.064	3.196	.076
	Within Groups	89.141	138	.646		
	Total	91.205	139			

From the above table following conclusions emerge

In summary, the comparison between national and multinational companies in terms of the underlying traits (empowerment, team orientation, and capability development) indicates some differences. While empowerment scores are the same, multinational companies tend to have higher mean scores in team orientation, and capability development, though the variability (standard deviation) in these scores is also higher for multinational companies.

The provided table appears to be an Analysis of Variance (ANOVA) table for sub-dimensions of involvement, specifically for three factors: ME (possibly referring to Empowerment), MTO (possibly referring to Team Orientation), and MCPI (possibly referring to Capability Development). Let's interpret the table:

The F-statistic is 3.196, and the p-value is 0.076. While the p-value is higher than the typical significance level of 0.05, it is close, suggesting a marginal or borderline significance for the Capability Development sub-dimension.

In summary, the ANOVA results indicate that there is a significant difference between groups for the Team Orientation sub-dimension, but no significant differences for the Empowerment sub-dimension. The Capability Development sub-dimension shows a borderline significance.

4. Discussion

The conducted research sheds light on crucial aspects of organizational culture and involvement within both national and multinational companies, building upon a foundation of existing scholarly work in the field (Cameron, Quinn, 2006; Denison, 1990). The findings offer valuable insights that contribute to our understanding of how these entities operate and foster employee engagement, aligning with prior studies on organizational culture and employee involvement (Mowday et al., 1982; Lawler, 1986) and can help organizations in framing intervention programs for the better mental health of the employees (Vajpayee, 2023).

Differential Involvement Scores

The stark difference in mean "Involvement" scores between national and multinational companies is a notable finding, echoing the sentiments of scholars such as Schein (1985) on the deep impact of organizational culture. Multinational companies exhibit a statistically significant lower mean involvement score, suggesting a divergence in organizational cultures, a concept consistent with the work of Deal and Kennedy (1982) on organizational cultures in different contexts.

Underlying Traits of Involvement

Examining the underlying traits of involvement, namely empowerment, team orientation, and capability development, reveals nuanced dynamics. While both national and multinational companies share similar mean scores in empowerment, multinational companies show a stronger emphasis on team orientation and slightly higher capability development scores. This nuanced perspective aligns with the Competing Values Framework proposed by Cameron and Quinn (2006), emphasizing the multifaceted nature of organizational effectiveness.

ANOVA Results for Sub-dimensions

The ANOVA results further elucidate the research landscape, highlighting significant differences in Team Orientation (MTO) between the two types of companies. This resonates with the insights from Bass and Avolio (1994), emphasizing the role of leadership in shaping organizational culture and fostering team collaboration. The borderline significance in Capability Development (MCPI) invites further exploration, pointing to potential areas of convergence or divergence that may impact employee development initiatives, a perspective supported by O'Reilly and Chatman (1996) on organizational effectiveness.

Practical Implications

For organizational leaders and practitioners, these findings hold practical significance, aligning with recommendations from studies on organizational effectiveness and employee engagement (Denison, 1990; Lawler, 1992). Multinational companies may benefit from tailored interventions to boost overall involvement, particularly in fostering team collaboration and capability development. National companies, on the other hand, should address the variability in empowerment perceptions, aiming for a more consistent organizational culture, as suggested by the works of Katz and Kahn (1978).

Future Research Directions

The research opens avenues for future investigations, drawing inspiration from the work of Cameron and Quinn (2006) on diagnosing and changing organizational culture. Understanding the factors influencing involvement disparities and delving into the drivers of variability in sub-dimensions offer promising areas for exploration. Longitudinal studies could provide a dynamic perspective, capturing the evolution of organizational culture and involvement over time, building upon the call for further research by scholars like Lawler (1986) and Verma, Vajpayee and Sanghani (2024).

Limitations

Acknowledging the limitations of the study is crucial, consistent with the emphasis on transparency and reflexivity in research (Denison, 1990). The sample size and potential biases may have impacted the generalizability of the findings. Future research endeavours should aim to overcome these limitations for a more comprehensive understanding of organizational dynamics, as suggested by recommendations from various scholars in the field.

Conclusion

In conclusion, this research contributes valuable insights into the intricacies of organizational culture and involvement, emphasizing the need for a nuanced approach in different organizational contexts (Vajpayee, 2017). The observed differences between national

and multinational companies, coupled with variations in sub-dimensions, offer a foundation for organizational leaders to enhance their strategies and foster a more engaged and cohesive workforce (Varma, Vajpayee, Sanghani, 2024). The journey towards a deeper understanding of organizational dynamics and its impact on involvement is ongoing, and future research endeavours will undoubtedly unveil more layers of complexity in this ever-evolving landscape, in line with the spirit of continuous improvement advocated by Cameron and Quinn (2006) and Patwari and Vajpayee, (2023).

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GLOBAL SUPPLY CHAIN COORDINATION – THE BUSINESS ANALYTICS USAGE IN INDUSTRY 4.0 CONDITIONS

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Purpose: The purpose of this publication is to present the applications of usage of business analytics in global supply chain coordination.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The integration of business analytics in global supply chain coordination within the framework of Industry 4.0 is a transformative strategy that propels organizations toward enhanced efficiency, adaptability, and competitiveness. This approach is particularly crucial as industries undergo significant technological transformations. Business analytics strategically deployed in the modern supply chain serves as a vital tool, addressing the complexities inherent in Industry 4.0. The diverse applications of business analytics, including demand forecasting, supply chain visibility, predictive maintenance, collaboration, and risk management, highlight its multifaceted benefits. These applications empower organizations to anticipate market demands, optimize inventory, ensure reliable production flows, foster collaboration, and proactively address risks, thereby bolstering overall supply chain resilience and responsiveness. The use of sophisticated software tools like SAP Integrated Business Planning, Oracle SCM Cloud, and IBM Watson Supply Chain underscores the pivotal role of technology in overcoming the intricate challenges of managing global supply chain processes. Despite the numerous advantages, challenges such as data quality, integration issues, implementation costs, and skill shortages necessitate careful consideration and strategic planning. Organizations must address these challenges, along with security and privacy concerns, resistance to change, and the complexity of analytics tools, through investments in training and change management strategies to fully unlock the potential of business analytics. The presented tables further illustrate the advantages and challenges, emphasizing the positive impact of business analytics on efficiency, risk management, and strategic alignment with organizational goals. In conclusion, the judicious use of business analytics offers substantial opportunities for optimizing global supply chain coordination in Industry 4.0, requiring organizations to navigate both advantages and challenges proactively to position themselves at the forefront of innovation and competitiveness in the dynamic landscape of modern industry.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of business analytics in the case of global supply chain coordination.

Keywords: business analytics, Industry 4.0, digitalization, artificial intelligence, real-time monitoring; supply chain.

Category of the paper: literature review.

1. Introduction

In the ever-evolving landscape of Industry 4.0, the integration of business analytics has emerged as a cornerstone for global supply chain coordination, ushering in a new era of efficiency, adaptability, and competitiveness. As industries undergo profound transformations driven by technological advancements, the strategic deployment of business analytics has become instrumental in navigating the complexities of the modern supply chain.

In the context of Industry 4.0, characterized by the convergence of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and automation, businesses are presented with unprecedented opportunities to enhance their supply chain operations. Business analytics, leveraging the vast amounts of data generated throughout the supply chain, plays a pivotal role in extracting actionable insights to optimize decision-making processes (Ghibakholl et al., 2022).

The purpose of this publication is to present the applications of usage of business analytics in global supply chain coordination.

2. The selected aspects of business analytics usage in global supply chain coordination

One of the key aspects of business analytics in global supply chain coordination is demand forecasting. The amalgamation of historical data, market trends, and predictive analytics enables organizations to anticipate consumer demands with a higher degree of accuracy. This proactive approach facilitates more efficient inventory management, reducing the risk of stockouts or excess inventory, and ultimately contributing to cost savings (Zeng et al., 2022; Pech, Vrchota, 2022).

Moreover, analytics-driven supply chain visibility is paramount in Industry 4.0. Real-time monitoring and analysis of various supply chain components provide stakeholders with a comprehensive understanding of the entire process, from raw material sourcing to end-product delivery. This heightened visibility enables swift identification and resolution of potential disruptions, thereby enhancing the overall resilience of the supply chain (Bakir, Dahlan, 2022).

Furthermore, predictive analytics in maintenance management has become indispensable for Industry 4.0 supply chains. By leveraging machine learning algorithms and IoT data, organizations can forecast equipment failures and schedule preventive maintenance, minimizing downtime and optimizing operational efficiency. This predictive maintenance approach not only extends the lifespan of machinery but also ensures a continuous and reliable production flow (Cillo et al., 2022).

In the realm of global supply chain coordination, business analytics fosters collaboration among diverse stakeholders (Scappini, 2016). Data-driven insights facilitate better

communication and coordination between suppliers, manufacturers, distributors, and retailers. This collaborative approach not only streamlines the flow of goods but also enables the rapid adaptation to market changes, reducing lead times and enhancing overall supply chain responsiveness.

The implementation of business analytics in Industry 4.0 also revolutionizes risk management strategies. By analyzing historical data and market trends, organizations can identify potential risks and develop mitigation strategies. Whether it be geopolitical uncertainties, natural disasters, or disruptions in the transportation network, analytics empowers businesses to proactively address challenges and ensure the continuity of supply chain operations (Gajdzik, Wolniak, 2022; Gajdzik et al., 2023).

The incorporation of business analytics in global supply chain coordination within the framework of Industry 4.0 represents a paradigm shift in how businesses approach and manage their operations (Jonek-Kowalska, Wolniak, 2021). The ability to harness the power of data for informed decision-making not only optimizes efficiency and reduces costs but also positions organizations at the forefront of innovation and competitiveness in the dynamic landscape of modern industry. As Industry 4.0 continues to unfold, business analytics will undoubtedly remain a cornerstone for driving the success of global supply chain coordination (Akundi et al., 2022).

Table 1 contains descriptions of how business analytics is used in the case of global supply chain coordination.

Table 1.

The usage of business analytics in global supply chain coordination

Application	Description
Demand Forecasting	Utilizing historical data and predictive analytics to estimate future demand, aiding in inventory planning and production scheduling.
Inventory Optimization	Analyzing supply and demand patterns to determine optimal inventory levels, reducing carrying costs while ensuring product availability.
Supplier Performance	Assessing and monitoring supplier performance through key performance indicators (KPIs) and analytics, ensuring reliability and quality in the supply chain.
Route Optimization	Optimizing transportation routes and logistics networks to minimize costs, reduce lead times, and enhance overall supply chain efficiency.
Risk Management	Identifying and mitigating potential risks in the supply chain, such as disruptions, geopolitical factors, and market fluctuations through data analysis.
Real-Time Visibility	Utilizing analytics to gain real-time visibility into the entire supply chain, enabling quick response to disruptions, and improving overall decision-making.
Cost Analysis	Analyzing cost structures across the supply chain to identify areas for cost reduction and efficiency improvement, contributing to overall cost-effectiveness.
Sustainability Tracking	Using analytics to monitor and report on sustainability metrics, ensuring compliance with environmental standards and meeting corporate social responsibility goals.
Order Fulfillment Analytics	Improving order fulfillment processes through analytics, reducing lead times, optimizing order processing, and enhancing customer satisfaction.
Performance Benchmarking	Comparing supply chain performance metrics against industry benchmarks to identify areas for improvement and maintain a competitive edge.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

3. Software used in global supply chain coordination in Industry 4.0 conditions

Business analytics software plays a pivotal role in enhancing the efficiency and effectiveness of global supply chain coordination. These sophisticated tools are designed to address the intricate challenges associated with managing and optimizing supply chain processes on a global scale. One such notable example is SAP Integrated Business Planning (IBP), an advanced solution that facilitates real-time collaboration and decision-making across the entire supply chain network. Business analytics software in the context of global supply chain coordination serves as a comprehensive platform for organizations to gain insights into various aspects of their supply chain operations. These tools are instrumental in demand planning and forecasting, enabling organizations to anticipate market trends and align their production and distribution strategies accordingly. Furthermore, they facilitate inventory optimization, ensuring that organizations maintain optimal stock levels to meet customer demand while minimizing carrying costs (Nourani, 2021).

Collaboration with suppliers is a critical aspect of global supply chain management, and business analytics software provides the necessary infrastructure for effective supplier collaboration. This includes features such as data sharing, communication channels, and joint planning mechanisms to synchronize activities and improve overall supply chain performance.

Scenario-based planning is another key functionality offered by business analytics software. Organizations can simulate different scenarios, considering factors like market fluctuations, geopolitical events, and disruptions, allowing them to develop robust contingency plans and enhance their resilience in the face of unforeseen challenges (Adel., 2022).

Oracle SCM Cloud is another example of business analytics software that contributes to the seamless coordination of global supply chains. This solution offers a comprehensive suite of applications embedded with analytics capabilities. It covers various aspects, including order management, procurement, transportation management, and predictive analytics, providing organizations with end-to-end visibility and control over their supply chain processes (Du et al., 2023; Fjellström, Osarenkhoe, 2023; Castro et al., 2014; Wang et al., 2023).

Table 2 highlighting examples of software and applications used in global supply chain coordination, along with descriptions of their usage.

Table 2.

The usage of business analytics software in global supply chain coordination

Software/Application	Description	Key Features
SAP Integrated Business Planning (IBP)	Advanced planning and analytics tool for optimizing global supply chain processes. Enables real-time collaboration and decision-making.	<ul style="list-style-type: none"> - Demand planning and forecasting - Inventory optimization - Supplier collaboration - Scenario-based planning

Cont. table 2.

Oracle SCM Cloud	Comprehensive suite of supply chain management applications with embedded analytics. Streamlines supply chain operations.	<ul style="list-style-type: none"> - Order management - Procurement - Transportation management - Predictive analytics
IBM Watson Supply Chain	Uses AI and ML to enhance supply chain visibility and predict disruptions. Enables data-driven decision-making.	<ul style="list-style-type: none"> - Supply chain visibility - Predictive analytics
Microsoft Dynamics 365 Supply Chain Management	Integrated supply chain management solution within the Dynamics 365 suite. Enhances visibility and collaboration.	<ul style="list-style-type: none"> - Inventory management - Order fulfillment\ - Warehouse management - Analytics
JDA Software (now Blue Yonder)	Provides end-to-end supply chain solutions, including planning, execution, and optimization.	<ul style="list-style-type: none"> - Demand and supply planning - Inventory optimization - Order fulfillment
Kinaxis RapidResponse	Cloud-based solution for concurrent planning in supply chain management. Enables real-time decision-making.	<ul style="list-style-type: none"> - Rapid scenario analysis - Demand and supply planning - Supply chain visibility
Manhattan Associates SCM	Offers supply chain solutions, including warehouse management and transportation optimization.	<ul style="list-style-type: none"> - Warehouse management\ - Order fulfillment - Transportation optimization
Tableau	Data visualization and business intelligence software. Used for analyzing and presenting supply chain data.	<ul style="list-style-type: none"> - Visual analytics - Dashboard creation - Data connectivity
Qlik Sense	Business intelligence and data visualization platform. Provides insights into supply chain performance.	<ul style="list-style-type: none"> - Associative data modeling - Data visualization - Dashboard development
Anaplan	Cloud-based planning platform that includes supply chain planning capabilities.	<ul style="list-style-type: none"> - Integrated business planning - Scenario modeling - Performance analytics

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

4. Advantages and problems of business analytics usage in global supply chain coordination

Business analytics plays a pivotal role in enhancing global supply chain coordination, offering a multitude of advantages that contribute to efficiency, resilience, and improved decision-making. One key benefit lies in improved forecasting capabilities. By analyzing historical data, market trends, and external factors, organizations gain a more accurate understanding of demand, facilitating precise inventory planning. Furthermore, the real-time insights provided by business analytics empower stakeholders to make informed decisions promptly. This heightened decision-making ability is crucial for adapting to dynamic market

conditions and ensuring seamless coordination throughout the supply chain. The result is a more agile and responsive operational framework.

Cost reduction and increased efficiency are inherent advantages of leveraging business analytics in supply chain management. By scrutinizing supply chain data, organizations can identify inefficiencies, optimize resource allocation, and ultimately reduce operational costs. This optimization process leads to a more streamlined and cost-effective supply chain (Charles et al., 2023).

Effective risk management and mitigation are also facilitated by business analytics. The ability to identify and assess potential risks allows organizations to implement proactive measures, ensuring the resilience of the supply chain against disruptions. This strategic approach minimizes the impact of unforeseen events and enhances overall risk management strategies. Supplier performance evaluation is another area where business analytics proves invaluable. Organizations can utilize analytics to assess supplier performance based on various metrics, fostering better relationships and ensuring a reliable and high-quality supply network (Nourani, 2021).

Inventory optimization is a critical aspect addressed by business analytics. Insights into demand patterns, lead times, and order quantities enable organizations to maintain optimal inventory levels, preventing both overstocking and stockouts. This, in turn, improves cash flow and operational efficiency.

Real-time visibility is a cornerstone advantage provided by business analytics. Stakeholders gain immediate access to comprehensive information about the entire supply chain, allowing for the monitoring of operations, tracking of shipments, and identification of bottlenecks. This real-time visibility facilitates prompt corrective actions and enhances overall supply chain performance.

Enhanced customer satisfaction is a natural outcome of optimized supply chain operations. By leveraging analytics to improve order fulfillment, reduce lead times, and meet delivery expectations, organizations can elevate customer satisfaction levels and strengthen their market position. Strategic planning and alignment with organizational goals are facilitated by the insights derived from business analytics. Long-term planning becomes more informed, enabling companies to adapt to market changes and maintain competitiveness.

Lastly, compliance and regulatory adherence are ensured through the use of analytics. Organizations can leverage data analytics to monitor and enforce compliance with various regulations and industry standards, reducing the risk of legal issues and maintaining a reliable and ethical supply chain. Overall, the adoption of business analytics in global supply chain coordination offers a comprehensive framework for optimizing operations, mitigating risks, and driving strategic growth (Greasley, 2019).

Table 3 contains the advantages of using business analytics in global supply chain coordination within Industry 4.0 conditions, along with descriptions for each advantage. These advantages demonstrate how the implementation of business analytics in global supply

chain coordination can contribute to efficiency, resilience, and overall improvement in business operations.

Table 3.

The advantages of using business analytics in global supply chain coordination

Advantage	Description
Improved Forecasting	Utilizing business analytics allows organizations to analyze historical data, market trends, and external factors, leading to more accurate demand forecasting and inventory planning.
Enhanced Decision-Making	Business analytics provides real-time insights into the supply chain, enabling stakeholders to make informed decisions promptly. This leads to better overall coordination and responsiveness.
Cost Reduction and Efficiency	Analyzing supply chain data helps identify areas of inefficiency, optimize resource allocation, and reduce operational costs, ultimately improving the overall efficiency of the supply chain.
Risk Management and Mitigation	Business analytics enables the identification and assessment of potential risks in the supply chain, allowing for proactive measures to mitigate disruptions and enhance risk management strategies.
Supplier Performance Evaluation	Organizations can use analytics to assess the performance of suppliers based on various metrics, fostering better relationships and ensuring a reliable and high-quality supply network.
Inventory Optimization	Analytics helps in maintaining optimal inventory levels by providing insights into demand patterns, lead times, and order quantities, preventing overstocking or stockouts and improving cash flow.
Real-Time Visibility	Business analytics provides real-time visibility into the entire supply chain, enabling stakeholders to monitor operations, track shipments, and identify bottlenecks for prompt corrective actions.
Enhanced Customer Satisfaction	By optimizing the supply chain through analytics, organizations can improve order fulfillment, reduce lead times, and enhance overall customer satisfaction by meeting delivery expectations.
Strategic Planning and Alignment	Analytics aids in aligning the supply chain with broader organizational goals and strategies. It provides insights for long-term planning, helping companies adapt to market changes and stay competitive.
Compliance and Regulatory Adherence	Businesses can use analytics to ensure compliance with various regulations and industry standards, reducing the risk of legal issues and maintaining a reliable and ethical supply chain.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

Table 4 contains the problems of using business analytics in global supply chain coordination within Industry 4.0 conditions, along with descriptions for each advantage. These problems underscore the importance of addressing data quality, integration, skill development, and change management to successfully harness the benefits of business analytics in global supply chain coordination.

Table 4.*The problems of using business analytics in global supply chain coordination*

Problem	Description
Data Quality Issues	Poor data quality, inaccuracies, and inconsistencies can undermine the effectiveness of business analytics, leading to flawed insights and misguided decision-making within the supply chain.
Integration Challenges	Difficulty in integrating diverse data sources and systems across the global supply chain can impede the seamless flow of information, hindering the ability to gain a comprehensive and real-time view.
High Implementation Costs	The initial investment required for implementing robust business analytics solutions can be substantial, posing a challenge for some organizations, especially smaller ones with limited financial resources.
Lack of Skilled Personnel	An insufficient number of personnel with the necessary skills to interpret and leverage analytics results may hinder the successful implementation and utilization of business analytics in supply chain management.
Security and Privacy Concerns	With the increasing reliance on data for decision-making, concerns regarding the security and privacy of sensitive information within the supply chain become more pronounced, potentially leading to breaches or unauthorized access.
Overemphasis on Historical Data	Relying too heavily on historical data without considering evolving market dynamics may result in suboptimal decision-making. The supply chain needs to adapt to current conditions rather than relying solely on past trends.
Resistance to Change	Employees and stakeholders may resist adopting new analytics-driven processes, causing friction and delaying the integration of business analytics into the existing supply chain coordination framework.
Complexity of Analytics Tools	The complexity of some analytics tools may pose a challenge for users, particularly those without a strong technical background. This complexity can limit the accessibility and effectiveness of analytics within the organization.
Incomplete or Insufficient Data	Gaps in the data collected or the absence of critical information may limit the accuracy and completeness of analytics insights, potentially leading to suboptimal decision-making within the supply chain.
Limited Predictive Accuracy	Despite advancements, predictive analytics may not always accurately forecast future events, and reliance on inaccurate predictions can result in inefficient resource allocation and disruptions in the supply chain.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

5. Conclusion

The integration of business analytics in global supply chain coordination within the framework of Industry 4.0 represents a transformative approach that propels organizations towards efficiency, adaptability, and competitiveness. As industries undergo significant transformations fueled by technological advancements, the strategic deployment of business analytics emerges as a vital tool for navigating the complexities of the modern supply chain.

The selected aspects of business analytics usage in global supply chain coordination, such as demand forecasting, supply chain visibility, predictive maintenance, collaboration, and risk management, highlight the diverse applications and benefits it brings to Industry 4.0. These applications enable organizations to anticipate market demands, optimize inventory,

ensure reliable production flows, foster collaboration, and proactively address risks, thereby enhancing overall supply chain resilience and responsiveness.

