

POLITECHNIKA ŚLĄSKA

SILESIAAN UNIVERSITY OF TECHNOLOGY

ZESZYTY NAUKOWE

SCIENTIFIC PAPERS

ORGANIZACJA I ZARZĄDZANIE

Zeszyt Naukowy nr 191

ORGANIZATION AND MANAGEMENT

Scientific Paper no. 191

Współczesne zarządzanie

Contemporary management

Pod redakcją

Radosława WOLNIAKA

Edited by

Radosław WOLNIAK

GLIWICE 2024

Kolegium redakcyjne

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**Wydano za zgodą
Rektora Politechniki Śląskiej**

**ISSN 1641-3466
ISSN 2720-751X**

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Wydawnictwo Politechniki Śląskiej
Gliwice 2024

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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 from Poland. The number consists of 42 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: human resource management, Industry 4.0/5.0, Corporate Social Responsibility, sustainable development, risk management, innovation management, quality management, production management, impact of COVID-19 pandemic on management, leadership, logistics, economics, public management, financial management, lean management and Smart City.

Radosław Wolniak

LEARNING AS PART OF KNOWLEDGE EXCHANGE PROCESSES IN THE CONTEXT OF ONLINE WORK, BASED ON THE EXAMPLE OF GENERATION Z EMPLOYEES

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Purpose: The objective of the argument in this paper is to attempt at answering the question whether learning and knowledge exchange are the key factors determining online work preferences for Generation Z employees.

Design/methodology/approach: The essence of knowledge management is that all knowledge, both explicit and tacit, accumulated by an organization becomes easily accessible to each of its members. This is important for decision-making processes and allows the organization to become more agile. Knowledge management is most often associated with modern information technologies. Thanks to them, streams of various data can be processed and analyzed in many different ways. However, in the literature there is an increasingly common attitude that more attention should be paid not only to the technological but also to the human aspect of knowledge management. The processes of knowledge exchange among employees have been subject to extensive research and studies, yet the recent years have added another thread to the discussion about the matter, i.e. a significant proportion of employees switching to the online work model. Based on the findings of the studies conducted on a group of employees representing Generation Z, the Principal Component Analysis (PCA) technique was applied to organize the factors with the highest relevance for the respondents in online work.

Findings: PCA demonstrated that the components recognized as most important were those relating to knowledge transfer and their impact on employee efficiency, and on the other hand employee relations as a factor that supports the learning processes.

Research limitations/implications: In order to dwell upon the underlying causes of this situation, it should be recommended to proceed with further in-depth qualitative research.

Practical implications: What the research communicates to the organization is that although Generation Z members are aware of the significance of the knowledge transfer and learning processes and they understand the role of peer relations in these processes, they are unable to overcome the social barriers created by the online working system due to lack of appropriate skills.

Originality/value: The paper reveals new aspects that play crucial role in shaping Generation Z attitude to online work from one side. On the other hand it also helps to design synthetic tool researching this area in the future.

Keywords: knowledge, learning, online work, Generation Z, PCA.

Category of the paper: Research paper.

1. Introduction

Nowadays several articles have been written on the characteristics and personal traits of Generation Z members, their values (Maloni et al., 2019; Cresnar, Nedelko, 2020), their attitudes to work and organizations (Barhate, Dirani, 2021), their adaptation to the workplace (Chillakuri, 2020), and also the similarities they share and the differences that distinguish them from other generations (Hernaus, Poloski Vokic, 2014; Klopotan et al., 2020; Mahmoud et al., 2021), especially from Generation Y (Raslie, Ting, 2021). Adaptation to the workplace is necessary for all the different generations to collaborate, which adds extra difficulty to human resources management (HRM) in order to ensure the efficient workflow at the workplace (Benítez-Márquez et al., 2021). In recent years, Generation Z members have entered the labor market, but their entry was aggravated by the COVID-19 pandemic and its effects on the economy, society and the labor market (Sakdiyakorn et al., 2021). Despite the pandemic and the consequent economic downturn, Generation Z has high expectations about their work (Snieska et al., 2020), with a well-defined career development plan (Barhate, Dirani, 2021).