The software used in global supply chain coordination under Industry 4.0 conditions, such as SAP Integrated Business Planning, Oracle SCM Cloud, IBM Watson Supply Chain, and others, underscores the role of sophisticated tools in addressing the intricate challenges of managing and optimizing supply chain processes on a global scale. These tools contribute to demand planning, inventory optimization, supplier collaboration, and scenario-based planning, fostering real-time decision-making and enhancing organizational resilience.

Despite the numerous advantages, it is crucial to acknowledge the challenges associated with business analytics usage in global supply chain coordination. Issues such as data quality, integration challenges, high implementation costs, and a shortage of skilled personnel underscore the need for careful consideration and strategic planning during implementation. Additionally, security and privacy concerns, resistance to change, and the complexity of analytics tools require organizations to invest in training and change management strategies to maximize the effectiveness of business analytics. Table 3 illustrates the advantages of using business analytics in global supply chain coordination, emphasizing how it improves forecasting, enhances decision-making, reduces costs, and fosters collaboration, among other benefits. These advantages showcase the positive impact of business analytics on efficiency, risk management, and strategic alignment with organizational goals.

Conversely, Table 4 outlines the challenges and problems associated with business analytics usage in global supply chain coordination. These problems highlight the importance of addressing data quality, integration challenges, and the need for skilled personnel and change management strategies to unlock the full potential of business analytics.

While business analytics presents tremendous opportunities for optimizing global supply chain coordination in Industry 4.0, organizations must navigate both the advantages and challenges carefully. By addressing these challenges proactively, businesses can leverage the power of data-driven insights to position themselves at the forefront of innovation and competitiveness in the dynamic landscape of modern industry.

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RISK MITIGATION – THE BUSINESS ANALYTICS USAGE IN INDUSTRY 4.0 CONDITIONS

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Purpose: The purpose of this publication is to present the applications of usage of business analytics in risk mitigation.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The incorporation of business analytics into risk mitigation strategies amid the landscape of Industry 4.0 signifies a pivotal paradigm shift in response to the multifaceted challenges posed by technological disruptions, supply chain vulnerabilities, regulatory changes, and cybersecurity threats. As industries undergo unprecedented digital transformations, traditional risk management approaches are rendered obsolete, prompting the integration of more data-driven and analytical methodologies. Business analytics plays a crucial role in this transformative shift, leveraging vast volumes of data generated in Industry 4.0 environments. Through advanced analytics techniques, organizations can proactively anticipate and respond to potential risks in real-time, with predictive analytics enabling the forecast of disruptions and the implementation of preemptive measures. Beyond immediate operational concerns, the applications of business analytics extend to supply chain optimization, cybersecurity monitoring, and regulatory compliance. The symbiotic relationship between business analytics and risk mitigation emerges as a cornerstone for sustainable and resilient business practices in the evolving landscape of Industry 4.0, emphasizing the necessity of addressing associated challenges and leveraging a diverse array of software applications for comprehensive risk management.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of business analytics in the case of risk mitigation.

Keywords: business analytics, Industry 4.0, digitalization, artificial intelligence, real-time monitoring; risk mitigation.

Category of the paper: literature review.

1. Introduction

Risk mitigation in the context of Industry 4.0 is a multifaceted challenge, encompassing a wide array of factors such as technological disruptions, supply chain vulnerabilities, regulatory changes, and cybersecurity threats. As industries undergo unprecedented digital transformations, the traditional risk management approaches are rendered obsolete, necessitating a paradigm shift towards more data-driven and analytical methodologies.

Business analytics plays a pivotal role in this shift by harnessing the vast volumes of data generated in Industry 4.0 environments. Through advanced analytics techniques, businesses can gain valuable insights into their operations, enabling them to anticipate and respond to potential risks in real-time. Predictive analytics, for instance, empowers organizations to forecast potential disruptions, enabling proactive measures to be implemented before issues escalate (Zeng et al., 2022; Pech, Vrchota, 2022).

The purpose of this publication is to present the applications of usage of business analytics in risk mitigation.

2. The selected aspects of business analytics usage in risk mitigation

The integration of business analytics in risk mitigation extends beyond the immediate operational realm. It extends to supply chain management, where analytics can be applied to assess and optimize the entire supply chain ecosystem (Akundi et al., 2022). Real-time monitoring of suppliers, demand forecasting, and inventory management are just a few areas where analytics can enhance visibility and resilience, reducing the impact of disruptions (Ghibakholl et al., 2022).

In the realm of cybersecurity, another critical facet of risk management, business analytics proves instrumental in identifying and mitigating potential threats. By analyzing patterns and anomalies in network data, businesses can detect cybersecurity breaches at an early stage, preventing significant data breaches and financial losses. This proactive approach to cybersecurity aligns with the agile nature of Industry 4.0, where the speed of response is paramount (Bakir, Dahlan, 2022).

Furthermore, regulatory compliance is a perennial concern for businesses, and Industry 4.0 brings forth a host of new regulations and standards (Jonek-Kowalska, Wolniak, 2021). Business analytics, with its ability to interpret and analyze regulatory requirements, facilitates adherence to compliance standards, mitigating legal and reputational risks (Scappini, 2016).

The incorporation of business analytics in the risk mitigation strategies of businesses operating in Industry 4.0 conditions is not just a choice but a necessity. The ability to harness the power of data for predictive and prescriptive insights empowers organizations to navigate the complexities of the modern industrial landscape (Gajdzik, Wolniak, 2022; Gajdzik et al., 2023). As Industry 4.0 continues to evolve, the symbiotic relationship between business analytics and risk mitigation will undoubtedly be a cornerstone for sustainable and resilient business practices (Cillo et al., 2022).

Table 1 contains descriptions of how business analytics is used in the case risk mitigation.

Table 1.

The usage of business analytics in risk mitigation

Application	Description
Predictive Analytics	Utilizes historical data and statistical algorithms to forecast potential risks and disruptions, enabling proactive mitigation measures.
Supply Chain Optimization	Applies analytics to enhance visibility and efficiency in supply chain management, reducing vulnerabilities and improving responsiveness to disruptions.
Cybersecurity Monitoring	Leverages data analytics to monitor network activities, detect anomalies, and identify potential cybersecurity threats, enabling early intervention and prevention.
Regulatory Compliance	Utilizes analytics to interpret and analyze regulatory requirements, ensuring businesses adhere to compliance standards and mitigate legal and reputational risks.
Operational Risk Analysis	Analyzes operational data to identify and assess risks associated with internal processes, systems, and human factors, allowing organizations to implement targeted risk mitigation strategies.
Customer Behavior Analysis	Examines customer data to identify patterns and trends that may pose risks to customer satisfaction or loyalty, enabling businesses to proactively address issues and enhance customer relationships.
Financial Risk Management	Applies analytics to assess financial data and market trends, helping organizations identify and manage financial risks such as market fluctuations, credit risks, and liquidity challenges.
Strategic Decision Support	Provides insights for strategic decision-making by analyzing various data sources, helping businesses make informed choices that align with their risk tolerance and long-term objectives.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020; Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

3. Software used in risk mitigation in Industry 4.0 conditions

In the contemporary business landscape, the integration of business analytics software has become instrumental in addressing the complexities of risk mitigation. Businesses, operating in an environment characterized by rapid technological advancements and dynamic market conditions, are increasingly turning to sophisticated analytics tools to fortify their risk management strategies. Among the array of business analytics software available, IBM Watson Analytics stands out, providing organizations with a comprehensive platform for exploring and

analyzing data to identify and mitigate risks. Its features encompass predictive modeling, data visualization, and cognitive capabilities, enabling a proactive approach to risk management.

SAS Enterprise Miner is another powerful tool specifically designed for data mining and predictive modeling. By leveraging this software, businesses can identify patterns and trends that may pose risks in various operational domains. Automated modeling, data mining, and statistical analysis are key features that contribute to effective risk mitigation strategies. Tableau, renowned for its robust data visualization capabilities, empowers organizations to gain insights into potential risks through interactive and intuitive dashboards. Its user-friendly interface facilitates quick and efficient analysis, fostering a deeper understanding of risk factors (Adel, 2022).

Microsoft Power BI, a business analytics tool by Microsoft, is widely adopted for risk management purposes. Offering interactive reports and dashboards, Power BI allows organizations to visualize and analyze data, supporting informed decision-making in risk mitigation strategies. Oracle Analytics Cloud, a cloud-based platform by Oracle, provides advanced analytics and machine learning tools for risk mitigation. With self-service analytics and collaboration features, it enables organizations to proactively address potential risks in their operations (Nourani, 2021).

SAP BusinessObjects is another comprehensive suite of business intelligence tools that includes capabilities for risk management. Businesses utilize this software for risk reporting, predictive analytics, and dashboards, contributing to a holistic approach to risk mitigation. Qlik Sense, with its associative data modeling and visualization capabilities, supports organizations in exploring data relationships and making informed decisions. Its interactive visualizations and real-time data exploration features contribute to a dynamic risk analysis process.

Palantir Gotham, designed for data integration and analysis, is particularly valuable for organizations dealing with complex and interconnected data sources. Its capabilities in link analysis, visualization, and collaboration contribute to effective risk mitigation in intricate operational landscapes. Alteryx, as a data blending and analytics platform, empowers users to prepare, blend, and analyze data from various sources. With features such as predictive analytics and workflow automation, Alteryx enhances the efficiency of risk mitigation.

The integration of business analytics software has become a cornerstone in modern risk mitigation strategies. These tools offer diverse features, from data exploration and visualization to predictive modeling and machine learning, providing organizations with the means to proactively identify, assess, and address potential risks in their operational environments (Du et al., 2023; Fjellström, Osarenkhoe, 2023; Castro et al., 2014; Wang et al., 2023).

Table 2 highlighting examples of software and applications used in risk mitigation, along with descriptions of their usage.

Table 2.*The usage of business analytics software in risk mitigation*

Software/Application	Description	Key Features
IBM Watson Analytics	Empowers businesses to explore and analyze data for risk identification and mitigation. Provides predictive analytics, data visualization, and cognitive capabilities.	Predictive modeling, data visualization, natural language processing, machine learning algorithms.
SAS Enterprise Miner	A comprehensive tool for data mining and predictive modeling, SAS Enterprise Miner aids in identifying patterns and trends for risk mitigation in various business domains.	Data mining, predictive modeling, machine learning, automated modeling, statistical analysis.
Tableau	Known for its powerful data visualization capabilities, Tableau enables businesses to gain insights into potential risks through interactive and intuitive dashboards.	Interactive dashboards, real-time data connectivity, drag-and-drop analytics, collaborative features.
Microsoft Power BI	A business analytics tool by Microsoft, Power BI allows organizations to visualize and analyze data for risk management. It offers interactive reports and dashboards.	Data visualization, interactive dashboards, self-service analytics, integration with Microsoft products.
Oracle Analytics Cloud	Oracle's cloud-based analytics platform facilitates risk mitigation by providing tools for data visualization, advanced analytics, and machine learning.	Self-service analytics, machine learning algorithms, data preparation, collaboration tools.
SAP BusinessObjects	SAP's suite of business intelligence tools includes risk management capabilities, allowing organizations to analyze and monitor risks in their business operations.	Risk reporting, dashboards, predictive analytics, integration with SAP applications.
Qlik Sense	Qlik Sense offers associative data modeling and visualization for risk analysis. It enables users to explore data relationships and make informed decisions.	Associative data modeling, interactive visualizations, data storytelling, real-time data exploration.
Palantir Gotham	Designed for data integration and analysis, Palantir Gotham is used for risk mitigation by organizations dealing with complex and interconnected data sources.	Data integration, link analysis, visualization, collaboration tools, scalable architecture.
Alteryx	Alteryx is a data blending and analytics platform that facilitates risk mitigation by enabling users to prepare, blend, and analyze data from various sources.	Data blending, predictive analytics, spatial analytics, workflow automation, data preparation.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020; Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

4. Advantages and problems of business analytics usage in risk mitigation

The incorporation of business analytics offers a multitude of advantages, reshaping the traditional approaches to risk management. One key advantage lies in the ability of analytics to enable organizations to adopt a proactive stance in identifying potential risks. By delving into historical data, patterns, and trends, businesses can anticipate and recognize emerging risks before they materialize, allowing for the implementation of timely and targeted mitigation strategies (Greasley, 2019).

Real-time monitoring and response form another critical advantage of leveraging business analytics in risk mitigation. Through the continuous analysis of data streams, organizations gain the capacity to respond swiftly to evolving risks, addressing them in their nascent stages and preventing potential escalation. This real-time responsiveness is pivotal in an environment where the landscape can change rapidly. Moreover, the data-driven nature of business analytics transforms decision-making processes. By providing decision-makers with insights derived from comprehensive data analysis, analytics facilitates informed and strategic decision-making aligned with an organization's risk tolerance and overarching objectives. This shift towards data-driven decision-making enhances the overall resilience and adaptability of the organization.

Enhanced visibility and transparency are inherent benefits of employing analytics tools in risk mitigation. These tools provide intuitive data visualizations, offering stakeholders a clearer understanding of various facets of the business. This heightened visibility promotes transparency within the organization, ensuring that potential risks are not only identified but also well-understood by key stakeholders. In the realm of supply chain management, analytics plays a pivotal role in improving resilience. Organizations can optimize their supply chains by identifying vulnerabilities and disruptions in real time. This optimization not only reduces the impact of supply chain risks but also ensures a more agile and responsive approach to challenges that may arise (Nourani, 2021).

The application of predictive modeling through analytics is particularly valuable for risk forecasting. By leveraging predictive analytics models, organizations can forecast future risks based on historical data, allowing for the formulation of proactive measures and the development of effective risk mitigation strategies. On the cybersecurity front, business analytics contributes to threat detection. Through the continuous monitoring of network activities and the identification of anomalies, analytics tools bolster cybersecurity measures, creating a more secure and resilient business environment in the face of evolving digital threats.

Furthermore, analytics supports organizations in navigating the complex landscape of regulatory compliance. By interpreting and analyzing regulatory requirements, businesses can ensure adherence to compliance standards, mitigating legal and reputational risks associated with non-compliance (Charles et al., 2023).

Lastly, the cost-effective allocation of resources is facilitated by the insights derived from data analysis. Organizations can prioritize resource allocation based on areas with higher risk, optimizing budget allocation for risk mitigation strategies and ensuring a more efficient use of available resources. In essence, the advantages of incorporating business analytics in risk mitigation extend beyond mere risk identification, fostering a holistic and adaptive risk management approach.

Table 3 contains the advantages of using business analytics in risk mitigation within Industry 4.0 conditions, along with descriptions for each advantage.

Table 3.*The advantages of using business analytics in risk mitigation*

Advantage	Description
Proactive Risk Identification	Business analytics enables organizations to proactively identify potential risks by analyzing historical data, patterns, and trends, allowing for timely and targeted risk mitigation strategies.
Real-time Monitoring and Response	The use of analytics facilitates real-time monitoring of data, allowing organizations to respond swiftly to emerging risks and mitigate their impact before they escalate.
Data-driven Decision Making	Analytics empowers decision-makers with data-driven insights, enabling informed and strategic decisions that align with an organization's risk tolerance and long-term objectives.
Enhanced Visibility and Transparency	By providing comprehensive data visualization, analytics tools enhance visibility into various aspects of the business, promoting transparency and a clearer understanding of potential risks.
Improved Supply Chain Resilience	Businesses can optimize supply chain management through analytics, identifying vulnerabilities and disruptions in real time, thereby enhancing resilience and reducing supply chain risks.
Predictive Modeling for Risk Forecasting	Predictive analytics models enable organizations to forecast future risks based on historical data, allowing for proactive measures and the development of effective risk mitigation strategies.
Cybersecurity Threat Detection	Business analytics aids in monitoring network activities, identifying anomalies, and detecting potential cybersecurity threats, contributing to a more secure and resilient business environment.
Compliance Management and Regulatory Adherence	Analytics tools assist in interpreting and analyzing regulatory requirements, ensuring organizations adhere to compliance standards and mitigate legal and reputational risks.
Cost-effective Resource Allocation	Through the analysis of data, organizations can allocate resources more effectively, focusing on areas with higher risk and optimizing budget allocation for risk mitigation strategies.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020; Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

Table 4 contains the problems of using business analytics in risk mitigation within Industry 4.0 conditions, along with descriptions for each advantage. These problems underscore the importance of addressing data quality, integration, skill development, and change management to successfully harness the benefits of business analytics in global supply chain coordination.

Table 4.*The problems of using business analytics in risk mitigation*

Problem	Description
Data Quality Issues	Businesses may encounter challenges related to the quality of data used in analytics, including inaccuracies, incomplete information, and inconsistencies, leading to unreliable risk assessments.
Lack of Skilled Personnel	The effective use of business analytics demands a skilled workforce with expertise in data analysis, statistics, and domain knowledge. A shortage of such personnel can hinder successful implementation.
Integration Challenges	Integrating analytics tools with existing systems and processes can pose challenges, resulting in compatibility issues and disruptions that may impede the seamless flow of information for risk mitigation.
Overemphasis on Historical Data	Relying solely on historical data for risk mitigation may overlook emerging or unprecedented risks, as analytics models might not account for novel situations that deviate from past patterns.

Cont. table 2.

Inadequate Understanding of Analytics	Organizations may face issues if there is a lack of understanding about how to interpret and utilize analytics insights for risk mitigation, leading to suboptimal decision-making and risk management strategies.
Cost and Budget Constraints	The implementation and maintenance of robust analytics solutions require significant financial investments. Budget constraints may limit access to advanced analytics tools, hindering effective risk mitigation.
Ethical and Privacy Concerns	The use of business analytics raises ethical concerns related to data privacy and consent. Mishandling sensitive information may lead to legal repercussions, damaging an organization's reputation.
Lack of Real-time Analytics Capabilities	Delayed or lagging analytics processes can be problematic in fast-paced environments, where real-time insights are crucial for identifying and responding to emerging risks promptly.
Unforeseen Technical Challenges	Technical issues, such as software glitches, server downtimes, or data breaches, may disrupt the functionality of analytics systems, potentially compromising the effectiveness of risk mitigation efforts.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020; Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

5. Conclusion

The adoption of business analytics in the realm of risk mitigation within the context of Industry 4.0 represents a crucial paradigm shift in response to the multifaceted challenges posed by technological disruptions, supply chain vulnerabilities, regulatory changes, and cybersecurity threats. As industries undergo unprecedented digital transformations, traditional risk management approaches become obsolete, necessitating the integration of more data-driven and analytical methodologies. The pivotal role played by business analytics in this transformative shift is evident in its ability to harness the vast volumes of data generated in Industry 4.0 environments. Through advanced analytics techniques, businesses gain valuable insights that enable them to anticipate and respond to potential risks in real-time. Predictive analytics, for instance, empowers organizations to forecast disruptions, allowing for proactive measures to be implemented before issues escalate.

The applications of business analytics in risk mitigation extend beyond immediate operational concerns. In supply chain management, analytics is applied to assess and optimize the entire supply chain ecosystem, enhancing visibility and resilience. In cybersecurity, analytics proves instrumental in identifying and mitigating potential threats by analyzing patterns and anomalies in network data. Additionally, analytics aids in regulatory compliance by interpreting and analyzing regulatory requirements, mitigating legal and reputational risks.

The publication further emphasizes the necessity of incorporating business analytics into the risk mitigation strategies of businesses operating in Industry 4.0 conditions. The ability to harness the power of data for predictive and prescriptive insights empowers organizations to navigate the complexities of the modern industrial landscape. The symbiotic relationship

between business analytics and risk mitigation emerges as a cornerstone for sustainable and resilient business practices in the evolving landscape of Industry 4.0.

The advantages of using business analytics in risk mitigation are highlighted, encompassing proactive risk identification, real-time monitoring and response, data-driven decision-making, enhanced visibility and transparency, improved supply chain resilience, predictive modeling for risk forecasting, cybersecurity threat detection, compliance management, and cost-effective resource allocation. However, it is essential to acknowledge the challenges and problems associated with the utilization of business analytics in risk mitigation. These include data quality issues, a lack of skilled personnel, integration challenges, overemphasis on historical data, inadequate understanding of analytics, cost and budget constraints, ethical and privacy concerns, lack of real-time analytics capabilities, and unforeseen technical challenges. Addressing these challenges is crucial to realizing the full potential of business analytics in effective risk mitigation.

In the realm of software applications, a diverse array of tools, such as IBM Watson Analytics, SAS Enterprise Miner, Tableau, Microsoft Power BI, Oracle Analytics Cloud, SAP BusinessObjects, Qlik Sense, Palantir Gotham, and Alteryx, is presented as integral components of risk mitigation strategies in Industry 4.0 conditions. These tools offer features ranging from predictive modeling and data visualization to machine learning and workflow automation, providing organizations with the means to proactively identify, assess, and address potential risks.

The integration of business analytics in risk mitigation strategies, accompanied by the utilization of advanced software applications, emerges as a necessity for organizations navigating the challenges of Industry 4.0. The advantages in terms of proactive risk management, real-time responsiveness, and informed decision-making are considerable. However, the associated challenges underline the importance of addressing data quality, skill development, integration, and ethical considerations to ensure the successful implementation and sustained effectiveness of business analytics in risk mitigation.

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FORECASTING DEMAND – UTILIZING BUSINESS ANALYTICS IN INDUSTRY 4.0 ENVIRONMENTS

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Purpose: The purpose of this publication is to present the applications of usage of business analytics in demand forecasting.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The rise of Industry 4.0 has revolutionized the business landscape by creating a data-rich environment fueled by interconnected devices and digital systems throughout the supply chain. In this era, business analytics emerges as a crucial tool, leveraging the abundance of data to uncover intricate patterns and trends in consumer behavior, market dynamics, and product demand. By analyzing historical data and integrating external factors, business analytics enables more accurate demand forecasts, essential for effective inventory management, production planning, and overall business success. Advanced analytics techniques such as machine learning and predictive modeling thrive in Industry 4.0 environments, enabling businesses to process large datasets and predict future demand with precision. Moreover, business analytics facilitates the integration of demand forecasting with other supply chain components, optimizing resource allocation and enhancing efficiency. Industry 4.0 also fosters greater customization and personalization of products and services through market segmentation analysis and tailored forecasting, driving competitive advantage. This publication has explored the applications of business analytics in demand forecasting, emphasizing its importance, aspects, software applications, advantages, and challenges within the Industry 4.0 context. By addressing these aspects, organizations can harness the power of business analytics to optimize operations, foster growth, and stay competitive in today's dynamic business environment.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of business analytics in the case of smart manufacturing.

Keywords: business analytics, Industry 4.0, digitalization, artificial intelligence, real-time monitoring; demand forecasting.

Category of the paper: literature review.

1. Introduction

Industry 4.0 generates a wealth of data from interconnected devices, sensors, and digital systems throughout the supply chain. Business analytics harnesses this data abundance to discern intricate patterns and trends in consumer behavior, market dynamics, and product demand. By analyzing vast datasets, businesses can derive actionable insights that inform more accurate demand forecasts. The real-time nature of Industry 4.0 operations necessitates agile and responsive forecasting capabilities. Business analytics enables organizations to conduct real-time analysis of incoming data streams, allowing for dynamic adjustments to demand forecasts in line with evolving market conditions. This agility ensures that businesses can swiftly adapt their production, inventory, and distribution strategies to meet fluctuating demand patterns.

Advanced analytics techniques such as machine learning and predictive modeling thrive in Industry 4.0 environments. These techniques excel at processing and analyzing large volumes of data to uncover hidden correlations and predict future demand with greater precision. By leveraging predictive models, businesses can anticipate demand variations, optimize resource allocation, and mitigate the risks associated with supply chain disruptions or market volatility. In addition, business analytics facilitates the integration of demand forecasting with other key components of the Industry 4.0 supply chain, such as inventory management, production planning, and logistics. By aligning demand forecasts with operational processes, businesses can optimize inventory levels, streamline production schedules, and enhance overall supply chain efficiency (Akundi et al., 2022).

Industry 4.0 enables greater customization and personalization of products and services to meet individual customer preferences. Business analytics enables businesses to segment markets, analyze customer behavior, and tailor demand forecasts to specific customer segments or product configurations. This customization enhances customer satisfaction, fosters brand loyalty, and drives competitive advantage in the marketplace.

The purpose of this publication is to present the applications of usage of business analytics in demand forecasting.

2. The selected aspects of business analytics usage in demand forecasting

Business analytics plays a crucial role in demand forecasting, serving as a cornerstone for strategic decision-making within organizations. Demand forecasting involves predicting future customer demand for products or services, which is essential for effective inventory management, production planning, and overall business success (Gajdzik, Wolniak, 2022;

Gajdzik et al., 2023). In the realm of demand forecasting, business analytics leverages historical data, statistical models, and advanced algorithms to analyze patterns, trends, and anomalies in past sales or demand data. By understanding historical demand patterns, businesses can identify seasonal fluctuations, cyclical trends, and other factors influencing consumer behavior (Zeng et al., 2022; Pech, Vrchota, 2022).

Business analytics also integrates external factors such as market trends, economic indicators, demographic shifts, and competitive intelligence into the forecasting process. This broader contextual understanding helps businesses anticipate changes in demand resulting from external factors, enabling proactive adjustments to production, inventory levels, and marketing strategies (Scappini, 2016). Moreover, advanced analytics techniques such as machine learning and predictive modeling enhance the accuracy of demand forecasts by identifying complex patterns and correlations within data sets (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Gajdzik, Wolniak, 2023; Swarnakar et al., 2023). These techniques enable businesses to develop more nuanced forecasts that account for various influencing factors and potential uncertainties (Bakir, Dahlan, 2022).

Additionally, business analytics facilitates scenario analysis and "what-if" simulations, allowing organizations to assess the impact of different scenarios on future demand (Cillo et al., 2022). By modeling various scenarios, businesses can evaluate the potential outcomes of different strategies and make informed decisions to optimize their operations and resources (Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). Furthermore, the integration of real-time data sources and technologies like Internet of Things (IoT) devices and social media analytics enhances the agility and responsiveness of demand forecasting processes. Real-time data enables businesses to adapt quickly to changing market dynamics and consumer preferences, thereby improving forecast accuracy and reducing the risk of stockouts or excess inventory (Ghibakholl et al., 2022).

Table 1 contains descriptions of how business analytics is used in the case of demand forecasting.

Table 1.

The usage of business analytics in demand forecasting

Aspect of demand forecasting	Description of Usage of Business Analytics
Historical Data Analysis	Utilizes past sales or demand data to identify patterns, trends, and anomalies, providing insights into historical demand behavior. Historical data analysis forms the foundation for building statistical models and forecasting algorithms.
Integration of External Factors	Incorporates external factors such as market trends, economic indicators, demographic shifts, and competitive intelligence into the forecasting process. By considering these factors, businesses can anticipate changes in demand influenced by external variables.

Cont. table 1.

Advanced Analytics Techniques	Leverages advanced analytics techniques such as machine learning, predictive modeling, and data mining to enhance the accuracy of demand forecasts. These techniques identify complex patterns and correlations within data sets, enabling more nuanced and precise forecasting.
Scenario Analysis and What-If Simulations	Conducts scenario analysis and "what-if" simulations to assess the impact of different scenarios on future demand. By modeling various scenarios, organizations can evaluate the potential outcomes of different strategies and make informed decisions to optimize operations.
Real-Time Data Integration	Integrates real-time data sources and technologies like IoT devices and social media analytics to enhance the agility and responsiveness of demand forecasting processes. Real-time data enables businesses to adapt quickly to changing market dynamics and consumer preferences.
Forecasting Accuracy Improvement	Aims to improve forecasting accuracy by continuously refining models, incorporating new data sources, and evaluating the performance of forecasting algorithms. Enhanced forecasting accuracy minimizes the risk of stockouts or excess inventory, leading to optimized resource allocation.
Demand Sensing and Dynamic Demand Forecasting	Utilizes demand sensing techniques and dynamic demand forecasting models to capture short-term demand fluctuations and respond quickly to changes in consumer behavior. These approaches enable businesses to adapt their operations in real-time to meet evolving demand patterns.
Inventory Optimization	Applies business analytics to optimize inventory levels by balancing supply and demand, reducing carrying costs, and minimizing the risk of stockouts or overstock situations. Inventory optimization ensures efficient allocation of resources and enhances overall supply chain performance.
Market Segmentation Analysis	Conducts market segmentation analysis using business analytics to identify distinct customer segments with unique demand patterns and preferences. By tailoring marketing strategies and product offerings to specific segments, businesses can optimize demand forecasting and enhance customer satisfaction.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

3. Software used in demand forecasting analysis in Industry 4.0 conditions

Business analytics software plays a crucial role in demand forecasting by leveraging advanced data analysis techniques to predict future customer demand. These software solutions enable businesses to analyze large volumes of historical sales data, market trends, and external factors to generate accurate forecasts. By employing statistical models, machine learning algorithms, and time-series analysis, business analytics software identifies patterns, trends, and correlations within the data, allowing organizations to anticipate changes in demand and optimize resource allocation accordingly (Jonek-Kowalska, Wolniak, 2021, 2022, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021; Orzeł, Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecula, Wolniak, 2022; Olkiewicz et al., 2021). Furthermore, business analytics software offers features such as interactive dashboards, data visualization tools, and scenario analysis capabilities, enabling

users to explore data insights, communicate forecasting results, and assess the impact of different scenarios on future demand. With the ability to integrate with other enterprise systems and collaborate in real-time, these software solutions facilitate cross-functional collaboration and alignment of demand forecasting processes across the organization (Adel, 2022).

Cloud-based business analytics software provides the flexibility and scalability needed to adapt to dynamic market conditions and evolving business requirements. By harnessing the power of business analytics software, organizations can make informed decisions, minimize risks, and capitalize on market opportunities, ultimately driving growth and competitiveness in today's rapidly changing business landscape (Du et al., 2023; Fjellström, Osarenkhoe, 2023; Castro et al., 2014; Wang et al., 2023).

Table 2 highlighting examples of software and applications used in demand forecasting, along with descriptions of their usage.

Table 2.

The usage of business analytics software in demand forecasting

Software/Application	Description	Key Features
Tableau	Tableau is a data visualization software that allows businesses to analyze and visualize large datasets to uncover insights relevant to demand forecasting. It enables users to create interactive dashboards and reports, making it easier to explore data trends and patterns. With Tableau, businesses can visualize historical demand data, identify correlations, and communicate forecasting results effectively to stakeholders.	<ul style="list-style-type: none"> • Interactive dashboards and reports • Visualization of historical demand data • Data exploration tools
SAS Forecast Server	SAS Forecast Server is a forecasting software solution that utilizes advanced analytics techniques to generate accurate demand forecasts. It employs statistical models, machine learning algorithms, and time-series analysis to predict future demand based on historical data and relevant factors. SAS Forecast Server offers automated forecasting capabilities, enabling businesses to streamline the forecasting process and achieve greater accuracy in demand predictions.	<ul style="list-style-type: none"> • -Statistical models and machine learning algorithms • Time-series analysis • Automated forecasting
IBM Planning Analytics	IBM Planning Analytics is a comprehensive planning and forecasting software platform that integrates business analytics with performance management capabilities. It enables businesses to create demand forecasting models, scenario analysis, and predictive modeling to optimize resource allocation and decision-making. IBM Planning Analytics offers collaborative features, allowing teams to collaborate on forecasting projects and share insights across the organization.	<ul style="list-style-type: none"> • Demand forecasting models - Scenario analysis • Predictive modelling • Collaboration features
Oracle Demand Planning	Oracle Demand Planning is a cloud-based demand forecasting solution that helps businesses optimize inventory levels, production schedules, and supply chain operations. It leverages historical sales data, market trends, and external factors to generate accurate demand forecasts. Oracle Demand Planning offers advanced analytics capabilities, such as predictive analytics and what-if analysis, enabling businesses to anticipate demand fluctuations and make data-driven decisions.	<ul style="list-style-type: none"> • Cloud-based demand forecasting • Predictive analytics • What-if analysis

Cont. table 2.

Microsoft Power BI	Microsoft Power BI is a business intelligence platform that enables businesses to analyze data, create visualizations, and share insights across the organization. It provides tools for data preparation, visualization, and interactive reporting, making it suitable for demand forecasting applications. With Microsoft Power BI, businesses can analyze historical demand data, identify trends, and generate forecasts to support decision-making processes.	<ul style="list-style-type: none"> • Data preparation tools • Data visualization • Interactive reporting
SAP Integrated Business Planning	SAP Integrated Business Planning (IBP) is an end-to-end planning solution that encompasses demand planning, supply chain planning, and inventory optimization. It leverages advanced analytics and machine learning algorithms to generate accurate demand forecasts and optimize inventory levels. SAP IBP offers real-time collaboration capabilities, enabling cross-functional teams to collaborate on demand forecasting projects and align planning processes across the organization.	<ul style="list-style-type: none"> • End-to-end planning solution • Advanced analytics and machine learning • Real-time collab

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

4. Advantages and problems of business analytics usage in demand forecasting

Utilizing business analytics in demand forecasting offers a multitude of advantages that contribute to improved decision-making, operational efficiency, and overall business performance. One significant advantage is the enhancement of forecast accuracy. By leveraging advanced analytics techniques such as statistical models and machine learning algorithms, businesses can analyze historical data and identify patterns, trends, and correlations. This leads to more precise predictions of future demand, enabling better resource allocation, reduced stockouts, and ultimately, enhanced customer satisfaction. Furthermore, business analytics facilitates better decision-making by providing decision-makers with actionable insights derived from data analysis (Charles et al., 2023). Visualizing trends, identifying opportunities, and assessing the impact of different scenarios enable organizations to make informed decisions that optimize inventory levels, production schedules, and marketing strategies. This strategic approach leads to more efficient operations, cost savings, and a competitive advantage in the market.

Real-time monitoring and adaptation are also key benefits of using business analytics in demand forecasting. With the ability to analyze data streams in real-time, businesses can identify emerging trends, respond to fluctuations in demand promptly, and adjust forecasting models dynamically. This agility enables organizations to minimize inventory costs, reduce excess inventory, and capitalize on opportunities in the market. Integration with supply chain

processes is another advantage of business analytics in demand forecasting. By aligning forecasting with inventory management, production planning, and logistics, businesses can optimize resource allocation, streamline operations, and improve supply chain efficiency. This integration ensures better coordination across the supply chain, reduces lead times, and enhances overall operational performance (Nourani, 2021).

Moreover, business analytics contributes to improved customer satisfaction by enabling businesses to anticipate customer demand more accurately and align their offerings with customer preferences. By analyzing customer behavior, market trends, and sentiment analysis, organizations can tailor products, promotions, and pricing strategies to meet customer needs effectively. This leads to increased brand loyalty and higher revenue generation. Additionally, cost savings and resource optimization are achieved through the use of business analytics in demand forecasting. By generating accurate demand forecasts, businesses can minimize excess inventory, reduce carrying costs, and avoid stockouts or overproduction. This leads to improved cash flow and a more efficient use of resources across the supply chain. Table 3 contains the advantages of using business analytics in demand forecasting within Industry 4.0 conditions, along with descriptions for each advantage. This table outlines the advantages of using business analytics in demand forecasting, including improved forecast accuracy, enhanced decision-making, real-time monitoring and adaptation, integration with supply chain processes, improved customer satisfaction, cost savings and resource optimization, and scalability and flexibility. Each advantage highlights how business analytics empowers organizations to optimize operations, drive growth, and gain a competitive edge in today's dynamic business environment (Greasley, 2019).

Table 3.

The advantages of using business analytics in demand forecasting

Advantage	Description
Improved Forecast Accuracy	Business analytics enhances forecast accuracy by analyzing historical data, identifying patterns, and utilizing advanced algorithms to generate more precise predictions. By leveraging statistical models, machine learning, and predictive analytics, businesses can anticipate changes in demand more accurately, leading to better resource allocation, reduced stockouts, and improved customer satisfaction.
Enhanced Decision-Making	Business analytics provides decision-makers with actionable insights derived from data analysis, enabling informed decision-making in demand forecasting. By visualizing trends, identifying opportunities, and assessing the impact of different scenarios, businesses can make strategic decisions to optimize inventory levels, production schedules, and marketing strategies. This leads to more efficient operations, cost savings, and a competitive advantage in the market.
Real-Time Monitoring and Adaptation	Business analytics enables real-time monitoring of demand patterns and market trends, allowing businesses to adapt quickly to changing conditions. With the ability to analyze data streams in real-time, organizations can identify emerging trends, respond to fluctuations in demand, and adjust forecasting models dynamically. This agility enables businesses to minimize inventory costs, reduce excess inventory, and capitalize on opportunities in the market.

Cont. table 3.

Integration with Supply Chain Processes	Business analytics integrates demand forecasting with other supply chain processes such as inventory management, production planning, and logistics. By aligning forecasting with these processes, businesses can optimize inventory levels, streamline production schedules, and improve supply chain efficiency. This integration ensures better coordination across the supply chain, reduces lead times, and enhances overall operational performance.
Improved Customer Satisfaction	Business analytics enables businesses to anticipate customer demand more accurately and align their offerings with customer preferences. By analyzing customer behavior, market trends, and sentiment analysis, organizations can tailor products, promotions, and pricing strategies to meet customer needs effectively. This leads to improved customer satisfaction, increased brand loyalty, and higher revenue generation.
Cost Savings and Resource Optimization	Business analytics helps businesses optimize resource allocation and reduce costs associated with inventory holding, stockouts, and production inefficiencies. By generating accurate demand forecasts, organizations can minimize excess inventory, reduce carrying costs, and avoid stockouts or overproduction. This leads to cost savings, improved cash flow, and a more efficient use of resources across the supply chain.
Scalability and Flexibility	Business analytics software offers scalability and flexibility to adapt to changing business requirements and accommodate growth. Whether it's scaling up to handle larger datasets or customizing forecasting models to specific business needs, analytics solutions provide the agility needed to meet evolving demands. This scalability ensures that businesses can continue to leverage analytics effectively as they expand operations, enter new markets, or introduce new products and services.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

Table 4 contains the problems of using business analytics in demand forecasting within Industry 4.0 conditions, along with descriptions for each advantage. These problems highlight some of the key challenges that businesses may encounter when using business analytics for customer behavior analysis. Overcoming these challenges requires a holistic approach, including addressing data quality issues, investing in talent and technology, and ensuring alignment with strategic objectives.

Table 4.

The problems of using business analytics in demand forecasting

Problem	Description
Data Quality Issues	One of the primary challenges in using business analytics for demand forecasting is the quality of data. Inaccurate, incomplete, or inconsistent data can lead to unreliable forecasts and erroneous decision-making. Data quality issues may arise from various sources, including errors in data entry, discrepancies between systems, and missing or outdated information. Addressing data quality issues requires robust data governance processes, data cleaning techniques, and continuous monitoring to ensure the accuracy and reliability of forecasting models.
Complexity of Analysis	Another challenge is the complexity of analysis involved in business analytics for demand forecasting. Analyzing large volumes of data, applying advanced statistical models, and interpreting complex algorithms require specialized skills and expertise. Organizations may face difficulties in hiring and retaining qualified data analysts or data scientists capable of conducting sophisticated analysis. Moreover, the complexity of analysis may result in longer processing times, making it challenging to generate timely forecasts and respond quickly to changes in demand.

Cont. table 4.

Lack of Integration with Business Processes	Business analytics solutions for demand forecasting may face challenges in integrating with existing business processes and systems. Siloed data sources, disparate software platforms, and organizational barriers may hinder seamless integration, leading to inefficiencies and data discrepancies. Without proper integration, businesses may struggle to leverage the full potential of analytics insights in decision-making and fail to realize the benefits of demand forecasting. Overcoming integration challenges requires alignment between IT and business stakeholders, investment in interoperable systems, and a cohesive data strategy.
Uncertainty and Volatility in the Market	Market uncertainty and volatility pose significant challenges to demand forecasting using business analytics. External factors such as economic conditions, regulatory changes, and geopolitical events can have unpredictable impacts on consumer behavior and demand patterns. Moreover, sudden shifts in market trends, emergence of new competitors, or disruptive technologies may invalidate existing forecasting models and render forecasts inaccurate. Addressing market uncertainty and volatility requires robust risk management practices, scenario planning techniques, and the flexibility to adapt forecasting models in response to changing market dynamics.
Overreliance on Historical Data	An inherent challenge in demand forecasting using business analytics is the overreliance on historical data. While historical data provides valuable insights into past demand patterns, it may not always capture emerging trends, market disruptions, or changes in consumer preferences. Relying solely on historical data without considering external factors or qualitative insights can lead to biases in forecasting models and missed opportunities. To mitigate the risk of overreliance on historical data, businesses need to complement quantitative analysis with qualitative inputs, market research, and expert judgment to capture the full spectrum of demand drivers.
Technology and Infrastructure Limitations	Technology and infrastructure limitations can impede the effectiveness of business analytics in demand forecasting. Legacy systems, outdated software, and inadequate IT infrastructure may lack the capabilities to handle large datasets, perform complex analytics, or support real-time forecasting. Moreover, scalability issues, data security concerns, and compatibility issues with emerging technologies can hinder the adoption and deployment of advanced analytics solutions. Addressing technology and infrastructure limitations requires investment in modernizing IT infrastructure, adopting cloud-based solutions, and leveraging emerging technologies such as artificial intelligence and edge computing to enhance analytics capabilities.
Interpretation and Communication Challenges	Effective interpretation and communication of analytics insights pose challenges in demand forecasting. Complex statistical models and technical jargon may be difficult for non-specialists to understand, leading to misinterpretation or mistrust of forecasting results. Moreover, presenting forecasts in a meaningful and actionable format to decision-makers requires effective communication skills and data visualization techniques. Overcoming interpretation and communication challenges requires fostering a data-driven culture, providing training and education on analytics concepts, and utilizing visualization tools to convey insights in a clear and concise manner.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

5. Conclusion

The advent of Industry 4.0 has ushered in a data-rich environment where interconnected devices and digital systems generate vast amounts of data across the supply chain. Leveraging this data abundance, business analytics emerges as a powerful tool for discerning intricate patterns and trends in consumer behavior, market dynamics, and product demand. Through the

analysis of historical data and integration of external factors, business analytics facilitates more accurate demand forecasts, crucial for effective inventory management, production planning, and overall business success. In the realm of demand forecasting, advanced analytics techniques such as machine learning and predictive modeling thrive in Industry 4.0 environments. These techniques enable businesses to process large datasets, uncover hidden correlations, and predict future demand with greater precision. Moreover, business analytics facilitates the integration of demand forecasting with other key components of the supply chain, optimizing resource allocation, streamlining production schedules, and enhancing overall efficiency.

Industry 4.0 also enables greater customization and personalization of products and services to meet individual customer preferences. Through market segmentation analysis and tailored forecasting, businesses can optimize demand forecasting and drive competitive advantage in the marketplace. This publication has presented the applications of business analytics in demand forecasting, highlighting its importance, selected aspects, software applications used, advantages, and challenges within the Industry 4.0 context. By understanding and addressing these aspects, organizations can harness the power of business analytics to optimize operations, drive growth, and gain a competitive edge in today's dynamic business landscape.

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THE USAGE OF KANO MODEL IN INDUSTRY 4.0 CONDITIONS

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Purpose: The purpose of this publication is to present the usage of Kano model approach in Industry 4.0 conditions.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The integration of the Kano model with Industry 4.0 represents a promising strategy for advancing product development, bolstering customer satisfaction, and enhancing overall competitiveness in the digital landscape. This integration combines the systematic approach of the Kano model with the innovative technologies and principles of Industry 4.0, offering manifold benefits while addressing various challenges. The Kano model's structured framework aids in comprehending and categorizing customer preferences, facilitating effective resource allocation and feature prioritization to drive heightened customer satisfaction and loyalty. Meanwhile, Industry 4.0's transformative technologies revolutionize manufacturing, fostering greater efficiency, flexibility, and responsiveness to customer needs. Despite its potential, integration hurdles include organizational understanding gaps in Industry 4.0, necessitating education, collaboration, and pilot projects for smoother assimilation. Additionally, challenges in data integration require robust architectures, quality assurance measures, and advanced analytics to harness the full potential of the Kano model within Industry 4.0. Addressing scalability concerns mandates modular design, standardized processes, and investments in scalable technologies to sustain integration efforts amidst organizational growth.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of Kano model in Industry 4.0 conditions.

Keywords: Industry 4.0; Quality 4.0, quality management; quality methods, Kano model.

Category of the paper: literature review.

1. Introduction

The Kano model and Industry 4.0 represent two distinct yet complementary frameworks that play crucial roles in modern business practices and product development strategies. The Kano model, as previously discussed, provides a structured approach to understanding and categorizing customer preferences and requirements. It helps businesses prioritize product

features and allocate resources effectively by differentiating between basic, performance, and delight attributes. By leveraging the insights offered by the Kano model, companies can tailor their offerings to better meet customer needs and expectations, ultimately driving customer satisfaction and loyalty (Barsalou, 2023; Maganga, Taifa, 2023).

On the other hand, Industry 4.0, often referred to as the fourth industrial revolution, encompasses the integration of advanced technologies such as artificial intelligence, Internet of Things (IoT), robotics, and big data analytics into manufacturing and production processes. Industry 4.0 aims to create smart factories and supply chains that are more efficient, flexible, and responsive to customer demands. Through the digitization and automation of various tasks, Industry 4.0 enables companies to achieve higher levels of productivity, quality, and customization while reducing costs and time-to-market.