As a consequence of advanced technology development, work can more frequently be done outside the workplace and can be distributed, specifically in the geographic sense. This has been demonstrated by the COVID-19 pandemic when employees were transferred to online work wherever possible (Mueller-Langer, Gómez-Herrera 2022; Nejman, Sadłowska-Wrzesińska, 2019). Online work has developed into an aspect of operating cost control, as has outsourcing; yet, organizations are now showing a stronger tendency to realize its negative aspects, particularly in respect of employee well-being and performance (Ishii et al., 2023; Morikawa, 2023). On the other hand, employee preferences regarding online work are increasing, even if this working model involves an average 7% decrease of their wages (Lee, 2023).

Due to the epidemic and generational changes, we observe re-evaluations regarding expectations for work and career, which appeared within a relatively short time (Green, 2022). Transformations in the labor market related to various forms of work performance, new pension solutions allowing for early retirement, as well as the mass entry of the youngest generation of employees, called “Generation Z” into the labor market (Rodriguez et al., 2019; Bencsik, Machova, 2016; Bencsik et al., 2016), create risks associated with irreversible loss of unique organizational expertise that cannot be replaced by external knowledge (Bloodgood, Chen, 2021; Mahnke et al., 2009; Timiyo, Foli, 2023; Ritala et al., 2015). Some knowledge leaks out from the organization, especially the part involving the core work, which is often underestimated (Hans et al., 2023). There is a need to employ people with slightly different competences, such as extraordinary intelligence, communication skills, the ability to solve problems or interpret information (Caratozzolo et al., 2023). Generation Z is said to be enticed by work flexibility and work-life balance. They are characterized by entrepreneurial mindset,

they appreciate honesty, face-to-face communication, initiative and social responsibility (Randstad Canada, 2014). At the same time, the demand for knowledge is changing at a significant pace – some of this knowledge becomes outdated and some is significantly underestimated. Employees must constantly update their qualifications and continuous learning is becoming a standard. For Generation Z, any negative feedback or failure is an important step towards innovation, learning and higher job performance. What seems to be a response to the knowledge demand variability is the agility in the process of intra-organizational knowledge propagation. Specifically, it is the development of a contact network for quickly locating the needed knowledge and its smooth transmission. In the context of the presented economic, social and demographic transformation, the authors defined the objective of their arguments in this paper as an attempt at answering the question whether knowledge exchange is the key factor determining online work preferences for Generation Z employees.

2. Learning as part of knowledge management

Currently, the importance of knowledge, both for the organization and for individual employees, finds its manifestation in the redefinition of a number of management concepts. Knowledge is a term that is becoming increasingly difficult to grasp in terms of its essence. It goes far beyond what is collected in books. The definition of the term is currently being discussed by philosophers, psychologists and specialists in the field of management or IT (Dreesens et al., 2020). As an intangible resource, it is difficult to measure and its value is revealed only when we realize what we want to know and only when we need to know. New knowledge can come to our minds unexpectedly, as a consequence of associating different, seemingly not convergent, types of knowledge or information, but we often have no control over this process close to “enlightenment”. The COVID-19 outbreak also resulted in the transformation of educational practices quickly to guarantee learning continuity (Casado-Aranda et al., 2021; Usher et al., 2021).

Boydell (Evans, 2005, p. 30) distinguishes four types of knowledge: what it is, how to do it, how to become oneself, how to achieve goals in cooperation with others, and three levels of knowledge: how to put it into practice, how to improve it, and how to combine it. Davenport and Prusak (2000) define knowledge as a fluid composition of focused experience, value, useful information and expert perspective, providing a basis for evaluating and assimilating new experiences and information. On the organizational level, an interesting division of knowledge (sustaining the socio-psychological perspective) is represented by Evans (2005, pp. 31-33). Evans divides knowledge into four types: I know what (operational knowledge), I know how (it is also a kind of operational knowledge consisting of our experience of how something works

and how something is done), I know why (the definition of work, its meaning), I know who (discernment of who is who and what knowledge they have).