The purpose of this publication is to present the usage of Kano model approach in Industry 4.0 condition.

2. The basics of Kano model approach

The Kano model, developed by Noriaki Kano in the 1980s, is a theory widely used in product development and customer satisfaction management. It offers a structured approach to understanding and categorizing customer preferences and requirements. This model is particularly valuable for businesses striving to enhance their competitive edge by delivering products and services that not only meet but exceed customer expectations. At its core, the Kano model proposes that customer satisfaction is not solely determined by meeting basic requirements but also by addressing additional factors that contribute to overall user experience. It introduces three main categories of product attributes: basic, performance, and delight (Yanamandra et al., 2023).

Basic attributes are fundamental features or functionalities that customers expect as a minimum requirement. These attributes, when present, do not necessarily lead to increased satisfaction, but their absence can result in significant dissatisfaction. For example, in a smartphone, basic attributes might include the ability to make calls, send text messages, and access the internet. Customers generally take these features for granted, and their presence is essential for the product to be considered functional and acceptable. Performance attributes refer to features that directly correlate with customer satisfaction in a linear manner. As the performance of these attributes improves, so does customer satisfaction. However, the absence of performance attributes does not necessarily lead to dissatisfaction. Instead, their presence enhances the perceived value of the product. Using the smartphone example, a longer battery life, faster processing speed, and high-resolution camera would be considered performance attributes. Customers appreciate these features and derive satisfaction from their presence (Singh et al., 2023).

Delight attributes, also known as excitors or delighters, are unexpected features that go beyond customer expectations and evoke a positive emotional response (Gajdzik et al., 2023). Unlike basic and performance attributes, which customers can articulate, delight attributes often surprise and delight customers, leading to increased loyalty and positive word-of-mouth promotion. These attributes differentiate a product in the market and create a lasting impression on users. In the context of a smartphone, features such as facial recognition, augmented reality capabilities, or personalized virtual assistants could be considered delight attributes (Jokovic et al., 2023).

The Kano model further distinguishes between must-be, one-dimensional, attractive, indifferent, and reverse attributes, based on how customers perceive the presence or absence of each attribute. Must-be attributes are basic features that are expected and result in dissatisfaction if absent but do not necessarily increase satisfaction when present. One-dimensional attributes are performance features where an increase in functionality directly leads to increased satisfaction. Attractive attributes are delighters that exceed customer expectations and generate positive feelings. Indifferent attributes have no significant impact on satisfaction, regardless of their presence or absence. Reverse attributes are features that, if present, can actually lead to dissatisfaction (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Gajdzik, Wolniak, 2023; Swarnakar et al., 2023).

By analyzing customer preferences and perceptions across these categories, businesses can prioritize product development efforts, allocate resources efficiently, and tailor marketing strategies to better meet customer needs and expectations. Implementing the Kano model enables organizations to create products and services that not only fulfill basic requirements but also delight customers, fostering long-term relationships and sustainable competitive advantage in the marketplace (Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021, 2022).

Table 1 contains description of Kano model key principles. This table outlines the main principles of the Kano model, categorizing product attributes based on their impact on customer satisfaction and perception.

Table 1.

Key principles of Kano model

Key principle	Description
Basic Attributes	Fundamental features or functionalities that customers expect as a minimum requirement. Their absence leads to dissatisfaction.
Performance Attributes	Features that correlate with customer satisfaction in a linear manner. Improving these attributes enhances satisfaction.
Delight Attributes	Unexpected features that go beyond customer expectations and evoke a positive emotional response, leading to increased loyalty.
Must-be Attributes	Basic features that are expected and result in dissatisfaction if absent but do not necessarily increase satisfaction when present.
One-dimensional Attributes	Performance features where an increase in functionality directly leads to increased satisfaction.

Cont. table 1.

Attractive Attributes	Delighters that exceed customer expectations and generate positive feelings, differentiating a product in the market.
Indifferent Attributes	Features that have no significant impact on satisfaction, regardless of their presence or absence.
Reverse Attributes	Features that, if present, can actually lead to dissatisfaction.

Source: (Almeida, Abreu, 2023; Jokovic et al., 2023; Khourshed, Gouhar, 2023; Maganga, Taifa, 2023; Liu et al., 2023; Yanamandra et al., 2023; Escobar et al., 2023; Bousdekis et al., 2023; Antony et al., 2023).

3. How Kano model method can be integrated with Industry 4.0 and Quality 4.0 concept

The relationship between the Kano model and Industry 4.0 lies in their shared focus on customer-centricity and innovation. By embracing Industry 4.0 technologies, organizations can gather vast amounts of data on customer behavior, preferences, and market trends in real-time. This data-driven approach aligns closely with the principles of the Kano model, allowing businesses to gain deeper insights into customer needs and preferences (Bousdekis et al., 2023). Moreover, Industry 4.0 enables companies to rapidly prototype and iterate product designs, facilitating the implementation of delight attributes that differentiate their offerings in the market. Furthermore, Industry 4.0 facilitates greater personalization and customization of products, which aligns with the concept of delight attributes in the Kano model. By leveraging advanced technologies such as AI and IoT, companies can offer tailored solutions that address specific customer needs and preferences, thereby enhancing customer satisfaction and loyalty (Alrabadi et al., 2023).

The integration of the Kano model method with Industry 4.0 and Quality 4.0 concepts represents a powerful approach to optimizing product development and enhancing overall quality management in the digital age (Maganga, Taifa, 2023).

Industry 4.0, with its emphasis on digitization, connectivity, and automation, provides a fertile ground for the application of the Kano model. By leveraging advanced technologies such as IoT sensors, AI-powered analytics, and digital twin simulations, companies can collect vast amounts of data on customer preferences, market trends, and product performance in real-time. This data-driven approach enables businesses to gain deeper insights into customer needs and expectations, aligning closely with the principles of the Kano model (Jonek Kowalska, Wolniak, 2021, 2022).

Moreover, Industry 4.0 facilitates greater agility and flexibility in the product development process, allowing companies to rapidly prototype, iterate, and customize products to meet evolving customer demands. By integrating the Kano model into the design and development phases, organizations can prioritize features and functionalities based on their impact on

customer satisfaction, thereby ensuring that resources are allocated effectively to deliver maximum value to customers. Furthermore, the integration of Quality 4.0 concepts, which focus on leveraging digital technologies to enhance quality management practices, complements the application of the Kano model and Industry 4.0. Quality 4.0 enables companies to implement advanced quality control techniques such as predictive analytics, real-time monitoring, and automated defect detection to ensure product consistency and reliability throughout the production process (Antony et al., 2023; Escobar et al., 2023; Antony et al., 2023; Salimbeni, Redchuk, 2023).

By integrating Quality 4.0 principles with the Kano model, organizations can proactively identify potential quality issues and address them before they impact customer satisfaction. For example, predictive analytics algorithms can analyze data from IoT sensors to anticipate product failures or performance issues, allowing companies to take preemptive measures to rectify the underlying causes. Moreover, the Kano model can help prioritize quality attributes based on their perceived importance to customers, guiding organizations in allocating resources to areas that have the greatest impact on overall customer satisfaction. By combining the insights from the Kano model with Quality 4.0 technologies, companies can establish a proactive quality management framework that not only meets but exceeds customer expectations, driving long-term loyalty and competitive advantage in the marketplace (Jonek-Kowalska, Wolniak, 2021, 2022, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021, Orzeł, Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecula, Wolniak, 2022; Olkiewicz et al., 2021).

The integration of the Kano model method with Industry 4.0 and Quality 4.0 concepts represents a synergistic approach to product development and quality management. By leveraging advanced technologies and data-driven insights, organizations can create innovative products that not only meet customer needs but also deliver exceptional quality and value, positioning themselves for success in the digital era.

Table 2 is listing examples of integration of Kano model method with Industry 4.0. This table outlines the integration of the Kano Model with Industry 4.0, highlighting the benefits and key considerations for manufacturers looking to leverage both frameworks to enhance customer satisfaction and competitiveness in the digital age.

Table 2.
Kano model integration with industry 4.0

Aspect	Description
Kano Model Overview	The Kano Model is a theory developed by Professor Noriaki Kano in the 1980s, used to prioritize customer needs and preferences into categories: basic, performance, and excitement. It assesses how different product features influence customer satisfaction.
Industry 4.0 Overview	Industry 4.0 refers to the fourth industrial revolution, characterized by the integration of digital technologies such as IoT, AI, big data, and automation into manufacturing processes. It emphasizes the use of cyber-physical systems to create smart factories that are more efficient, flexible, and interconnected.

Cont. table 2.

Integration Benefits	By applying the Kano Model within Industry 4.0, manufacturers can better understand and prioritize customer preferences, leading to the development of products and services that align with market demands. Industry 4.0 technologies enable mass customization by integrating customer feedback directly into the manufacturing process, allowing for the creation of personalized products tailored to individual preferences. The Kano Model facilitates agile development methodologies by categorizing features based on their impact on customer satisfaction, allowing manufacturers to quickly adapt to changing market needs and preferences.
Data Integration	Industry 4.0 relies heavily on data collection and analysis from various sources, including sensors, machines, and customer feedback channels. Integrating the Kano Model with Industry 4.0 involves incorporating customer satisfaction data into the manufacturing process, enabling real-time adjustments and improvements based on customer preferences.
Predictive Analytics	By leveraging predictive analytics algorithms within Industry 4.0 systems, manufacturers can anticipate customer preferences and trends based on historical data. Integrating the Kano Model with predictive analytics allows for the proactive development of features that are likely to excite customers, leading to competitive advantages in the market.
Continuous Improvement	Industry 4.0 promotes a culture of continuous improvement through technologies like IoT and AI, which provide real-time insights into production processes. By integrating the Kano Model with Industry 4.0, manufacturers can continuously monitor customer satisfaction metrics and iterate on product features to maintain or enhance customer satisfaction levels over time.
Real-Time Feedback	Industry 4.0 enables the collection of real-time feedback from customers through various channels, such as social media, online reviews, and IoT-enabled devices. Integrating the Kano Model with real-time feedback mechanisms allows manufacturers to promptly identify and address emerging customer needs and preferences, fostering greater customer loyalty and market competitiveness.
Product Lifecycle Management	The Kano Model can be integrated into product lifecycle management (PLM) systems within Industry 4.0 frameworks, enabling manufacturers to track and manage customer satisfaction metrics throughout the entire product lifecycle. This integration facilitates data-driven decision-making at every stage, from product design and development to post-sales support and service, ensuring that customer needs are consistently met and exceeded.

Source: (Almeida, Abreu, 2023; Jokovic et al., 2023; Khourshed, Gouhar, 2023; Maganga, Taifa, 2023; Liu et al., 2023; Amat-Lefort et al., 2023; Alrabadi et al., 2023; Singh et al., 2023; Barsalou, 2023; Antony et al., 2023; Saihi et al., 2023; Sureshchandar, 2023; Swarnakar et al., 2023; Gimerska et al., 2023; Salimbeni, Redchuk, 2023; Yanamandra et al., 2023; Escobar et al., 2023; Bousdekis et al., 2023; Antony et al., 2023).

Table 3 is describe the advantages Kano model approach usage in industry 4.0. This table illustrates how the integration of the Kano Model with Industry 4.0 offers numerous advantages for manufacturers, ranging from improved customer satisfaction and product development to enhanced agility, customization, and competitive positioning in the market.

Table 3.

The advantages of Kano model integration with industry 4.0

Advantage	Description
Enhanced Customer Satisfaction	By integrating the Kano Model with Industry 4.0, manufacturers can gain deeper insights into customer preferences and priorities. This leads to the development of products and services that better meet customer needs, ultimately enhancing satisfaction levels and fostering greater brand loyalty.

Cont. table 3.

Improved Product Development	Industry 4.0 technologies enable rapid prototyping and iterative product development cycles. By incorporating the Kano Model into this process, manufacturers can prioritize features based on their impact on customer satisfaction, resulting in more focused and efficient product development efforts. This leads to the creation of products that resonate more strongly with target markets, driving sales and profitability.
Agile Response to Market Dynamics	Industry 4.0 facilitates agile manufacturing processes, allowing companies to quickly adapt to changing market conditions and customer preferences. By integrating the Kano Model, manufacturers can identify emerging customer needs in real-time and respond promptly with innovative product features or modifications. This agility enables companies to stay ahead of competitors and maintain a competitive edge in dynamic market environments.
Customization and Personalization	Industry 4.0 enables mass customization through flexible manufacturing systems and digital technologies. Integrating the Kano Model with these capabilities allows manufacturers to tailor products to individual customer preferences, delivering personalized experiences that drive customer satisfaction and brand differentiation. This customization enhances perceived product value and fosters stronger customer relationships.
Data-Driven Decision Making	Industry 4.0 generates vast amounts of data from various sources throughout the product lifecycle. By integrating the Kano Model with data analytics tools, manufacturers can extract actionable insights from this data, informing strategic decision-making processes. These data-driven decisions lead to more informed product design, marketing strategies, and resource allocations, resulting in improved overall business performance and profitability.
Continuous Improvement and Innovation	Industry 4.0 promotes a culture of continuous improvement and innovation through iterative design processes and real-time feedback loops. By integrating the Kano Model, manufacturers can systematically track customer satisfaction metrics and iteratively improve product features to meet evolving market demands. This fosters innovation and ensures that products remain competitive and relevant in the long term.
Competitive Advantage	The integration of the Kano Model with Industry 4.0 provides companies with a significant competitive advantage in the marketplace. By aligning product development efforts with customer preferences and leveraging digital technologies for agile manufacturing, companies can differentiate themselves from competitors, attract more customers, and capture greater market share. This sustainable competitive advantage drives long-term business success and growth.

Source: (Almeida, Abreu, 2023; Jokovic et al., 2023; Khourshed, Gouhar, 2023; Maganga, Taifa, 2023; Liu et al., 2023; Amat-Lefort et al., 2023; Alrabadi et al., 2023; Singh et al., 2023; Barsalou, 2023; Antony et al., 2023; Saihi et al., 2023; Sureshchandar, 2023; Swarnakar et al., 2023; Gimerska et al., 2023; Salimbeni, Redchuk, 2023; Yanamandra et al., 2023; Escobar et al., 2023; Bousdekis et al., 2023; Antony et al., 2023).

Table 4 is describe the problems of Kano model approach usage in Industry 4.0 and methods to overcome them. Addressing these problems requires a strategic and thoughtful approach, involving a combination of technological solutions, organizational change management, and ongoing adaptation to evolving industry standards and practices.

Table 4.*The problems of Kano model integration with industry 4.0*

Problems	Description of Problem	Overcoming Strategies
Lack of understanding of Industry 4.0 concepts	Many organizations struggle to fully comprehend the intricacies and implications of Industry 4.0, making it challenging to integrate the Kano model effectively within this framework.	<ol style="list-style-type: none"> 1. Education and Training: Provide comprehensive training programs to employees and management on Industry 4.0 concepts and how they relate to the Kano model. 2. Collaboration: Foster partnerships with experts in Industry 4.0 to gain insights and guidance on integrating the Kano model within this context. 3. Pilot Projects: Initiate small-scale pilot projects to experiment with the integration of the Kano model and Industry 4.0, allowing for iterative learning and adjustment.
Data Integration Challenges	Industry 4.0 relies heavily on data-driven processes, and integrating the Kano model within this environment requires overcoming challenges related to data collection, analysis, and utilization.	<ol style="list-style-type: none"> 1. Data Architecture: Develop a robust data architecture that facilitates seamless integration of Kano model data with other Industry 4.0 systems and processes. 2. Data Quality Assurance: Implement measures to ensure the accuracy, consistency, and reliability of data used in conjunction with the Kano model in Industry 4.0 applications. 3. Advanced Analytics: Employ advanced analytics techniques such as machine learning and artificial intelligence to derive meaningful insights from Kano model data within Industry 4.0.
Scalability Issues	As organizations grow and evolve within the context of Industry 4.0, scalability becomes a crucial concern for integrating the Kano model effectively across diverse products and services.	<ol style="list-style-type: none"> 1. Modular Approach: Design the integration of the Kano model with Industry 4.0 systems in a modular fashion, allowing for scalability and adaptability to changing business needs. 2. Standardization: Establish standardized processes and methodologies for applying the Kano model across different product lines and business units within the Industry 4.0 framework. 3. Scalable Technologies: Invest in technologies that can scale efficiently alongside the growth of Industry 4.0 initiatives, ensuring compatibility with the integrated Kano model.

Source: (Almeida, Abreu, 2023; Jokovic et al., 2023; Khourshed, Gouhar, 2023; Maganga, Taifa, 2023; Liu et al., 2023; Amat-Lefort et al., 2023; Alrabadi et al., 2023; Singh et al., 2023; Barsalou, 2023; Antony et al., 2023; Saihi et al., 2023; Sureshchandar, 2023; Swarnakar et al., 2023; Gimerska et al., 2023; Salimbeni, Redchuk, 2023; Yanamandra et al., 2023; Escobar et al., 2023; Bousdekis et al., 2023; Antony et al., 2023).

4. Conclusion

The integration of the Kano model with Industry 4.0 presents a promising approach to enhancing product development, customer satisfaction, and overall competitiveness in the digital era. By combining the structured approach of the Kano model with the advanced technologies and principles of Industry 4.0, organizations can unlock numerous benefits and overcome various challenges.

The Kano model offers a systematic framework for understanding and categorizing customer preferences, distinguishing between basic, performance, and delight attributes. This model helps businesses prioritize product features and allocate resources effectively, leading to enhanced customer satisfaction and loyalty. On the other hand, Industry 4.0 revolutionizes manufacturing processes through digitization, connectivity, and automation, enabling companies to achieve higher levels of efficiency, flexibility, and responsiveness to customer demands. However, integrating the Kano model with Industry 4.0 is not without its challenges. One significant issue is the lack of understanding of Industry 4.0 concepts among organizations, hindering effective integration efforts. To address this, strategies such as education and training, collaboration with industry experts, and initiating pilot projects can help bridge the knowledge gap and facilitate smoother integration.

Another challenge is data integration, as Industry 4.0 relies heavily on data-driven processes, and integrating the Kano model requires overcoming challenges related to data collection, analysis, and utilization. Developing a robust data architecture, ensuring data quality assurance, and leveraging advanced analytics techniques can help address these challenges and derive meaningful insights from Kano model data within Industry 4.0 applications. Scalability issues also arise as organizations grow within the context of Industry 4.0, making it crucial to design the integration of the Kano model in a modular fashion, establish standardized processes, and invest in scalable technologies.

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BENEFITS DERIVED BY BUSINESSES FROM INNOVATIONS

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Purpose: This publication is aimed at identifying the potential financial benefits derived by businesses from innovations. A research gap has been identified and will be the basis for designing and implementing research involving enterprises.

Design/methodology/approach: A systematic review of the literature in the Web of Science and Scopus databases, in accordance with the approach proposed by H. Snyder (Snyder, 2019) was used for this research.

Findings: Thanks to the literature review, attention was paid to the unequivocal results of prior research on the benefits that can be achieved by businesses which decide to implement innovations.

Originality/value: The research has shown a potential research gap in current publications in the selected databases of research results in terms of evaluating the benefits of innovations if non-refundable EU subsidy is obtained.

Keywords: innovations, financial benefits, enterprise.

Category of the paper: Literature review.

1. Introduction

Many authors write about the significance of innovations. The concept was popularised by J.A. Schumpeter, who is often considered to be a forerunner or protagonist of the theory of innovation (Gust-Bardon, 2012; Musiał, Chrzanowski, 2018). In his view innovation is (1) introducing a new product which has not been available to customers thus far or equipping with new characteristics or enhancing an existing product in a considerable manner, (2) introducing a new manufacturing method which has not been used so far in a given area, opening a new market, creating a new market segment or entering a new geographical market, (3) obtaining a new source of raw materials or intermediate products irrespective of whether it existed earlier or not or (4) introducing a new organisation in a specific industry, e.g. by creating or eliminating a monopoly (Schumpeter, 1960).

In the definition of innovations proposed by Schumpeter, it should be noted that it is about the real activities of an innovator which are crowned with the effect of marketing a solution. This means that Schumpeter does not treat activities only characterised by innovativeness as innovations, as he sees innovations as being related to inventiveness and manifested by, for example, new inventions. If an invention is not commercialised, i.e. if it is not marketed, it is not considered by Schumpeter to be an innovation, which he associates with inventiveness.

S. Taylor believes that a society develops along with the implementation of new ideas which allow for new solutions to existing problems or improvements to existing systems, processes and products. In his opinion, the proper support and implementation of innovations requires an understanding of how an innovation may be implemented in a world in which people live to ensure benefits to improve their lives. Thus, this seems to demonstrate the final outcome of the development of modern solutions (Taylor, 2017). The fact that innovations are the driving force of progress should raise no doubts.

2. Research Methodology

The method of systematic literature review was used in the analysis. The procedure was based on methodological guidelines suggested by W. Czakon (Czakon, 2011) and H. Snyder (Snyder, 2019). Thanks to this approach, the research procedure may be replicated.

The research problem defined for this research was determining a possible influence of innovations implemented in businesses on the benefits generated thereby, especially financial ones. The following research questions were posed:

1. How can innovations affect the financial results of the enterprise implementing them?
2. What factors determine the financial benefits of implementing an innovation?

The research procedure consisted of several stages. Two of the most popular international databases for publications, Web of Science and Scopus, were selected for the purposes of this research. Based on the analysis of the literature, keywords were specified as filter criteria in databases. Upon choosing publications, their titles and article abstracts were analysed; those not related to the assumptions of this research were rejected. The selected small group of publications was further analysed in terms of content.

This text is the first part of a series of papers. The next article will include the results of empirical research carried out in companies based on the literature review described above.

3. Course of Research and Research Results

The term “benefits of innovations” was chosen to be the first search criterion in databases of scientific publications. In this way, 165 items from Web of Science and 246 items from Scopus were chosen. After combining both sets and removing duplicates, 274 elements were obtained for the purposes of analysis of titles and abstracts. After this stage, there were only 92 publications left for further analysis of their content. This analysis reduced the number to only 22 items meeting the specific requirements to the greatest extent.

The analysis of the content suggested that innovations may have a positive influence on the likelihood of survival for companies which implement them. Additionally, research published by E. Cefis and O. Marsili confirms that the effect intensifies over time and depends on the age and size of the company. It was observed that the risk of going out of business is highest among small, young companies. However, it is also surprising that the same risk applies to companies which use innovations to the greatest extent in order to survive on the market, especially in the long term (Cefis, Marsili, 2006).

M. Cuijpers, H. Guenter, and K. Hussinger studied the costs of innovative operations, and after analysing 433 German production companies they came to the conclusion that the problem may be solved by cooperating on innovations, which may also increase the efficiency of process innovations. Even though it may generate extra costs, e.g. project delays, this does not affect the results in terms of innovations at the company level. Thus, it may be concluded that companies may balance the costs and benefits of such cooperation in a portfolio of innovative projects (Cuijpers, Guenter, Hussinger, 2011). C. Wang, Y. Cen, R. Sun and H. Ying also looked at the high costs and considerable uncertainty of innovative activities. It is their view that a good solution may be to establish cooperation when carrying out research and development (Wang, et al., 2021). Rising costs result from stronger market competition, which in turn forces greater expenses on research and development. However, the uncertainty of innovations may mean that the benefits derived from it are lower than the costs. This is emphasised by J. Wei, who believes that this may be solved by an attempt to distribute costs among a higher number of entities, e.g. as part of industrial clusters (Wei, 2011). Turning to imitation, which may bring greater benefits to companies than innovations and which is the result of governmental intervention in China and India to promote state companies, is another solution suggested by E. Yan (Yan, 2020).

The benefits of innovation in business may include various factors, such as efficiency, an increased competitive advantage and improved reputation. Technology companies which rely on new products or improve existing products have an advantage over those which simply manufacture traditional products or services with a low level of novelty (Bolatan et al., 2022). This has been confirmed by V. Intrama, who writes that the benefits resulting from innovations are non-debatable. Most importantly, they may increase goodwill, no matter whether the

company produces goods or renders services. He also emphasises that process efficiency may be improved, leading to enhanced productivity (Intrama, 2020). E. Fontela believes that lower manufacturing costs may also be a benefit of innovations. In addition to enterprises that implement innovations and their owners, suppliers, employees or consumers who may purchase cheaper products also have a share in this cost reduction (Fontela, 1994). On the basis of their research, A.N. Mai, H.V. Vu, B.X. Bui and T.Q. Tran reported that higher profits are earned by innovative companies in comparison to non-innovative companies. They also note that the same effect is observed in both the short term and the long term (Mai et al., 2019). The same view is also shared by M.E. Ogbari, M.A. Olokundun, J. Taiwo-Adelakun, O.J. Kehinde and A.B. Amaihian, who point to an increased profit rate (Ogbari et al., 2019). Positive economic results may result from increased productivity, which may be related to production costs of not only products, but also services (Mason, 1992). Profits are particularly noticeable in businesses which implement innovations on a global scale, as confirmed by J.C. Percival and B.P. Cozzarin (Percival, Cozzarin, 2008). B.-H. Tsai, in turn, states that companies with a sizeable market share may derive even greater benefits. He also confirms the correlation between market share or innovations and company goodwill (Tsai, 2007). P. Ueasangkomsate enumerates the benefits of implementing innovations such as cost reduction, also through reduced employment, lower demand for office space, time flexibility, quicker response time, stimulated cooperation, increased market penetration and work flexibility (Ueasangkomsate, 2022). V. Vannoni, in turn, observes a relationship between innovations and company turnover and its size (through increased employment), though innovations do not always translate into increased profitability of operations (Vannoni, 2019).

However, R.W. Fri claims that innovative companies may not achieve economic benefits or they may be unavailable (Fri, 2003). J. Damijan, C. Kostevc and M. Rojec, in turn, determined that only manufacturing companies characterised by growth in productivity below average may derive considerable benefits from the effective implementation of innovations. Enterprises which develop well do not achieve any additional benefits from innovations (Damijan, Kostevc, Rojec, 2012). In the book they edited, K.-E. Sveiby, P. Gripenberg and B. Segercrantz are critical of the assessment that innovations are important economic measures of enterprise functioning. They emphasise the possibility of undesired consequences and argue that external factors may reduce the benefits of innovations (Sveiby, Gripenberg, Segercrantz, 2012).

Even though they do not question the positive influence of innovations on businesses, L.O. Meertens, N. Sweet and M.E. Iacob point out that research and development entities which have problems proving their value added may experience issues related to costs. This is particularly painful in crises, when their budgets are reduced to decrease costs in the short term. Such steps may result in decreased competitiveness, not only of companies but even of whole industries or economies (Meertens, Sweet, Iacob, 2015).

M. Rousseau, B. Mathias, L. Madden and T. Crook point out that even though innovations are considered to be the driving force of development of many organisations, businesses may often find it difficult to realise the expected benefits of innovations. Research on innovations often yields ambiguous results. Based on the research, they conclude that benefits expressed as non-financial values (e.g. increased market share or sales dynamics) indicate considerably better effects from innovations than financial measures (e.g. ROA). They also point out that large companies frequently derive greater benefits from innovations than small companies, which may imply that there are additional factors which affect the outcomes of the innovation implementation process (Rousseau, et al., 2016). Innovative companies may bear a higher financial risk resulting from a compromise between innovation and product reliability. A. Mackelprang, M. Habermann and M. Swink note that unexpected failures may generate costs which substantially reduce the positive economic result of innovations (Mackelprang, Habermann, Swink, 2015).

C. Poblete drew interesting conclusions regarding the role of innovations in business results. In his opinion, innovation may act as a motivating force which increases the developmental expectations of companies (Poblete, 2018).

4. Summary and Conclusions

The literature review has identified the unclear, heterogeneous benefits of innovations. To summarise the research findings, the following general conclusions can be drawn:

Innovations do not always lead to describable economic benefits, especially profits or profitability of operations.

The costs of innovative activities, especially research and development, are so high that they may significantly reduce the potential benefits of innovations. Cooperating with other entities may be a method to overcome these obstacles.

Entities involved in research and development always have problems proving added value and very frequently face problems with cost level, which results in cost reductions – especially in times of crisis – and disturbed functioning, which threatens the level of innovations not only in companies or industries, but also entire economies.

State interventionism may have an adverse effect on market balance, which may lead to companies focusing on imitation to avoid competition with favoured state enterprises.

The introduction of innovations in companies may enhance non-financial factors (market share or sales dynamics), but it may also increase the company's chances of survival.

Financial benefits such as increased profit may depend on enterprise size (larger enterprises achieve better results) and the type of innovation implemented (global innovations are more prone to stimulate profit than innovations at the national or local level).

The risk related to reliability of products is a serious problem with innovation, which may also lead to higher costs of warranty service and lower benefits of innovation.

This research shows that innovations may potentially lead to improved financial results of enterprises, but do not guarantee them. Therefore, further analysis of the relationship is necessary. It seems particularly important to analyse more deeply matters related to interventions with public funds as a potential disturbance of market rules and a factor contributing to increased innovation and stimulating financial results of the beneficiaries. Therefore, it is justified to conduct research on innovative enterprises in two groups: those which implement innovations without support from subsidies and those which receive such aid. Obviously, it seems important to investigate the type of operations and innovations in which such support is most effective and efficient.

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EXPLORING PUBLIC OPINION: A SENTIMENT ANALYSIS OF YOUTUBE COMMENTS ON HEAT PUMP VIDEOS

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Purpose: This study aims to ascertain public sentiments, thoughts, and opinions about “heat pumps” through sentiment analysis of comments posted on YouTube videos.

Design/methodology/approach: Video comments were automatically downloaded and pre-processed. This preprocessing involved removing all characters except for letters, as well as eliminating URLs, hashtags, emojis, and search-related words from the text. The sentiment value of each comment was then assessed. Visual representations were employed to depict the distribution of positive, negative, and neutral sentiments across the comments. Additionally, a word cloud was used to highlight the most frequently occurring words within these comments.

Findings: For the comments on videos about heat pumps, the proportions of positive, negative, and neutral sentiments were calculated. Additionally, data concerning the number of videos published, the total views received by these videos, their duration, the number of comments made, and the length of these comments were collected and analysed.

Research limitations/implications: The study focused exclusively on comments from videos containing the words “heat pump” in their titles, assuming relevance to the subject of heat pumps. Only comments in Polish were selected for analysis. The sentiment analysis was conducted autonomously using the “ccl emo” service, without manual oversight. This analysis was limited to assessing the sentiments of YouTube users, based on the assumption that the comments reflect discussions pertinent to the video content.

Practical implications: Automated analysis of public opinions on photovoltaics.

Originality/value: Opinions about heat pumps were gathered and analysed. The increasing number of videos and comments indicates a steady rise in interest in heat pumps within Poland.

Keywords: sentiment analysis, YouTube, heat pump, text mining.

Category of the paper: research paper, case study.

1. Introduction

As global warming becomes increasingly evident in the environment, society is confronted with numerous climate-related challenges aimed at substantially reducing greenhouse gas emissions from the heating and cooling of buildings (Decuyper et al., 2022). The heating and

cooling of buildings account for one-tenth of anthropogenic greenhouse gas emissions. (Edenhofer, 2015). These emissions are expected to rise sharply in the coming decades (Ürge-Vorsatz et al., 2015). Heating systems require a swift transition to low-carbon alternatives to meet global climate targets (Martiskainen et al., 2021).

Thanks to technological advancements, heat pumps now have the potential to halve or more the emissions from heating and cooling in various settings (Billimoria et al., 2021). Heat pumps are versatile, utilizing renewable energy sourced from the air, water, ground, or exhaust from buildings to provide heating and cooling (Nowak, 2018). Two prevalent types of heat pumps are air-source, which transfers heat to and from the outdoor air, and ground-source, which transfers heat to and from the ground (Kircher, Zhang, 2021). Heat pumps can serve multiple functions, including heating and cooling buildings, generating electricity, and supplying hot water (Soltani et al., 2019). In recent years, heat pump technology has advanced significantly, improving both in efficiency and in heating performance at low temperatures (Chua et al., 2010). Despite their benefits, heat pumps encounter several barriers to widespread adoption, including the fact that their lifetime costs are not always competitive with existing technologies, such as natural gas furnaces (Billimoria et al., 2021). Even when the operating costs of heat pumps are competitive, the initial purchase and installation expenses can be prohibitively high (Bergman, 2013). Additional barriers to the adoption of heat pumps include locating installers who are knowledgeable about modern heat pump technology, selecting the appropriate models and sizes of heat pumps, and navigating the process of finding and applying for rebates, tax credits, and other incentives (Snape et al., 2015).

In the digital era, it has become common for people to express their opinions on social media. These expressions of thoughts, feelings, and judgments can be analyzed using a technique known as sentiment analysis. Sentiment analysis offers an automated approach to examining sentiment, emotion, and opinion expressed in written language (Xu et al., 2022). It involves the analysis, processing, summarizing, and interpretation of subjective texts with emotional nuances, such as valuable feedback on individuals, events, products, etc., shared by users online (Deng et al., 2022). It can be conducted to evaluate an individual's viewpoint or inclination towards a subject or issue, determining whether it leans towards a positive or negative perspective (Pang et al., 2002).

A significant data source containing people's opinions can be the comments posted on YouTube videos. YouTube is an online video platform that is rapidly expanding and receives nearly two billion views daily (Aydın, Yılmaz, 2021; Snelson, 2011). According to data as of May 09, 2024, more than 5 billion YouTube videos are viewed each day, there are 2.5 billion monthly active YouTube users, and more than 500 hours of YouTube videos are uploaded per minute (Omnicores, n.d.). As the world's largest video platform, YouTube presents a diverse array of media content created by both companies and individuals. This content includes music videos, promotional videos for products, vlogs, review videos, and educational content. (Muhammad et al., 2019).

A variety of tools can be utilised for analysing data retrieved from the internet. Due to the substantial volume of data, techniques such as text mining, data mining, machine learning, topic modelling, sentiment analysis, and similar approaches are commonly employed. The examination of data gathered from social media represents a burgeoning field. Its popularity is increasing due to its cost-effectiveness, easy accessibility, and the element of anonymity (Das et al., 2015, 2019; Evans-Cowley, Griffin, 2012). The literature contains numerous studies on sentiment analysis conducted on data extracted from the Internet (Ağrali, Aydin, 2021; Pang, Lee, 2004, 2008; Read, 2005). The utilization of sentiment analysis of text to ascertain public opinions on renewables was presented in (Corbett, Savarimuthu, 2022; Ibar-Alonso et al., 2022; Jain, Jain, 2019a, 2019b; Kim et al., 2021; Loureiro, Alló, 2020; Zarrabeitia-Bilbao et al., 2022).

2. Research Methodology

On May 5, 2024, a total of 4025 videos related to heat pumps were found on YouTube. Python 'scrapetube' library was utilized for this purpose (Twersky, n.d.). This library enables video searches on YouTube without the need for the official YouTube API. For conducting video searches, the author employed 57 phrases associated with heat pumps. These phrases were various combinations of the following three 2-grams: “pompa ciepła” (heat pump), “pompa gruntowa” (ground source heat pump), “pompa powietrzna” (air source heat pump). Examples of phrases included, among others, the following:

- “pompa ciepła”, “pompie ciepła”, “pomp ciepła” etc.
- “gruntowa pompa”, “pompa gruntowa”, “pompy gruntowej” etc.
- “pompa powietrzna”, “powietrzna pompa”, “powietrznej pompie” etc.

In the next step, comments posted by users under each video were downloaded using the "youtube-comment-downloader" package. This package provides a straightforward script for downloading YouTube comments without the need to utilise the YouTube API (*Youtube-Comment-Downloader*, n.d.).

The next phase involved the author removing:

- comments written in languages other than Polish,
- comments that were identical to others posted by the same user (often advertising services, products, or job opportunities from a company); the content was treated as a character string and compared using the "==" operator.

Subsequently, the content of the comments was pre-processed. This included the removal of URLs, hashtags, emojis, user names, search terms, and any characters that were not letters. The word count of each cleaned comment was then verified, and comments containing fewer than four words were excluded. After these processes, there were 185874 comments remaining.

These comments were associated with one of 2857 videos. The other 1168 videos either had no comments or their comments were eliminated during the pre-processing phase.

In the following step, the `ccl_emo` (https://wiki.clarin-pl.eu/pl/nlpws/services/ccl_emo; <https://clarin-pl.eu/index.php/wydzwiek>) service, developed by CLARIN-PL¹, was utilized. Known as "Wydzwięk" in Polish and "Sentiment" in English, this service is designed for the statistical analysis of texts' tones and emotions. (Grubljesic et al., 2019; Janz et al., n.d.).

Additionally, other services provided by CLARIN-PL were employed. These included:

- Any2txt - a service that converts text files (e.g. doc, docx, xlsx) into plain text.
- Speller2 - a service that checks the spelling of the text, utilizing a tool known as Autocorrect (<https://languagetool.org/pl>) for this purpose.
- Wcrft2 - is a basic morpho-syntactic tagger for the Polish language.
- WSD - a service designed for word sense disambiguation, specifically tailored for Polish texts. It employs plWordNet as a source of potential meanings, which organizes lexical units into synsets connected through lexico-semantic relationships. Each lexical unit encapsulates a lexical meaning and is defined by three elements: a lemma, a part of speech, and a sense identifier (Janz et al., n.d.).

The selected lexical units stored in plWordNet were enhanced with emotive annotations. Lexical units were characterized by (Janz et al., n.d.):

- sentiment polarity: it was evaluated using a 5-point scale, ranging from strong and weak through negative and positive, to neutral;
- basic emotions: gladness, trust, enjoyment of something expected, sadness, anger, fear, disgust, and surprise at something unpredictable. These emotions correspond to the eight basic emotions identified by Plutchik in his Wheel of Emotions (Plutchik, 1980; Wierzbicka, 1992a, 1992b);
- fundamental human values: utility, the good of another, truth, knowledge, beauty, happiness, uselessness, harm, ignorance, error, ugliness, unhappiness. These are the basic human values as indicated by (Puzynina, 1992).

In the next step, the sentiment of each comment was determined based on the polarity of the words it contained. A comment is considered to have a negative sentiment if it contains more negative words than positive ones. On the other hand, a comment is classified as having a positive sentiment when the number of negative words is fewer than the positive ones. A neutral sentiment is noted when the ratio of positive to negative words is equal. Additionally, each comment was analysed to identify the number of words annotated with basic emotions and fundamental human values.

¹ CLARIN-PL is a Polish scientific consortium, part of the European Research Infrastructure CLARIN (Common Language Resources and Technology Infrastructure) (CLARIN-PL, n.d.)

3. Results

A ribbon chart shown in Figure 1 illustrates the total number of videos retrieved, categorized into those with comments and those without. Additional detailed information can be found in Table 1. Importantly, there was a notable rise in video publication starting in 2019, with 129 videos published, and reaching a peak in 2023 with 1867 videos. Although the production of videos in 2024 has declined, it should be noted that the data was collected up until May 09, 2024. Therefore, the total count of videos for 2024 might increase as more videos could be published in the latter months of the year. As the chart shows, in the analysed dataset, the number of videos with comments was lower than those without comments only in the year 2012.

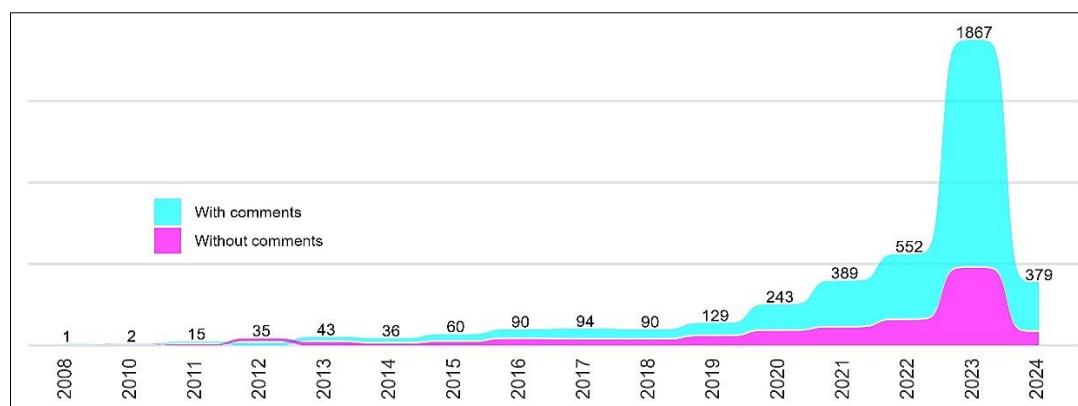


Figure 1. Distribution of the retrieved videos over the years. Note: videos for 2024 only gathered until May 9, 2024.

Sources: original research.

Table 1.

Distribution of the retrieved videos over the years. Note: videos for 2024 only gathered until May 9, 2024

Year	With comments	Without comments	Total
2008	1 (100%)	(0%)	1
2010	1 (50%)	1 (50%)	2
2011	9 (60%)	6 (40%)	15
2012	17 (48,57%)	18 (51,43%)	35
2013	22 (51,16%)	21 (48,84%)	43
2014	24 (66,67%)	12 (33,33%)	36
2015	38 (63,33%)	22 (36,67%)	60
2016	50 (55,56%)	40 (44,44%)	90
2017	58 (61,7%)	36 (38,3%)	94
2018	54 (60%)	36 (40%)	90
2019	72 (55,81%)	57 (44,19%)	129
2020	153 (62,96%)	90 (37,04%)	243
2021	278 (71,47%)	111 (28,53%)	389
2022	395 (71,56%)	157 (28,44%)	552
2023	1390 (74,45%)	477 (25,55%)	1867
2024	295 (77,84%)	84 (22,16%)	379
Total	2857 (70,98%)	1168 (29,02%)	4025

Sources: original research.

Figure 2 illustrates the number of films published by individual users. For example, in 2011, videos without comments were published by fifth users. One of them published two videos, while the remaining four each published one film. The box plots shown on the diagrams allow us to observe the distribution of the number of published films. For instance, the third quartile for films with comments in 2023 is 3, indicating that 75% of users published three or fewer films (in this case, meaning two or one film). To enhance the clarity of the chart for films with comments, 15 values were modified. If the number of published films exceeded 15, it was randomly replaced with a whole number between 16 and 20. The modified counts of published films ranged from 16 to 45. These numbers are now represented on the chart in the range from 16 to 20.

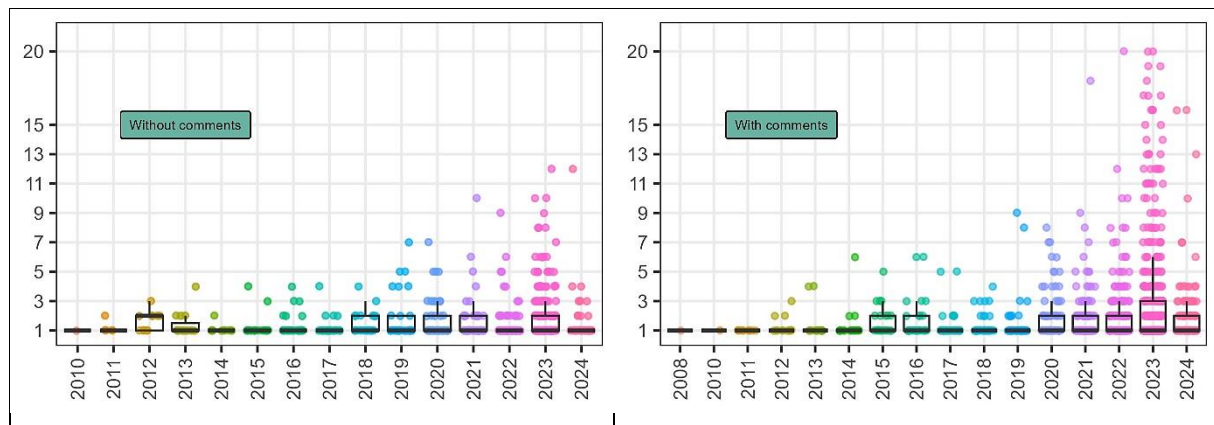


Figure 2. The number of videos published by users.

Sources: original research.

Figure 3 shows the view counts for videos, segmented into those with comments and those without. Each data point on the graph represents the view count for an individual video. To enhance the figure's clarity, a square root transformation was applied to the y-axis values, compressing higher values and expanding lower ones for better visibility. Further clarity was achieved by modifying view counts exceeding 0.8M, assigning them a fixed value between 1.04M and 1.05M. Among the videos without comments, one, published in 2024, has accumulated approximately 3.79M views to date. In contrast, among the videos with comments, there are 14 videos; the most viewed has attracted about 32.3M views, while the view counts of the remaining 13 videos range from 0.9M to 4M. The box plots shown in the figure illustrate the distribution of view counts across the videos. It can be observed that there were significantly more videos with comments, and they were viewed more frequently compared to those without comments. In the analysed dataset, there were no videos with comments from 2009, and none without comments from 2008 and 2009.