One of the objectives of knowledge management is to produce and distribute knowledge in order to facilitate access to resources, particularly human resources and to create an environment that promotes knowledge generation, sharing, learning, enhancement, organization, and utilization for the benefit of the organization and its employees (Graczyk-Kucharska, 2019). Technology and personnel needs are changing along with the world's ongoing changes. In today's organization, effective human resource management is crucial. Nieves, Quintana, and Osorio (2016) in their study analyze two theoretical approaches: HRM and perspective of knowledge.

Knowledge management can also be interpreted as an integrated approach by which data assets of an organization are found, recorded, analyzed, retrieved, managed, and shared (Cui et al., 2019). These assets refer to databases, records, regulations, procedures, as well as employees' skills and experiences (Idrees et al., 2023). Employees are able to perform their duties at work more efficiently if they share their expertise (Haider et al., 2023).

Thus, knowledge management should also focus on the learning process, including mutual learning (Akhmadi, Tsakalerou 2022). This process is a condition for the transfer of knowledge between employees, most often latent knowledge (Kamei and Ashworth 2023). To have it unveiled, we need a favorable, stress-free (Sadłowska-Wrzesińska, Piosik, Nejman, 2022) environment for the exchange of knowledge, because a person cannot be forced to share knowledge, nor can they be forced to accept new one. In today's organizational reality, therefore, the competence to learn and teach others effectively comes to the fore.

3. Methodology

The research findings presented in this paper are a part of a quantitative survey on the "Leadership aspects of online work management", which was conducted among young Generation Z representatives working online. The survey was conducted in December 2022.

This paper presents a fragment of the study findings concerning the respondents' opinions on the impact of online work on the learning and knowledge exchange processes.

The study was conducted with quantitative research methods involving the survey technique. The study covered young people representing Generation Z, having the experience with online work covering at least the year 2022. The classification which is most popular in literature defines Generation Z as persons born after 1995, although some researchers may include those born in 1990 in this group, whereas in other approaches the group only includes the people who were born in 2000 or later (Dreyer, Stojanová, 2022; Skýpalová et al., 2023; Urlick et al., 2017).

Because there are no statistics of the number of online workers in Poland, the main focus is on the group of young, economically active people. On the basis of *Rocznik Statystyczny Pracy 2021* (Employment Statistics Yearbook 2021), the population of the employed in Poland, aged 15-34 (which is the age range of interest for the researchers) was established at 4802 thousand people. The gender and age structure of the studied population is presented in Table 1.

Table 1.

Age and gender structure of the study group

Age groups	Population total '000 % of the population	Female '000 % of the age group	Male '000 percentages for the population	Sample size	Female sample size	Male sample size
15-24	917 19.09%	357 38.93%	560 61.07%	73	28	45
25-29	1761 36.67%	760 43.16%	1000 56.84%	141	61	80
30-34	2124 44.23%	928 43.69%	1196 56.30%	170	74	96
Total	4802	2045	2756	384	163	221

Source: own research.

For the population estimated as shown above, with the following statistical assumptions: fraction size: 0.5; confidence level: 95%; maximum error: 5%, the sample size was defined as a population of 384.

The survey was carried out with the use of quantitative research methods, involving CATI (Computer Assisted Telephone Interview – 50% respondents) and CAWI (Computer-Assisted Web Interview – 50% respondents).

2783 online workers were contacted. Some of them refused to take part in the survey, others did not qualify in terms of the study criteria (e.g. not having the experience with online work during 2022), otherwise specific age or gender groups were full.

The research assumption being the experience of online work in 2022 was intended to eliminate the group of employees whose work system was based on the online model only because of the COVID-19 epidemic. Those employees would typically carry out their tasks and responsibilities on the basis of extraordinary procedures, diverging significantly from the online work conditions defined in literature, the first and foremost of which is the voluntary choice of this particular working model. Hence, the opinions of respondents who were forced to work online because of certain external circumstances could lead to false conclusions about their attitudes and beliefs.

Ultimately, 387 correctly filled surveys were obtained (excess surveys do not disrupt the planned population sample structure).

The research instrument was a standardized survey composed of 57 closed-ended statements and 8 questions about the respondents' social and demographic characteristics. Likert scaling was applied to the responses (the Likert scale method can be used to determine the relative intensity of the various answers (Babbie, 2004, p. 192)). The research instrument (survey) is a proprietary tool developed by members of the research team – the Czestochowa

University of Technology, Faculty of Management, Department of Applied Sociology and Human Resources Management staff.

PCA (Principal Component Analysis), which was used to process the study findings, is among the most popular statistical techniques within the factor analysis practice, used to analyze the behaviors and attitudes of respondents (Nardo et al., 2005; Pupelis, Šeinauskienė, 2023). The analysis was conducted with Statistica software.

4. Principal Component Analysis method

Empirical research in the field of management studies requires specific research tools. Building questionnaires is a process in which the researcher has to balance the focus on maximizing the information obtained through the study and the research efficiency. Increasing numbers of survey questions coincides with decreasing levels of readiness to take part in a study and, in the case of surveys executed through the online channel or by phone, an increasing tendency to terminate the survey (Kaczmarek, 2016). Considering the relatively short time which respondents are willing to devote to participation in a survey, the structure of the research instrument needs to be precisely conceived (Kaczmarek, 2013). Where the Likert scale is used in a questionnaire, it seems equally important to consider the number of statements used; with excessive number of test items, measurement quality will deteriorate as a consequence of such incidents as random answers given by respondents wanting to end their study participation as soon as possible. On the other hand, where an insufficient number of statement is generated, certain significant aspects of the studied issue may be disregarded (Kaczmarek, 2016). Attempts at resolving the issue with the number of test items for the Likert scale are undertaken in the form of reliability analysis, typically using Cronbach's alpha.

Yet the real challenge for the researcher is studying phenomena having multiple aspects. For these studies, multidimensional analysis will establish the relationships between variables in a dataset or the relationships between the objects defined by these variables (Walesiak, 2006). By applying the Principal Component Analysis, researchers are able to reduce large volumes of data to a small number of complex dimensions called components (Sztemberg-Lewandowska, 2017). Principal components are distinguished so that the first one explains the most variance of the input variables, the next one explains the most of total variance in what is left after the first component, etc. The number of principal components needed to explain all the joint variance of the studied variables equals the number of the variables, yet the most common practice is to consider a few initial components which will explain most of the overall variance of the input variables. A solution in which the components explain >60% of all the variation can be considered acceptable (Kaczmarek, 2016), although there are mentions of 80% or even 90% requirements (Górniak, 1998).

The analytical procedure for the Principal Component Analysis method is well presented in subject-matter literature, particularly in the field of psychological and social studies methodology (Capecchi et al., 2023; Lloyd et al., 2023; Nardo et al., 2005; Okón, 1968); nevertheless, it is reasonable to present its key assumptions and analytical tasks, comprising the following (Kaczmarek, 2016):

- 1) Selection of variables for analysis.
- 2) Defining a correlation matrix and eliminating uncorrelated variables.
- 3) Identifying the factors and their rotation.
- 4) Interpretation of results.

Principal Component Analysis requires the availability of variables measured on an interval scale, yet it is permitted to apply it to measurements on five-point or seven-point ordinal scales (Sagan, 2004, p. 89).

Analysis of the correlation matrix plays an important part in adequate selection of variables. A prerequisite for a methodologically correct application of this technique is that uncorrelated variables are eliminated. Before setting the correlation matrix, it should be verified whether the data under consideration has adequate statistical properties, specifically a non-zero standard deviation and the Kaiser–Meyer–Olkin (KMO) test value, i.e. the product of the correlation coefficients for the variables and the partial correlation coefficients for these variables. KMO value is the measure of sampling adequacy of variables. It is used to test whether partial correlation coefficients of the analyzed data are low. The value range is from 0 to 1. The higher the value, the greater the existing correlations of the variables. A KMO value below 0.5 challenges the suitability of Principal Component Analysis.

Another problem faced by the researcher is the determination of the number of components, which are usually called factors in PCA, like in other factor analysis techniques. This decision is arbitrary, yet multiple criteria exist that may assist the decision process. The most popular of those are (Kaczmarek, 2013):

- Kaiser's eigenvalue criterion – the eigenvalue of each principal component is presumed to be >1 , i.e. higher than the variance of a single variable;
- Cattell's scree test criterion – eigenvalues are presented as a scree plot and the components to retain are those forming the slope, while the scree components are ignored.