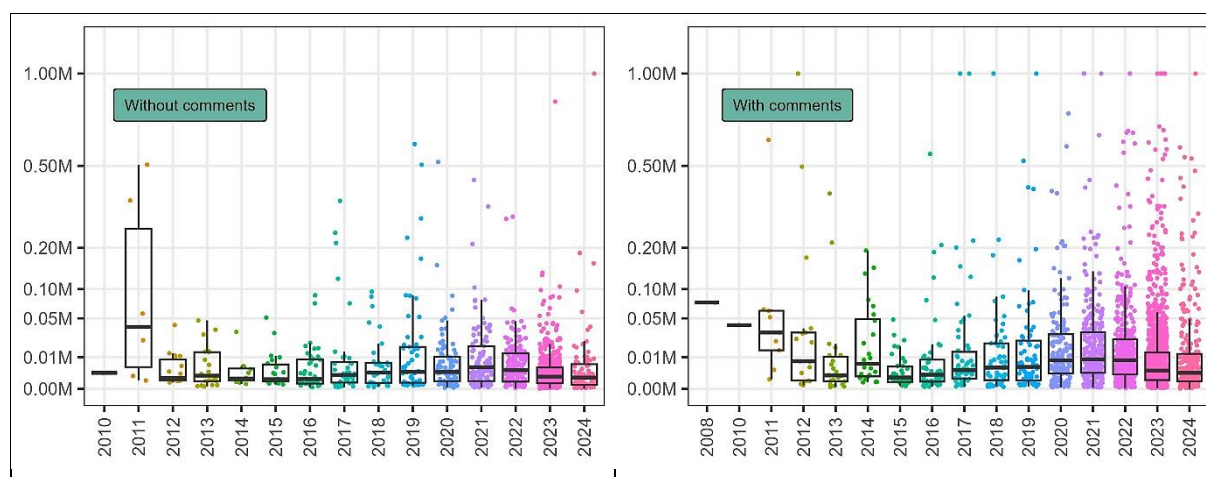


Figure 3. View counts of videos.

Sources: original research.

Table 2 presents the annual distribution of comments received by videos. For instance, videos from 2023 accumulated a total of 29,008 comments, of which 14,560 were replies to other comments. Comments in the analysed dataset were only received by videos from the year 2012 onwards. The high proportion of reply comments underscores the active exchange of information among users.

Table 2.

Total number of comments by year

Year	Comments	Comments as replies	Total
2012	20 (100%)	0 (0%)	20
2013	34 (100%)	0 (0%)	34
2014	39 (84%)	7 (16%)	46
2015	32 (68%)	15 (32%)	47
2016	54 (59%)	37 (41%)	91
2017	1003 (68%)	465 (32%)	1468
2018	318 (51%)	300 (49%)	618
2019	595 (46%)	697 (54%)	1292
2020	2637 (39%)	4011 (61%)	6648
2021	10327 (45%)	12417 (55%)	22744
2022	14161 (38%)	22491 (62%)	36652
2023	33882 (41%)	48478 (59%)	82360
2024	14006 (41%)	19848 (59%)	33854
Total			185874

Sources: original research.

The left side of Figure 4 illustrates the annual count of comments received by videos, with each video depicted as a single point on the chart. For instance, a video from 2013 garnered 14 comments. The box plots included in the figure demonstrate the distribution of comment counts. For example, the third quartile for 2022 is 36, suggesting that 75% of the videos that year received no more than 36 comments. To enhance the clarity of the figure, certain values have been adjusted. The number of comments exceeding 500 were randomly replaced with whole numbers between 501 and 600. There were 40 films for which the number of comments in a given year exceeded 500 (the number of received comments ranged from 511 to 3535).

The right side of the figure shows the distribution of comments received, not categorized by year, and includes both a box plot and a density plot, which indicates that the most common number of comments received is 1. On this chart, the number of comments exceeding 500 was also modified. There were 50 such films. Throughout the study period, they received between 502 and 5020 comments in total.

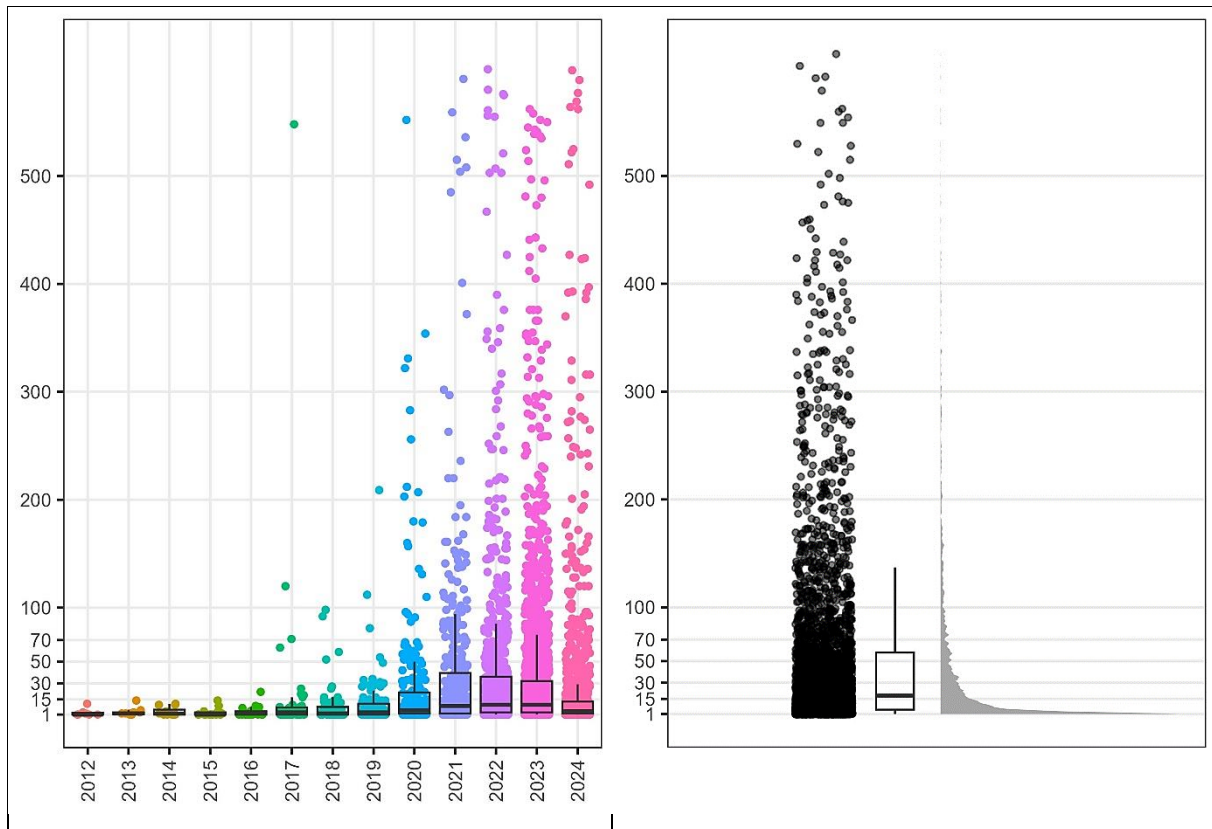


Figure 4. The number of comments received by videos.

Sources: original research.

Figure 5 shows the duration of films with comments in minutes. On the left side, the lengths are segmented by year. For instance, the longest film in 2011 was approximately 10 minutes. The box plots in the figure illustrate the distribution of film durations. For example, for 2022, the third quartile is about 16 minutes, indicating that 75% of the films from that year were 16 minutes or shorter. To improve the legibility of the diagram, some durations have been adjusted. If a film's duration exceeded 90 minutes, it was randomly adjusted to a number between 90 and 100. A total of 32 films had durations over 90 minutes, with specific durations ranging from 93 to 196 minutes. These adjusted durations are depicted on the plots within the 90 to 100-minute range. On the right side, the diagram shows the distribution of film durations without annual segmentation. Alongside the box plot, a density plot is also included, from which we can deduce that the most common film duration is approximately 1 minute.

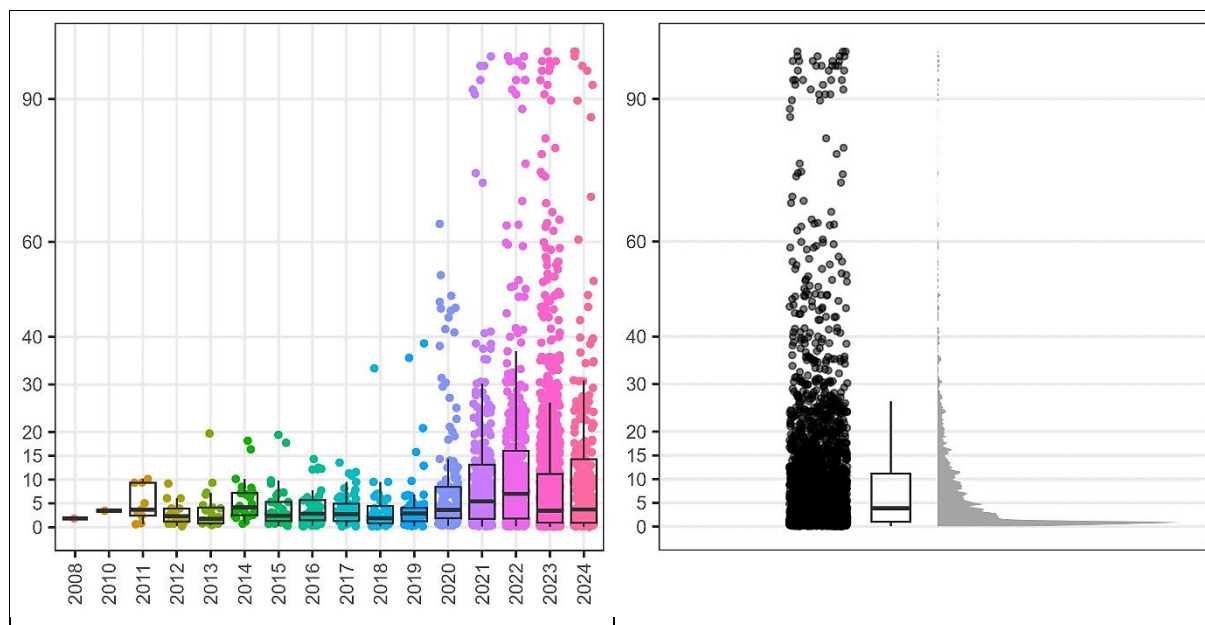


Figure 5. The duration of videos with comments in minutes.

Sources: original research.

Figure 6 and Table 3 present information about the number of words in comments. Figure 6 illustrates the number of comments containing from 4 to 100 words. These comments constituted approximately 94,8% of all comments. The largest group consisted of comments composed of 6 words. The largest group of comments consisted of 5 words. There were 9085 such comments.

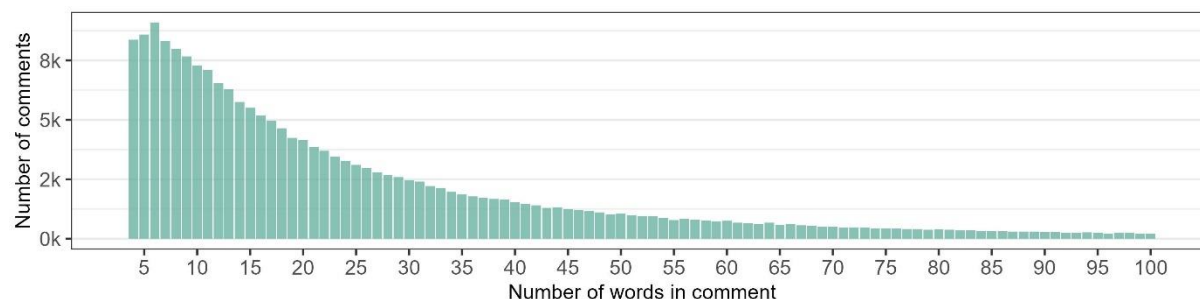


Figure 6. Number of words in comments.

Sources: original research.

Table 3.

Number of words in comments

Number of words in the comment	Number of comments
from 4 to 10	57302 (27,40%)
from 11 to 20	54386 (26,00%)
from 21 to 40	49882 (23,85%)
from 41 to 100	36757 (17,58%)
from 101 to 250	9693 (4,63%)
from 251 to 500	1018 (0,49%)
from 501 to 1388	102 (0,05%)
Total	209140

Source: original research.

Table 3 displays the percentage distribution of comments by word count. The predominant group comprised comments of 4 to 10 words, accounting for 27.4 percent of all comments. Additionally, there were 102 comments containing between 501 and 1388 words.

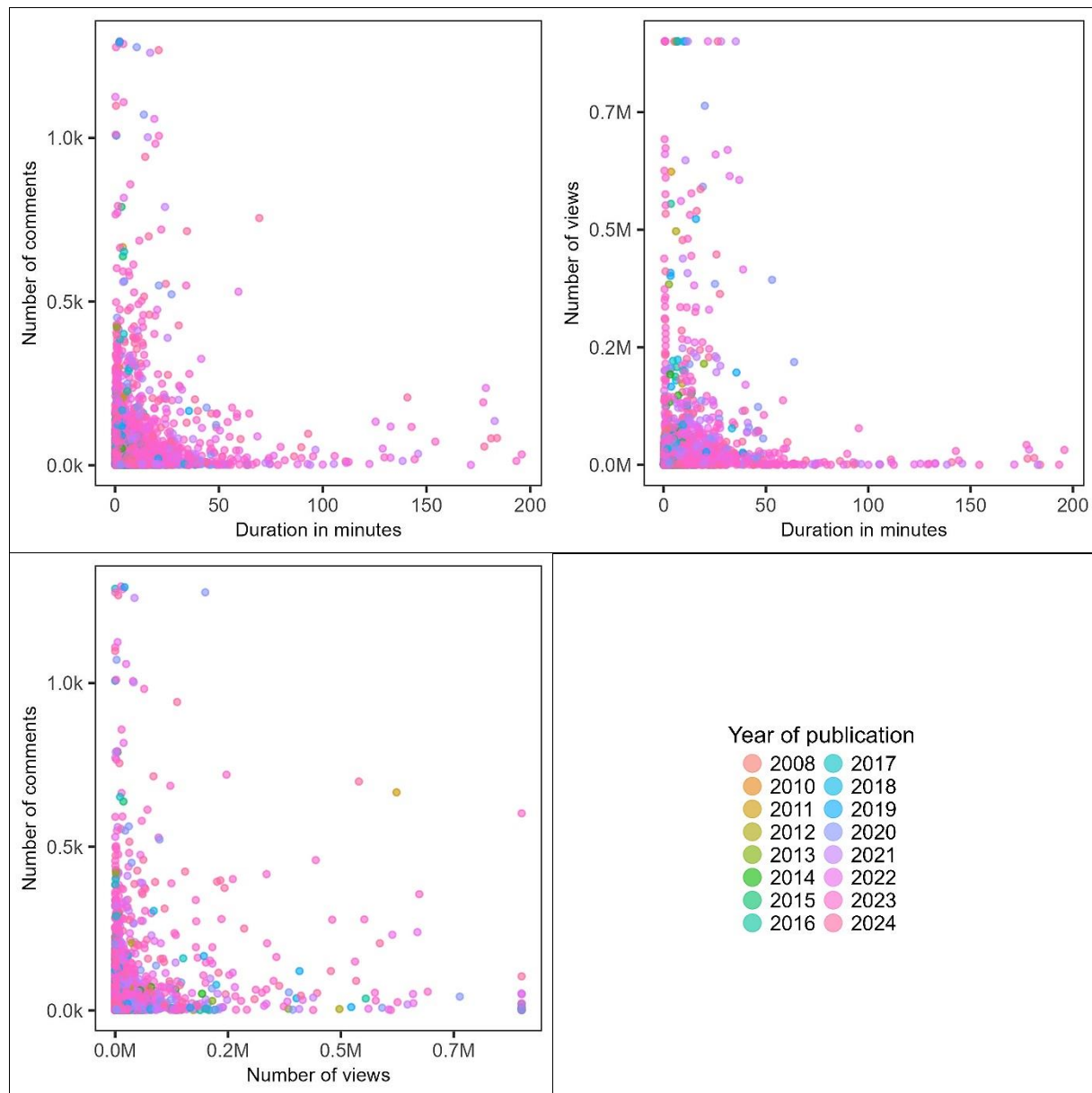


Figure 7. Relationship between duration, number of comments and views of films.

Sources: original research.

Figure 7 illustrates the correlations between three film attributes: duration (in minutes), the number of comments received, and the number of views. These relationships are depicted using three scatter plots, with the publication year of each film indicated by different colours. To enhance the clarity of the charts, selected values were modified. If the Number of views exceeded 800k, it was replaced with a random number ranging from 900.1k to 900.5k (there were 14 such instances). If the Number of comments exceeded 1.2k, it was replaced with a random number between 1.25k and 1.3k (there were 12 such instances). The variable Duration in minutes was not modified.

Figure 8 displays the annual distribution of positive, negative, and neutral comments. From this, it is evident that in 2022, 4.5% of comments were negative, 85.8% were neutral, and 9.5% were positive.

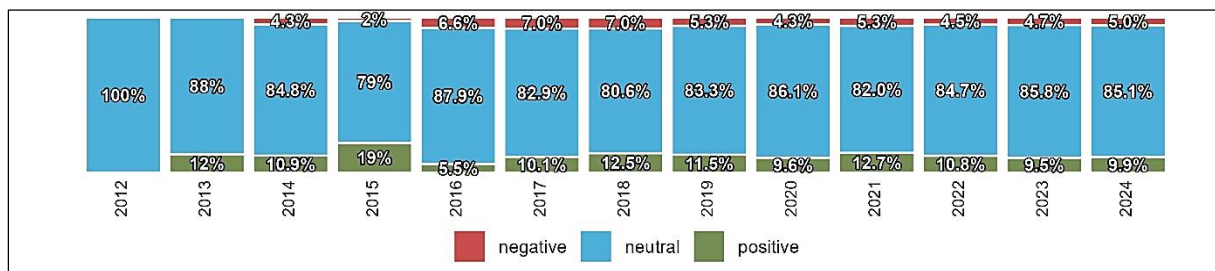


Figure 8. Percentage of positive, negative, and neutral comments.

Sources: original research.

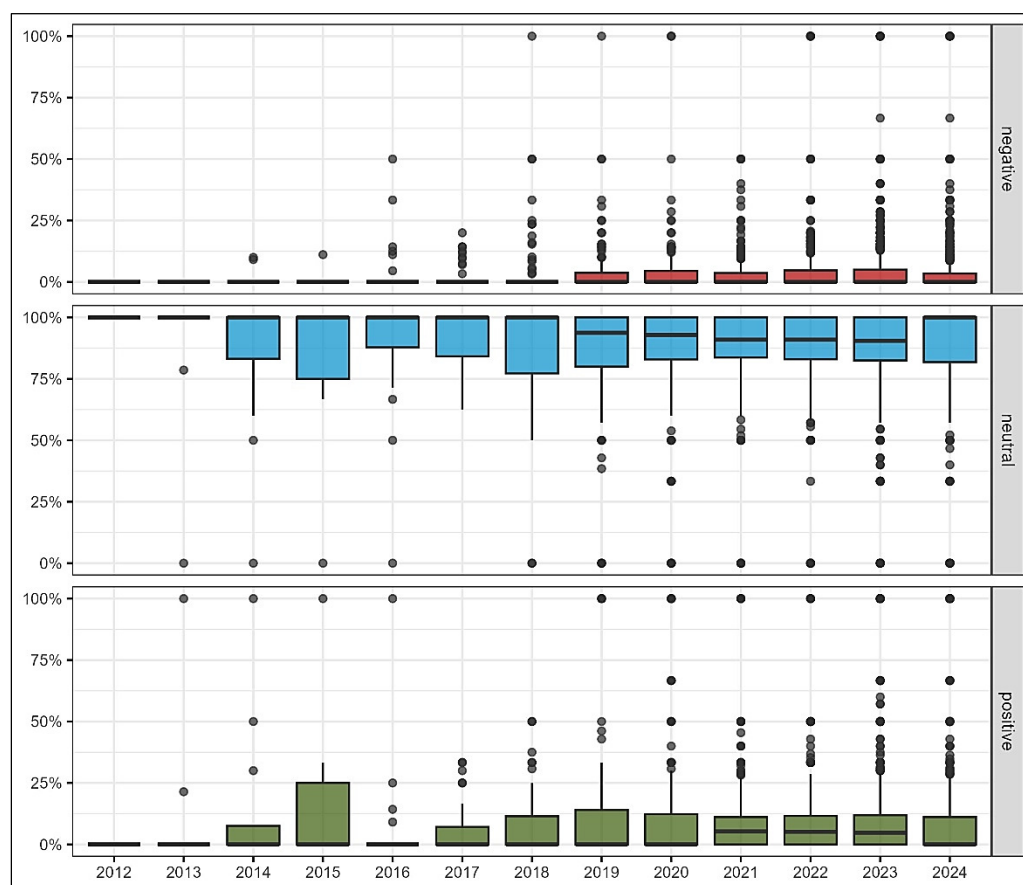


Figure 9. Distribution of the percentage of comments received by individual videos.

Sources: original research.

Figure 9 illustrates the distribution of positive, negative, and neutral comments received by individual videos, segmented by year. This distribution is represented using box plots. Individual data points showing a value of 100% for negative, positive, or neutral comments indicate that some videos received exclusively negative, positive, or neutral comment. Additionally, From the chart, we can see, for instance, that the third quartile for positive

comments in 2015 being approximately 25% suggests that up to 75% of the videos received no more than 25% positive comments.

Figure 10 displays the yearly distribution of words annotated with fundamental emotions. The color green signifies positive emotions, which include feelings such as gladness, enjoyment of something expected, and trust. Conversely, negative emotions are marked in red, encompassing emotions like disgust, fear, anger, surprise with something unpredictable, and sadness.

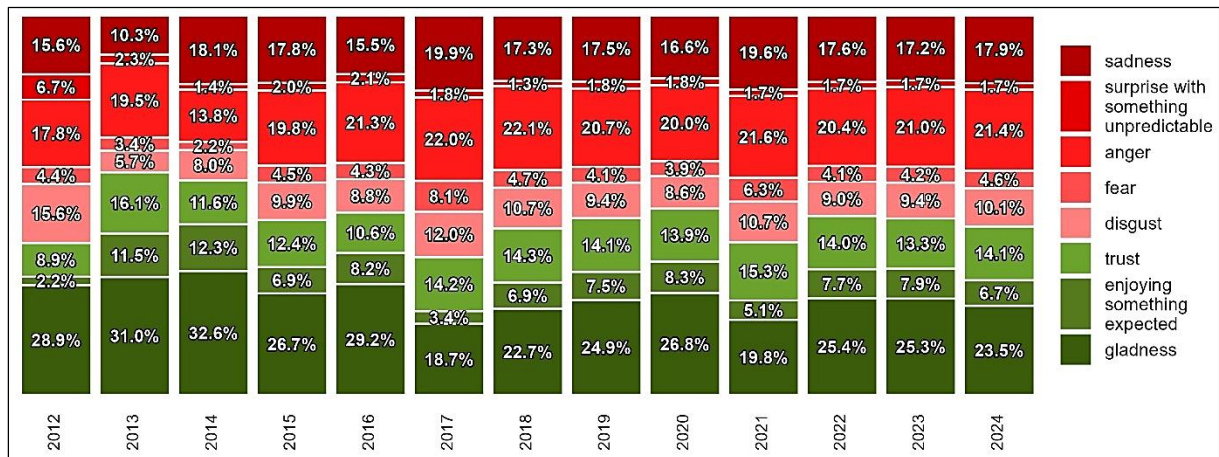


Figure 10. Percentage of words with annotated basic emotions by year.