In the next step, to facilitate the interpretation of the developed solution, the factors (principal components) are rotated so that every variable has a high loading only in one factor (component), while the latter has at least a few near 0 loadings and a few near 1 or near -1 loadings.

As we know the wording of the statements used in the questionnaire, we can undertake a content analysis, i.e. naming the defined factors. Where Principal Component Analysis is applied to determine the dimensionality and uniformity of the scale, an additional step for the researcher is to eliminate items weakly correlated to others measuring the same property.

In this way, both the points which are not specific to any factor and show equally strong correlation to two or more factors and the points weakly correlated to all factors can be eliminated from a scale composed of multiple statements.

5. Principal Component Analysis - findings

According to the method algorithm presented earlier, the analytical procedure aimed at determining the dimensionality and uniformity of scale included the following actions.

Step 1 – selection of variables for analysis. The analysis covered 57 variables. The following scale was used in the responses: 1 – completely disagree, 5 – completely agree. Four questionnaire validity procedures have been used: content (Rossiter 2008), face (Czakon, 2014), construct (Cronbach, Meehl, 1955) and nomological (Czakon, 2014) ones. The scale reliability was validated using Cronbach's alpha that is a measure of internal consistency ($\alpha = .970019$).

During the questionnaire construction phase, the points on scale were divided into segments by topical area. The knowledge/information/learning area is presented in Table 2.

Table 2.

Factors to assess opinions on online work in the context of knowledge transmission, information and learning

Question ref.	Online work
m8[17]	Forces you to learn to use new technical solutions
m8[18]	Involves independent problem solving
m8[19]	Facilitates rapid exchange of information
m8[20]	Fosters understanding of communicated data
m8[21]	Leads to overburdening with data
m8[22]	Makes it easier to evaluate whether certain information is true
m8[23]	Facilitates learning from your peers
m8[24]	Streamlines learning new things
m8[25]	Facilitates explaining new knowledge more effectively to other employees
m8[26]	Supports gathering and documenting personnel knowledge
m8[27]	Enables you to learn from more experienced employees
m8[28]	Facilitates identification and location of people having the desired knowledge
m8[29]	Encourages you to search for information/knowledge among peers
m8[30]	Facilitates knowledge transfer from the superior

Source: Own research.

A graphic presentation of the respondents' answers distribution across the studied area is shown on Figure 1.

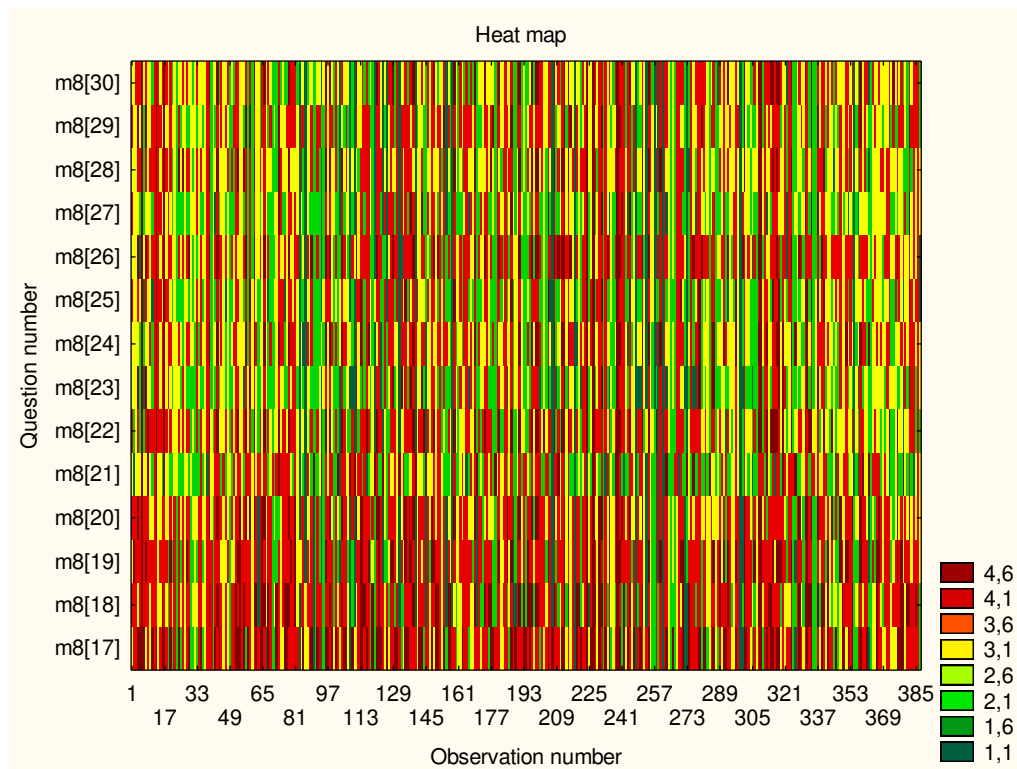


Figure 1. Heat map – online work in the context of knowledge transmission/information/learning (response scale 1-5).

Source: Own research.

The presented heat map shows that the respondents were generally in agreement with statements on remote work forcing them to learn to use technical innovations, solve problems independently, facilitating quick communication, fostering understanding of communicated data, gathering and documenting staff knowledge. At the same time, the respondents would rather disagree with the statements on remote work leading to data overburden, fostering learning from peers, enabling better explanation of new knowledge to other employees or facilitating learning from more experienced employees.

Step 2 – defining a correlation matrix and eliminating uncorrelated variables. The correlation analysis was preceded with an assessment of the values of generated descriptive statistics, particularly the standard deviation. Non-zero values of standard deviation were obtained in both measurements for all the variables. Based on correlation analysis, two statements were eliminated from the dataset of 57 statements: “online work leads to a feeling of isolation” and “online work puts an emphasis on communication in writing (e-mails, text messages, etc.)”. Few statistically significant correlations were present for these variables. Based on the obtained KMO (Kaiser-Meyer-Olkin) value of 0.968 and near-zero Barlett sphericity test result for 55 variables, a positive decision was undertaken on the suitability of principal component analysis for clarifying the correlation matrix structure.

Step 3 – identifying the factors and their rotation. After conducting the Scree test (Figure 2) and applying the Kaiser eigenvalue criterion, 7 factors (components) were distinguished which explain 72.23% of all the variance (Table 3).

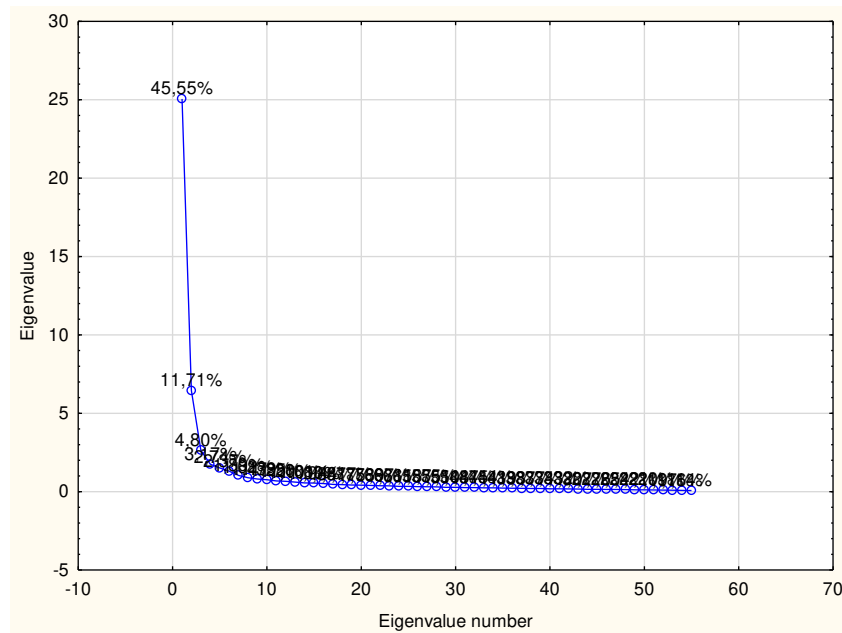


Figure 2. Scree graph.