Sources: original research.

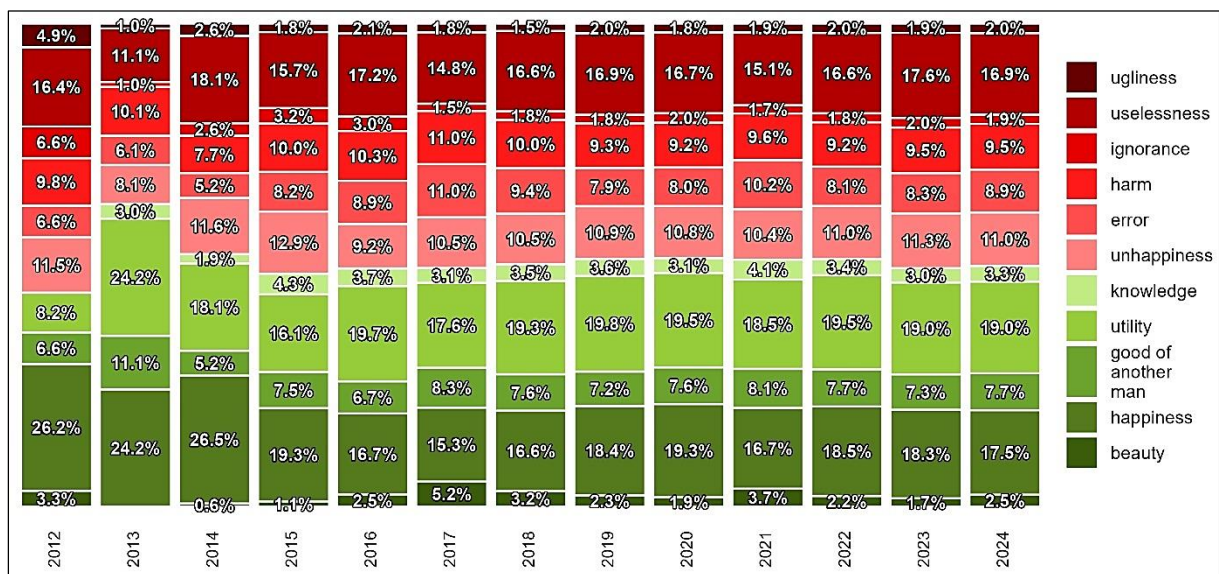


Figure 11. Percentage of words with annotated fundamental human values by year.

Sources: original research.

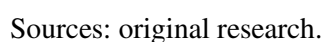


Figure 11 illustrates the distribution of words annotated with fundamental human values. Positive human values are depicted in green, including beauty, happiness, the good of another man, utility, and knowledge. Notably, the value "truth" does not appear among the positive human values. Negative human values are highlighted in red and include unhappiness, error, harm, ignorance, uselessness, and ugliness.

Figure 12 displays a word cloud of the most commonly used words in comments. This visualization allows for an analysis of the themes present in the comments. The size of each word in the cloud is proportional to its frequency of occurrence, with more common words appearing larger. The two most frequently occurring words, "pompa" (ang. pump) - 69,288 occurrences and "ciepło" (ang. heat) - 64,207 occurrences, were removed from the word cloud.

4. Conclusion

The analysis of data concerning videos related to heat pump (including the number of published videos, their view counts, the number of comments, and their sentiment) allowed for drawing the following conclusions:

- corresponding to an increasing number of videos and comments, it can be observed that interest in heat pump is continuously growing, particularly after the year 2019;
- it's evident that there is variation in the views count of videos; videos with comments were more frequently viewed;
- retrieved videos most commonly had one comment and a duration of one minute;
- among the comments, those with a neutral tone are predominant;
- starting from 2019, there are generally twice as many positive comments as negative ones;
- the videos exhibit variation in the distribution of the number of positive, negative, and neutral comments, among them were those that received only negative, positive, or neutral comments;
- analysing the most commonly used words reveals that comments were not solely focused on heat pumps but also covered general topics:
 - heating systems for houses and buildings, using different equipment and energy carriers,
 - system for heating water and air,
 - the type of heat pump,
 - the air quality,
 - systems for producing electricity from solar energy,
 - the information about solutions encouraging the replacement of non-ecological heat sources with ecological ones.

The research conducted confirms that comments on YouTube videos can serve as a valuable data source for understanding people's thoughts, feelings, and opinions about heat pumps. It should be noted that this study specifically analysed the views of Polish-speaking YouTube users.

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ASSESSMENT OF SOIL CONTAMINATION OF UKRAINE WITH HEAVY METALS DURING THE WAR

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Purpose: This paper reviews the impacts of heavy metals on soil degradation and examines the influence of military equipment on agricultural lands during the war.

Design/methodology/approach: The systematic research method involves a comprehensive approach focused on interrelated elements of land pollution by heavy metals during the war. The analysis is based on official data on soil contamination by heavy metals (Lead (Pb), Cadmium (Cd), Mercury (Hg), Chromium (Cr), Arsenic (As)) in Ukraine and other countries of the world during the war period from burned military equipment. Combining multiple methods has provided a more complete and detailed understanding of complex interactions.

Findings: This study aims to assess the spatial distribution, concentration levels, and potential sources of heavy metal contamination in Ukrainian soils during the period of war. By employing a multidisciplinary approach encompassing field surveys, soil sampling, laboratory analyses, and geographic information systems mapping, the authors seek to elucidate the impact of warfare activities on soil quality and identify hotspots of contamination across war affected regions.

Research limitations/implications: The implications of this study underscore the importance of stakeholder engagement and adaptive management for effective integration.

Originality/value: These results could be especially interesting for researchers whose studies are interdisciplinary.

Keywords: heavy metals, soil degradation, military equipment, agricultural productivity, contamination, environmental sustainability.

Category of the paper: Research paper.

JEL: Q54, Q590, Q520, Q15, O44.

1. Introduction

Soil degradation due to heavy metal contamination poses a significant threat to agricultural productivity and environmental sustainability. This paper elucidates the mechanisms through which heavy metals disrupt soil ecosystems and explores the ramifications of military equipment on crop yield concerning soil contamination. Heavy metals, such as lead, cadmium, and arsenic, often originate from industrial activities, mining, and military operations, exerting detrimental effects on soil health. Additionally, military machinery, including tanks, artillery, and aircraft, can indirectly influence soil quality and crop yield through soil compaction, chemical deposition, and disturbance of microbial communities. Understanding these interactions is crucial for devising effective mitigation strategies to safeguard agricultural lands and ensure food security in regions affected by military activities.

The ongoing war in Ukraine has not only inflicted human suffering and geopolitical tensions but has also raised significant concerns about environmental degradation, particularly regarding soil contamination by heavy metals. Soil, as a vital component of ecosystems, plays a pivotal role in sustaining life and supporting agricultural productivity. However, the indiscriminate use of heavy weaponry, industrial activities, and the destruction of infrastructure during periods of conflict can result in the release of toxic heavy metals into the soil, posing grave risks to human health, ecosystem integrity, and agricultural sustainability.

Understanding the extent and severity of soil contamination by heavy metals during times of conflict is imperative for devising effective mitigation strategies and facilitating post-conflict recovery efforts. Heavy metals such as lead, cadmium, mercury, and arsenic, which are often associated with military activities, industrial processes, and urban warfare, can persist in the environment for prolonged periods, posing long-term threats to soil quality, water resources, and human health.

This study *aims* to assess the spatial distribution, concentration levels, and potential sources of heavy metal contamination in Ukrainian soils during the period of war. By employing a multidisciplinary approach encompassing field surveys, soil sampling, laboratory analyses, and geographic information systems (GIS) mapping, we seek to elucidate the impact of warfare activities on soil quality and identify hotspots of contamination across affected regions.

Moreover, this research endeavors to evaluate the implications of soil contamination on agricultural productivity, food security, and human health, considering the potential uptake of heavy metals by crops and subsequent exposure through the food chain. By integrating socio-economic data and environmental indicators, the authors aim to elucidate the socio-environmental consequences of soil contamination, particularly in war-affected communities where access to clean water, nutritious food, and healthcare services may already be compromised.

Ultimately, the findings of this study will not only contribute to the scientific understanding of soil contamination dynamics during war but also inform policymakers, environmental agencies, and humanitarian organizations about the urgent need for remediation efforts, risk communication strategies, and sustainable development initiatives in post-conflict settings. By fostering collaboration between science, government agencies, and civil society, the authors aspire to mitigate the long-term environmental and health impacts of soil contamination, thereby promoting resilience and recovery in conflict-affected regions of Ukraine.

2. An overview of the literature

The presence of heavy metals in soils represents a pressing environmental concern globally. Anthropogenic activities, including industrial processes, mining operations, and military maneuvers, contribute to the accumulation of heavy metals in soils, thereby posing risks to ecosystem health and agricultural sustainability. Moreover, military activities, beyond direct combat, have unintended consequences on soil quality and crop productivity.

According to calculations taken from a study by the Ukrainian Nature Conservation Group, 50 tons of iron, 1 ton of sulfur compounds, and 2,35 tons of copper got into the soil because of the shelling of just one square kilometer of the field in the Kharkiv region—these are only the substances with the highest content (Munitions and chemicals, 2022). Moreover, during the explosion of even one kilogram of explosives, several tens of cubic meters of such toxic gases as sulfur oxide, nitrogen oxide, and carbon monoxide are released into the atmosphere. According to experts, the levels of heavy metals in the soil exceed the norm by 30 times (Expert, 2024).

The study of M. Berlinger, V. Klos, A. Doroginski, O. Lytvyn (2020) delves into the environmental repercussions of the war in Ukraine by assessing the contamination levels of soil with heavy metals. Employing field surveys, soil sampling, and laboratory analyses, the authors provide a detailed examination of the spatial distribution and concentration levels of heavy metals, shedding light on the extent of environmental degradation in the conflict-affected regions.

Heavy metal pollution of soils in the Donetsk region as a result of war has been investigated in article P. Kurylo, O. Kharlamova, O. Chornobay, S. Kovalenko (2019). Focusing on the Donetsk region, this research investigates the negative impact of military conflict on soil pollution by heavy metals. Through geospatial analysis, environmental assessments, and soil quality evaluations, the authors reveal the significant contamination levels and discuss the implications for ecosystem health, agricultural productivity, and human well-being in the region.

I. Babicheva, O. Kalita, Y. Romanyuk (2018) explored the influence of military activities on the levels of heavy metals in soils across Eastern Ukraine. Utilizing field surveys, soil sampling techniques, and statistical analyses, the authors elucidate the contamination patterns, identify potential sources of pollution, and assess the associated risks to agricultural sustainability and public health in conflict-affected areas.

V. Kravets, L. Skorobogatov, I. Danylenko, O. Kovtun, M. Chorniy (2017), investigated soil pollution in areas affected by military actions in Eastern Ukraine. This research evaluates the distribution, sources, and environmental implications of heavy metal contamination. Through interdisciplinary approaches encompassing environmental monitoring, soil analysis, and risk assessment, the authors offer insights into the magnitude of soil pollution and advocate for targeted remediation efforts to mitigate the long-term impacts on ecosystems and human health.

The scientists O. Tytova, V. Steshenko, S. Zadorozhna (2016) were focused on the environmental consequences of war, their study investigates alterations in the concentrations of heavy metals in soils across Eastern Ukraine. Through comparative analyses, spatial mapping, and risk characterization, the authors assess the ecological risks posed by soil contamination and emphasize the importance of holistic approaches to environmental management and post-conflict reconstruction in the region.

Some researchers emphasize the importance of the use of straw to improve soil properties reduced the availability of toxic metals, although it increased the availability of trace elements. Scientist Evangelia E. Golia (2023) notes that wheat straw can become a key factor in improving the condition of the soil, increasing its fertility and limiting the risks of toxic pollution. In addition, scientists emphasize that it is now necessary to take into account the principles of the circular economy when making certain management decisions. Other researchers might focus on the importance of effective government policies (Yakymchuk et al., 2022).

These descriptions provide an overview of the key findings and methodologies employed by each author or research team in their respective studies on soil contamination with heavy metals during the war in Ukraine.

Heavy metals, characterized by high density and toxicity, adversely affect soil ecosystems through various pathways. Upon introduction into soils, these metals accumulate over time, leading to contamination that can persist for decades or even centuries (Prykhodko, Bondar, Hromova, 2011). The primary sources of heavy metal contamination include industrial emissions, improper waste disposal, and agricultural practices involving metal-based fertilizers and pesticides. Once in the soil, heavy metals interfere with vital processes such as nutrient cycling, water retention, and microbial activity, consequently impairing soil fertility and plant growth. Furthermore, heavy metals can bioaccumulate in crops, posing risks to human health through the food chain (Shpak, Kryukova, Kudryashova, 2013).

The mechanisms underlying heavy metal toxicity in soils are multifaceted and involve physical, chemical, and biological processes (Dovbush, Kozlova, Kovalenko, Yakovlevm, 2014). Physically, heavy metals alter soil structure and texture, affecting porosity, water infiltration, and root penetration. Chemically, these metals can alter soil pH, disrupt nutrient availability, and facilitate the release of harmful ions such as aluminum and manganese. Biologically, heavy metals inhibit enzymatic activity, impede microbial diversity, and induce oxidative stress in plants and soil organisms. Collectively, these mechanisms contribute to diminished soil productivity and compromised ecosystem resilience.

Military activities, including training exercises and deployments, can exert indirect pressures on agricultural lands and soil quality. Heavy military equipment such as tanks, armored vehicles, and artillery cause soil compaction and erosion, disrupting soil structure and reducing water infiltration rates. Additionally, the deployment of munitions and explosives introduce chemical pollutants into soils, further exacerbating contamination. Moreover, the passage of military convoys and vehicles lead to soil disturbance and the loss of vegetation cover, increasing the susceptibility of soils to erosion and degradation (Hladun, Ivanko, Dudka, 2012).

The degradation of soils due to heavy metal contamination and military activities has significant implications for agricultural productivity and food security. Contaminated soils exhibit reduced crop yields, altered nutrient dynamics, and increased vulnerability to pests and diseases (Kovalchuk, Orlov, Boyko, 2015). Moreover, the long-term persistence of heavy metals in soils poses risks to human health and ecosystem integrity (Yakymchuk, Baran-Zgłobicka, 2023). In regions affected by military conflicts or training exercises, efforts to rehabilitate degraded soils and mitigate contamination are essential for restoring agricultural productivity and ensuring sustainable land use practices (Lewandowska et al., 2023; Yakymchuk, Byrkovych, Kuzmych, 2023).

A. Splodytel, O. Holubtsov, S. Chumachenko, L. Sorokina (2023) estimated that the combustion of military equipment with the subsequent entry of pollutants into the human body is a risk factor for the development of various pathologies, growth and complications of the course of many diseases. In particular, scientists note that these substances are toxic to humans, especially in abnormally high concentrations. But it turns out that even small concentrations of pollutants change the activity of enzymes in the human body, affect the circulation of nuclei and protein synthesis, cause changes at the genetic level. Ministry of Ecology and Natural Resources of Ukraine: Conducts environmental monitoring and publishes reports on soil contamination levels in Ukraine, including during wartime (Ministry of Ecology, 2024).

3. Research methods

The systemic method applied to research involves an integrated approach focusing on interconnected elements within assessment of soil contamination by heavy metals. Here are the main methods employed to this research:

Field Surveys and Soil Sampling: Researchers conduct systematic field surveys in the conflict-affected areas of Ukraine to identify sampling sites representative of different environmental conditions. Soil samples are collected using standardized protocols, considering factors such as soil depth, land use, and proximity to potential pollution sources.

Laboratory Analysis: Soil samples undergo rigorous laboratory analysis to determine the concentration levels of heavy metals. Techniques such as atomic absorption spectrometry (AAS), inductively coupled plasma mass spectrometry (ICP-MS), and X-ray fluorescence (XRF) spectroscopy are commonly employed to quantify the presence of heavy metal contaminants accurately.

Geospatial Analysis: Geographic information systems (GIS) are utilized to integrate spatial data, including soil sampling locations, land use/land cover maps, and pollution source inventories. Spatial interpolation techniques, such as kriging or inverse distance weighting, are applied to generate spatial distribution maps of heavy metal contamination, facilitating the identification of contamination hotspots.

Statistical Analysis: Statistical methods, such as analysis of variance (ANOVA), principal component analysis (PCA), and cluster analysis, are employed to analyze the relationships between heavy metal concentrations and various environmental parameters. These analyses help identify potential pollution sources, assess spatial trends, and elucidate factors influencing soil contamination.

Risk Assessment: Environmental risk assessment models, such as the potential ecological risk index (PERI) or the human health risk assessment (HHRA), are utilized to evaluate the ecological and human health risks associated with soil contamination by heavy metals. These models consider factors such as metal toxicity, exposure pathways, and receptor sensitivity to estimate the overall risk posed by contaminated soils.

Socio-Economic Surveys: Socio-economic surveys and interviews with local communities are conducted to assess the socio-economic impacts of soil contamination on livelihoods, agricultural practices, and public health. These surveys provide valuable insights into community perceptions, adaptive strategies, and the socio-economic implications of environmental degradation during times of conflict.

Remote Sensing: Remote sensing data, such as satellite imagery and aerial photographs, are utilized to complement ground-based assessments and facilitate the mapping of land cover changes, vegetation health, and landscape disturbances associated with military activities.

Remote sensing techniques enhance the spatial analysis of soil contamination and support monitoring efforts in inaccessible or war-affected areas.

By employing these multidisciplinary methods, researchers can comprehensively assess soil contamination by heavy metals in Ukraine during times of war, providing valuable insights for environmental management, risk mitigation, and post-conflict recovery planning.

Various methods and formulas based on the results of the analysis of soil samples can be used to assess soil contamination with heavy metals. Below are some of them:

1. Soil Contamination Index, I_{SC} :

$$I_{SC} = \frac{C_{metal}}{N_{metal}} \quad (1)$$

where:

C_{metal} - concentration of the metal in soil sample,

N_{metal} - permissible limit of metal concentration in soil.

2. Bioaccumulation Factor, BAF :

$$BAF = \frac{C_{plant}}{C_{soil}} \quad (2)$$

where:

C_{plant} - concentration of metal in plant,

C_{soil} - concentration of metal in soil from which plant uptake metal.

3. Leaching Factor, LF :

$$LF = \frac{C_{leachate}}{C_{soil}} \quad (3)$$

where:

$C_{leachate}$ - concentration of metal in leachate after soil sample extraction,

C_{soil} - concentration of metal in soil sample.

4. Soil Ecological Risk Index, I_{SER} :

$$I_{SER} = \sum_{i=1}^n (I_{SCi} \times TF_i) \quad (4)$$

where:

I_{SCi} - soil contamination index for i^{th} metal,

TF_i - toxic factor considering the toxicity of specific metal.

5. Total Soil Pollution Index, I_{TSP} :

$$I_{TSP} = \sum_{i=1}^n (C_i \times W_i) \quad (5)$$

where:

C_i - concentration of i^{th} metal in soil,

W_i - weighting coefficient considering the toxicity of each metal.

These formulas and methods make it possible to generally estimate the level of soil contamination by heavy metals and to determine the influence of such contamination on the state of the natural environment and human health.

4. Main Results

Many countries of the world throughout history had wars on their territories, went through many trials. It is worth mentioning the experience of Syria, Afghanistan, Iraq, Congo Democratic Republic and others. For instance, the Syrian conflict, ongoing since 2011, has caused extensive damage to the country's soil and biodiversity. Intensive bombing campaigns, urban warfare, and the use of chemical weapons have led to soil contamination with heavy metals, toxic chemicals, and unexploded ordnance. The destruction of agricultural infrastructure and landmines contamination have further exacerbated soil degradation, jeopardizing food security and livelihoods. Biodiversity loss in Syria is evident through habitat destruction, deforestation, and the displacement of wildlife populations due to conflict-related activities.

Decades of conflict in Afghanistan have left a legacy of soil degradation and biodiversity loss. The use of landmines, improvised explosive devices (IEDs), and aerial bombardment has rendered large swathes of land unusable for agriculture and human habitation. Soil erosion, desertification, and deforestation have accelerated due to conflict-induced displacement, population movements, and resource exploitation. Biodiversity in Afghanistan faces threats from habitat destruction, illegal wildlife trade, and the disruption of ecological corridors.

The Iraq War, characterized by intense military operations and insurgency, has had detrimental impacts on soil quality and biodiversity. Oil spills, pollution from military bases, and the destruction of infrastructure have contaminated soil with hazardous substances and heavy metals. Land degradation, salinization, and desertification have been exacerbated by conflict-induced displacement and environmental mismanagement. Biodiversity loss in Iraq is evident through the destruction of wetlands, depletion of wildlife populations, and the degradation of ecosystems such as marshlands and forests.

In Democratic Republic of the Congo (DRC) war has resulted in widespread deforestation, soil erosion, and biodiversity loss. Illegal mining activities, resource plundering, and land grabbing have degraded soil quality and fragmented habitats, threatening the survival of endemic species and diminishing ecosystem resilience. The exploitation of natural resources, including minerals and timber, fuels conflict dynamics and exacerbates environmental degradation, perpetuating a cycle of instability and ecological decline.

Here are some examples of how warfare, including military equipment used in combat, can lead to deterioration of soil quality and contamination with heavy metals:

1. *Artillery Shelling and Bombardment:* During armed conflicts, artillery shelling and bombardment are common military tactics used to target enemy positions. The explosive force generated by artillery shells and bombs can cause significant soil disturbance, leading to soil compaction, erosion, and fragmentation. Additionally,

the detonation of munitions releases heavy metals such as lead, copper, and zinc into the soil, contaminating the surrounding environment.