Source: Own research.

Table 3.

Defined principal components indicating the key dimensions of online work

Component number and name	Eigenvalue	% of all variance	Cumulative eigenvalue	Cumulative percentage
1. knowledge, information and efficiency	25.05	45.54	25.05	45.54
2. relationships and learning	6.44	11.71	31.49	57.25
3. communication	2.63	4.79	34.13	62.05
4. work-life balance in the context of time commitment	1.74	3.17	35.87	65.23
5. motivation	1.51	2.74	37.38	67.97
6. stress factors, distractions	1.31	2.37	38.68	70.34
7. work-life balance in the context of work burden	1.04	1.88	39.72	72.23

Source: Own research.

Step 4 – interpretation of results. It can be concluded on the basis of the principal component analysis that the opinions expressed on online work by Generation Z employees in the survey can be reduced to seven dimensions, of which the two initial ones being “knowledge, information and efficiency” and “relationships and learning” refer to the area of knowledge exchange in the context of work performance and its social environment. The first of these factors explains as much as 45.54% of all the variance, whereas the second one explains 11.71%. Structuring of the factors as test points on a scale involved the contributions of the variable based on correlation as well as common variable resources based on correlation.

6. Discussion

The completed survey covered such aspects of online work as: employee relations, knowledge transfer/information/learning, motivation, work organization, work-life balance and employee well-being. Application of the PCA method has demonstrated that the matters related to knowledge, information and learning categories have turned out to be essential in terms of building opinions and attitudes towards online work. However, these were structured differently than the assumptions for the survey. It should be noted that these categories are perceived by Generation Z employees, particularly those with a preference toward online work (Astorquiza-Bustos, Quintero-Peña, 2023; Bamieh, Ziegler, 2022), mainly with regard to work performance, although it should not be disregarded that the respondents associate the knowledge exchange/learning processes with building social relationships at the workplace. It should be further emphasized that the respondents were critical about the impact of online work on the opportunity to learn from peers, to better clarify new knowledge to other employees or to learn from more experienced employees. Hence, these aspects are important for young workers but not realized to a satisfactory degree in online work. These processes are particularly important in social and professional adaptation, which is a key phase for a young worker in their advancement toward maximum performance on the job (Yarbrough, Ramos Salazar, 2023). They are also important as components of career development and building their position in the organization. As noted by Bloom et al. (2015), online work may lead to limitations in terms of accessibility of broadly defined knowledge as well as promotion and career development opportunities. Moreover, matters of employee relationships should be associated with the preferences Generation Z have about feedback in the learning process and job performance (Hegade, Shettar, 2022; Steyn et al., 2020). It seems that organizations should pay special attention to managing those aspects of online work environment which can make today's learner become a mentor to another employee tomorrow, thus fostering uninterrupted transfer of the organization's knowledge. In addition to the generational reference, aspects of personnel functioning in online jobs should be analyzed in the context of the COVID-19 pandemic as well. The research findings on that period pointed to the aspects work-life balance and well-being being essential for those employees who switched to online work on a mass scale during the pandemic (Augstein et al., 2023; Chou et al., 2023). Numerous employees had to manage household chores, caring activities and learning at home simultaneously (Vaziri et al., 2020) while worrying about well-being and health issues (Fogarty et al., 2022). It had a great impact on satisfaction with remote work (Carillo et al., 2021) and work performance (Burk et al., 2021). In the course of preparation of the survey, it was intentionally assumed that the respondents should have the experience of working online in 2022 when almost the whole world has returned to normal functioning in terms of work. However, the change that occurred in the "new normal" was mainly that employees began to intentionally choose online work as their preferred system (Šmite et al., 2023). Interestingly, work-life balance aspects were of less importance for the respondents in their evaluation of online work (components 4 and 7).