2. *Tank and Vehicle Movements:* Heavy military vehicles, including tanks and armored vehicles, traverse through various terrains during combat operations. The continuous movement of these vehicles can result in soil compaction and disruption of soil structure, impairing soil porosity and water infiltration rates. Moreover, the leakage of fuel, lubricants, and hydraulic fluids from damaged or destroyed vehicles introduces petroleum hydrocarbons and other contaminants into the soil, further exacerbating pollution levels.
3. *Aerial Bombing and Airstrikes:* Aerial bombing and airstrikes involve the deployment of explosives from aircraft to target enemy infrastructure, military installations, and strategic locations. The impact of aerial bombs and missiles upon detonation causes extensive soil disturbance, crater formation, and fragmentation of soil particles. This disturbance disrupts soil stability and accelerates erosion processes, leading to soil degradation and loss of fertility. Additionally, the combustion of jet fuel and explosives releases toxic substances and heavy metals, such as cadmium and mercury, into the soil and air.
4. *Deployed Munitions and Landmines:* Unexploded ordnance (UXO), landmines, and improvised explosive devices (IEDs) left behind in conflict zones pose long-term risks to soil quality and human safety. The presence of buried munitions and explosives contaminates the soil with heavy metals, explosives residues, and chemical agents. Moreover, the detonation of UXO or landmines can cause soil upheaval, crater formation, and dispersal of contaminated soil particles, further spreading pollution within the environment.

These examples highlight how the use of military equipment and tactics during warfare can lead to soil degradation, compaction, erosion, and contamination with heavy metals, posing significant environmental and public health concerns in conflict-affected regions.

Military equipment and weaponry used in armed conflicts introduces a variety of heavy metals into the soil, exacerbating soil degradation and negatively impacting biodiversity. Some of the main metals found in military equipment and their effects on soil and biodiversity are:

1. Lead (Pb) is commonly used in ammunition, bullets, and batteries found in military equipment. When ammunition explodes or corrodes, lead particles are dispersed into the soil. Lead contamination in soil can inhibit plant growth, disrupt soil microbial communities, and accumulate in food crops, posing risks to human and wildlife health. Additionally, lead exposure can lead to neurological disorders and reproductive issues in animals, further impacting biodiversity.

2. Cadmium (Cd) is present in various components of military equipment, including coatings, platings, and electronic devices. Upon disposal or destruction of military hardware, cadmium can leach into the soil, contaminating groundwater and affecting soil fertility. Cadmium is highly toxic to plants, inhibiting root growth, nutrient uptake, and photosynthesis. Accumulation of cadmium in the food chain can lead to bioaccumulation in animals and pose risks to terrestrial and aquatic ecosystems.
3. Mercury (Hg) is used in switches, sensors, and batteries in military electronics. When military equipment is damaged or dismantled, mercury can be released into the environment, contaminating soil and water bodies. Mercury pollution in soil can impair microbial activity, disrupt nutrient cycling, and bio accumulate in organisms, leading to toxicity in wildlife and humans. Chronic exposure to mercury can cause neurological damage and reproductive abnormalities in animals, affecting biodiversity.
4. Chromium (Cr) is present in coatings, paints, and corrosion-resistant materials used in military vehicles and equipment. Disposal of military hardware can result in chromium leaching into the soil, where it persists and accumulates. Chromium contamination can alter soil pH, impairing microbial activity and nutrient availability. Furthermore, hexavalent chromium, a highly toxic form of chromium, can induce genotoxicity and carcinogenic effects in organisms, posing threats to biodiversity.
5. Arsenic (As) is used in ammunition, paints, and electronic components of military equipment. Soil contamination with arsenic can occur through the disposal of munitions or the degradation of arsenic-containing materials. Arsenic accumulation in soil can inhibit plant growth, disrupt soil microbial communities, and contaminate food crops. Chronic exposure to arsenic can lead to cancer, developmental abnormalities, and immune system suppression in wildlife and humans, impacting biodiversity.

Similar problems were faced in Belgium and France after the First World War. Thus, Europe lost 23% of cultivated land and is still overcoming the consequences of the war (Expert, 2024). For example, in France, heavy metals and other pollutants remain in the soil for many years (Fig. 1). Some areas of grain fields and pastures here have not been cultivated for more than a century precisely because of funnels and shells that did not explode, but remained in the ground since the war. In addition, according to official data, in 2016, the French chemical industry produced up to 1.3 million tons of hazardous waste. More than 31% of France's land and soil pollution is related to petroleum hydrocarbons in 2018, and 23% to heavy metals and metalloids. It should be noted that contamination by radioactive substances has been reduced to zero, although it is the main source of energy in this country (Statista, 2024).

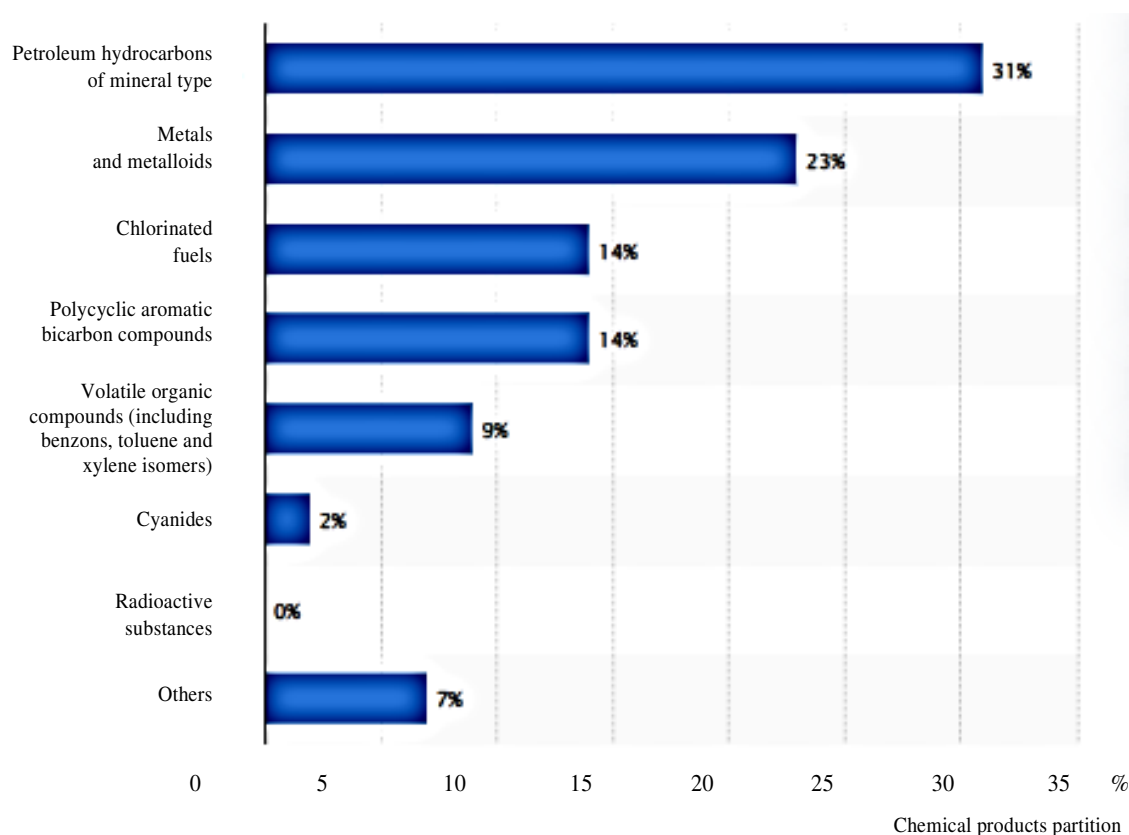


Figure 1. Characterization of pollutants in soil in polluted areas of France.

Source: The data is based on the latest available statistics from EPA, 2023; International cooperation, 2021; European Commission, 2021; Statista, 2024 [18-03-2024].

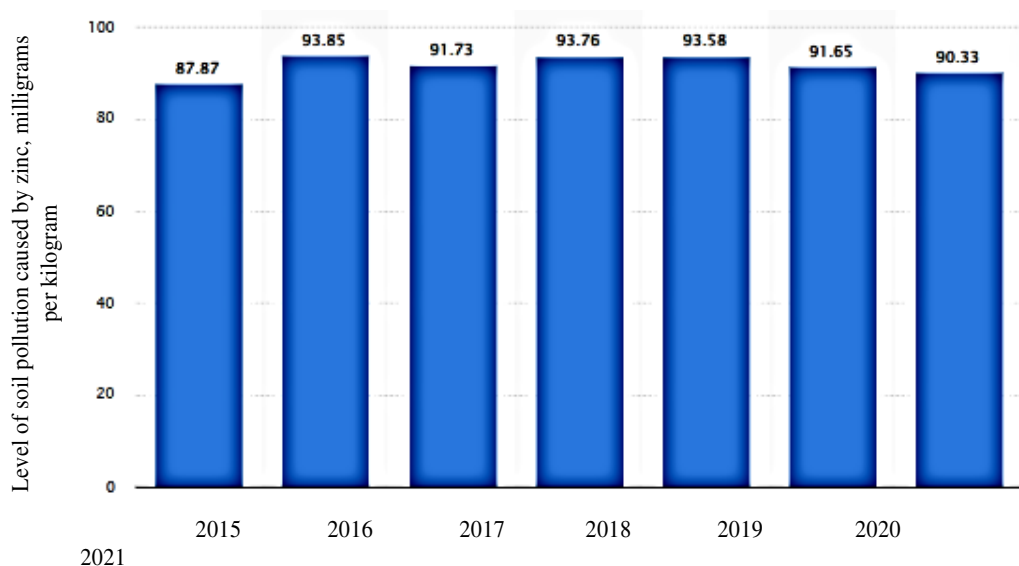


Figure 2. Level of soil pollution caused by zinc (Zn) in South Korea from 2015 to 2021 (in milligrams per kilogram).

Source: The data is based on the latest available statistics from Statista, 2024; EPA, 2023; European Commission, 2023 [18-03-2024].

In South Korea the level of soil pollution caused by zinc amounted around to 90.33 mg/kg in 2021. In the last seven years, the highest level was recorded around 93.85 mg/kg, while the lowest level was around 87.87 mg/kg in 2016.

These heavy metals persist in the soil long after war, posing ongoing risks to soil quality, ecosystem health, and biodiversity. Efforts to remediate contaminated sites, implement pollution prevention measures, and promote sustainable land management practices are essential for mitigating the environmental impacts of military activities and safeguarding biodiversity in conflict-affected regions. Here’s a table outlining heavy metals commonly found in soil, their normal values, and their exceedances in Ukraine during war (tab. 1).

Table 1.
The presence of heavy metals in the soils of Ukraine, which were affected by military actions

Heavy Metal	Normal Concentration in Soil (mg/kg)	Exceedance during War (mg/kg)
Lead (Pb)	20-50	Exceedance: 70-150
Cadmium (Cd)	0.3-1.0	Exceedance: 2.0-5.0
Mercury (Hg)	0.05-0.1	Exceedance: 0.3-0.5
Arsenic (As)	5-10	Exceedance: 20-50
Chromium (Cr)	30-150	Exceedance: 200-500
Copper (Cu)	20-100	Exceedance: 150-300
Zinc (Zn)	50-150	Exceedance: 200-400
Nickel (Ni)	10-50	Exceedance: 50-150
Manganese (Mn)	200-800	Exceedance: 1000-2000
Selenium (Se)	0.1-1.0	Exceedance: 2.0-5.0
Aluminum (Al)	1000-5000	Exceedance: 5000-10000

Source: The data is based on the latest available statistics from Statista, 2024; EPA, 2023; European Commission, 2023; Splodytel et al., 2023; Tóth et al., 2016; Evangelia, 2023; Ministry of Ecology, 2024 [18-03-2024].

These values are approximate and vary depending on soil type, geographical location, and other factors. During wartime, the exceedance of these heavy metals in Ukrainian soil can be attributed to various sources, including the use of heavy weaponry, military vehicles, and industrial facilities affected by conflict. Such contamination have detrimental effects on soil quality, agricultural productivity, and biodiversity, leading to long-term environmental degradation and ecological imbalances.

According to the data of Institute of Soil Protection of Ukraine on soil sampling in the Sumy Oblast in places of hostilities, it was found that exceedance of MPC was found in all soil samples. Calculations show that the gross lead content was 113.5%. Gross zinc content at soil sampling points in the combat zone varied from 35.52 to 1012.31 mg/kg of soil, outside the combat zone — from 35.98 to 214.86 mg/kg of soil. Therefore, this indicates that the average zinc content in the samples from the combat sites is 3.9 times higher than the background value. The highest degree of disturbance of the soil cover was found in the areas of burned equipment. The zinc content exceeded the background value here from 471.1 to 764.8%. The lowest zinc content was found in the places where air bombs fell. It is known that the permissible dose of cadmium for humans is 70 mg/kg per day for adults and completely excludes its presence in drinking water and food for children. At the same time, it was recorded that the gross content of cadmium in the polluted territories exceeded the background value by 1.4 times (Vplyv aviabomb, 2024).

Currently, the worst military-technogenic load on landscapes is characteristic of the Luhansk (North Luhansk), Severodonetsk-Lysychansk and Toretsk-Horlivsk-Yenakiev industrial agglomerations. For these areas characterized by an increase in the level of mercury, arsenic and cadmium in the soil, which exceeded maximum permissible concentrations and background values. In the soil samples, scientists also found an increased content of lead, copper, zinc, nickel, strontium, chromium, and phosphorus (Splodytel et al., 2023). The results of analytical studies proved significant excess of the regional background values of the content of lead (35-14000 mg/kg), copper (35-95 mg/kg, separate areas — 250-330 mg/kg), nickel (84-300 mg/kg) and other heavy metals, for example, manganese, chromium and zinc Mn, Cr, Zn (Splodytel et al., 2023).

To mitigate the negative impact of heavy metals in soil, the authors of this article propose to implement such measures as:

- *Soil Remediation Techniques* – implement soil remediation techniques such as soil washing, soil flushing, and phytoremediation to remove or reduce heavy metal concentrations in contaminated soil. These methods involve the physical or chemical treatment of soil to extract or immobilize heavy metals, restoring soil quality and reducing environmental risks;
- *Vegetative Cover and Green Infrastructure* – establish vegetative cover and green infrastructure, including the planting of trees, shrubs, and grasses, to stabilize soil, enhance soil structure, and promote natural filtration processes. Vegetation can act as a barrier to heavy metal leaching, uptake contaminants from soil, and improve soil health through organic matter deposition and nutrient cycling;
- *Land Use Planning and Zoning* – develop land use plans and zoning regulations that restrict or prohibit activities known to contribute to soil contamination, such as industrial operations, mining, and waste disposal sites, in sensitive areas prone to heavy metal pollution. Implementing strict land use controls can prevent further degradation of soil quality and protect vulnerable ecosystems from contamination risks;
- *Waste Management and Pollution Control* – implement effective waste management practices and pollution control measures to prevent the release of heavy metals into the environment. Promote the use of clean technologies, pollution prevention strategies, and waste recycling programs to minimize the generation and disposal of hazardous wastes containing heavy metals, reducing the risk of soil contamination;
- *Environmental Monitoring and Regulation* – strengthen environmental monitoring programs and regulatory frameworks to monitor soil quality, assess contamination levels, and enforce compliance with pollution control standards. Conduct regular soil testing, sampling, and analysis to track changes in heavy metal concentrations over time, identify pollution sources, and prioritize remediation efforts based on risk assessments;

- *Public Awareness and Education* – raise public awareness and promote education initiatives to inform communities, stakeholders, and policymakers about the risks associated with heavy metal contamination in soil and the importance of adopting sustainable land management practices. Encourage community participation, citizen science projects, and environmental advocacy campaigns to mobilize support for soil conservation and pollution prevention efforts.

By implementing these measures, it is possible to mitigate the negative impact of heavy metals in soil, protect human health and ecosystem integrity, and promote sustainable land use practices for future generations.

In the aftermath of war, evaluating the condition of soils emerges as a crucial task with far-reaching implications for environmental recovery, public health, and sustainable development. The devastation wrought by warfare extends beyond human casualties and physical infrastructure to encompass profound impacts on natural ecosystems, particularly soils, which serve as the foundation of terrestrial life support systems. Understanding the extent and severity of soil degradation following military operations is imperative for devising effective remediation strategies, restoring ecosystem functions, and promoting resilience in conflict-affected regions.

Firstly, soil assessment provides vital insights into the extent of contamination and pollution resulting from military activities. Explosions, bombings, and the deployment of chemical agents during conflicts can introduce hazardous substances, heavy metals, and toxic residues into the soil matrix, posing risks to human health, water resources, and biodiversity. By conducting systematic soil sampling, analysis, and monitoring, it becomes possible to identify hotspots of contamination, prioritize remediation efforts, and mitigate the long-term environmental impacts of warfare.

Moreover, evaluating soil quality post-conflict is essential for safeguarding agricultural productivity and food security. Agriculture represents a fundamental livelihood for many communities in conflict-affected areas, and the condition of soils directly influences crop yields, nutritional content, and land suitability for cultivation. Soil degradation, compaction, and erosion resulting from military operations can undermine agricultural productivity, exacerbate food shortages, and perpetuate cycles of poverty and vulnerability. Assessing soil fertility, nutrient levels, and structural integrity enables targeted interventions, such as soil restoration techniques and land rehabilitation programs, to enhance agricultural resilience and ensure sustainable food production in post-conflict settings.

Furthermore, soil assessment plays a pivotal role in mitigating environmental risks and protecting ecosystem services. Healthy soils support a myriad of ecological functions, including nutrient cycling, water filtration, and carbon sequestration, which are essential for maintaining biodiversity, climate regulation, and ecosystem stability. However, the disruption of soil processes and degradation of habitat quality due to warfare jeopardizes these critical services, leading to biodiversity loss, habitat fragmentation, and ecological imbalance. By quantifying

the ecological impacts of soil degradation, policymakers and conservationists can implement conservation measures, habitat restoration initiatives, and protected area management strategies to safeguard ecosystems and promote biodiversity conservation in conflict-affected landscapes.

There are several avenues for mobilizing financial resources to address the negative impacts of heavy metals in soil:

1. International Aid and Development Agencies – international organizations such as the United Nations Development Programme (UNDP), World Bank, and European Union provide financial assistance and technical support to countries affected by war-related environmental degradation. These organizations offer grants, loans, and capacity-building programs to fund soil remediation projects, environmental assessments, and sustainable development initiatives.
2. Environmental Funds and Foundations, such as the Global Environment Facility (GEF) and the Green Climate Fund (GCF), allocate resources for environmental conservation and climate resilience projects worldwide. These funds support initiatives aimed at mitigating soil pollution, promoting ecosystem restoration, and enhancing biodiversity conservation in conflict-affected regions.
3. Multilateral and Bilateral Agreements – multilateral agreements and treaties, such as the Stockholm Convention on Persistent Organic Pollutants (POPs) and the Minamata Convention on Mercury, facilitate international cooperation and financial assistance for addressing soil contamination issues. Bilateral partnerships between donor countries and recipient nations also play a crucial role in mobilizing resources for environmental rehabilitation and sustainable development.
4. Non-Governmental Organizations (NGOs) and Civil Society Groups. NGOs and civil society organizations actively engage in fundraising efforts and advocacy campaigns to support environmental initiatives in conflict-affected areas. Organizations like the International Union for Conservation of Nature (IUCN), Conservation International, and the Environmental Defense Fund (EDF) mobilize public donations, corporate sponsorships, and philanthropic grants to finance projects related to soil remediation, biodiversity conservation, and community resilience.
5. Private Sector Investments. Private sector entities, including corporate enterprises, impact investors, and sustainable finance institutions, can contribute financial resources to soil remediation efforts through public-private partnerships (PPPs) and sustainable development projects. Companies with corporate social responsibility (CSR) initiatives may allocate funding for environmental restoration programs and pollution abatement measures in regions affected by conflict-induced soil contamination.

By leveraging these financial resources and engaging with diverse stakeholders, countries impacted by the negative effects of heavy metals in soil can access the necessary funding and support to implement effective remediation strategies, restore ecosystem health, and promote sustainable development pathways.

5. Conclusions

In this study, the authors summarized the main points presented in the article, proved the essential importance of leveling the negative impact of military equipment on the state of soil contamination with heavy metals as a result of the war in Ukraine. The main results are:

1. The assessment of soils in the aftermath of military operations is paramount for understanding the environmental consequences of warfare, safeguarding human health and livelihoods, and preserving ecosystem integrity. By conducting comprehensive soil evaluations, stakeholders can develop evidence-based interventions, promote sustainable land management practices, and foster resilience in post-conflict environments. Investing in soil assessment and restoration efforts is not only essential for mitigating the immediate impacts of conflict but also for laying the foundation for long-term environmental recovery and sustainable development in conflict-affected regions.
1. Ukraine has to cooperate for mobilizing financial resources to address the negative impacts of heavy metals in its soil with different organizations – International Aid and Development Agencies, Environmental Funds and Foundations, Multilateral and Bilateral Agreements, Non-Governmental Organizations (NGOs) and Civil Society Groups, Private Sector Investments. Today Ukraine can access the necessary funding and support to implement effective remediation strategies, restore ecosystem health, and promote sustainable development pathways.
2. Military equipment and weaponry used in armed conflicts can introduce a variety of heavy metals into the soil, exacerbating soil degradation and negatively impacting biodiversity. Some of the main metals found in military equipment and their effects on soil and biodiversity are: Lead (Pb), Cadmium (Cd), Mercury (Hg), Chromium (Cr), Arsenic (As), all these heavy metals persist in the soil long after war, posing ongoing risks to soil quality, ecosystem health, and biodiversity. Efforts to remediate contaminated sites, implement pollution prevention measures, and promote sustainable land management practices are essential for mitigating the environmental impacts of military activities and safeguarding biodiversity in war-affected regions.
3. In places of war hostilities, it was found that gross lead content was 113.5%. Gross zinc content at soil sampling points in the combat zone varied from 35.52 to 1012.31 mg/kg of soil, this indicates that the average zinc content in the samples from the combat sites is 3.9 times higher than the background value. The zinc content exceeded the background value from 471.1 to 764.8%. The gross content of cadmium in the polluted territories exceeded the background value by 1.4 times. Currently, the worst military-technogenic load on landscapes is characteristic of the Luhansk (North Luhansk), Severodonetsk-Lysychansk and Toretsk-Horlivsk-Yenakiev industrial agglomerations.

For these areas characterized by an excess of the regional background values of the content of lead (35-14000 mg/kg), copper (35-95 mg/ kg, separate areas 250-330 mg/kg), nickel (84-300 mg/kg) and other heavy metals, for example, manganese, chromium and zinc Mn, Cr, Zn.

4. The interaction between heavy metals and military activities represents a complex environmental challenge with far-reaching implications for soil health and agricultural sustainability. Addressing soil degradation and contamination requires interdisciplinary approaches that integrate soil science, environmental engineering, and military policy. By understanding the mechanisms of heavy metal toxicity and the impacts of military equipment on soil ecosystems, policymakers and stakeholders can develop strategies to mitigate these threats and promote resilient agricultural systems in affected regions.
5. The case studies presented highlight the intricate interplay between warfare, soil degradation, and biodiversity loss in conflict-affected countries. Urgent action is needed to address environmental challenges in post-conflict reconstruction efforts, promote sustainable land management practices, and conserve biodiversity to mitigate the long-term impacts of warfare on ecosystems and human well-being.

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