7. Conclusions

The matters related to knowledge, information and learning categories have turned out to be essential in terms of building opinions and attitudes towards online work. It should be noted that these categories are perceived by Generation Z employees mainly with regard to work performance, although it should not be disregarded that the respondents associate the knowledge exchange processes with building social relationships at the workplace. This aspect is particularly important with respect to Generation Z for which major competence gaps are being identified in terms of social competence. What it communicates to the organization is that although Generation Z members are aware of the significance of the knowledge transfer and learning processes and they understand the role of peer relations in these processes, they are unable to overcome the social barriers created by the online working system due to lack of appropriate skills. In order to dwell upon the underlying causes of this situation, it should be recommended to proceed with further in-depth qualitative research.

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DETERMINANTS OF MANAGERIAL COMPETENCIES IN THE LEADERSHIP ECOSYSTEM 5.0

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Purpose: The purpose of this publication is to present the determinants of managerial competencies in the Leadership ecosystem 5.0. The identification of the elements of the Leadership ecosystem 5.0. and its characteristics were also performed.

Design/methodology/approach: In the theoretical part, a critical literature analysis was conducted. This included international literature from major databases and Polish literature. Additionally, in order to identify research problems, a diagnostic survey method with Likert scale analysis was used.

Findings: The research conducted was based on the authors' categorization of leadership competency areas. The most important competency areas were identified. Furthermore, the research results enabled the identification of criteria distinguishing a leader from a manager. Factors essential for the effective performance of the leader's role were presented. Additionally, indicators of competence within the context of the Leadership ecosystem 5.0 were highlighted.

Research limitations/implications: The research is intended to be expanded in the future to include a more extensive and more diverse research sample.

Practical implications: The research results and conclusions constitute implications for the development of competencies adequately matching the challenges of the Leadership ecosystem 5.0. The 5.0 Leadership ecosystem brings many benefits, such as increased efficiency, cost reduction, and sustainability. For managers responsible for team creation, member selection, and work organisation, the results and conclusions of the research are deemed a valuable information source aimed at enhancing the organisation's effectiveness.

Originality/value: The article proposes an original model of the Leadership ecosystem 5.0. It presents the conceptualization process and characterizes the elements of this ecosystem.

Keywords: competencies, leadership 5.0, ecosystem, manager, commander.

Category of the paper: Research paper.

1. Introduction

Contemporary reality can be described as incredibly volatile and unstable against the background of the past. Over millennia, the constant striving for development seems to be a special trait of human beings. Development in various aspects of life, and especially economic development, the basis of which is the development of technology. Following Fromm (2017), it can be noted that technology makes humankind omnipotent, and science makes it omniscient. Industrial civilization, being the brainchild of liberal thought, has brought people the freedom to choose and decide for themselves, but it has also brought a number of threats.

Apparently, the human being is the decision-maker for changes. Still, unfortunately, often, their knowledge and capabilities are poorer than the environment and the surroundings which are the author of their own plans. Increasingly often, especially in the business world, the acronym VUCA is used to describe the modern environment. The acronym VUCA stands for volatility, uncertainty, complexity, and ambiguity. Used for the first time by US Army leaders to describe the post-Cold War environment. It is still used to characterize the environment that leaders must face (Strategic Leadership Primer, 1998). Currently, VUCA has actually become an idea taken over by the leadership of all sectors of society to describe the nature of the world in which they operate: the accelerating rate of change (volatility), lack of predictability (uncertainty), interconnectivity, causes, and forces of impact (complexity) and massive potential for erroneous readings (ambiguity) (Forsythe et al., 2018).

VUCA has become not only an official threat to the development, stabilization, and functioning of any organization, but also a fashionable way to motivate leaders. While reviewing the literature, a research gap was identified regarding the inclusion of the VUCA environment as an element of the 5.0 Leadership ecosystem (Baran, Woznyj, 2021; Bennett, Lemoine, 2014; Du, Chen, 2018; Kautish et al., 2022; Luthans, Broad, 2022; Troise et al., 2022; Zhang-Zhang et al., 2022). On the ScienceDirect platform, 8 records were identified with the term VUCA in the title of an article or chapter in the area of Business, Management and Accounting and Social Sciences (November 29, 2023). BazTech showed 5 records with the term VUCA in the article title (November 29, 2023). However, no connection was found between the issues of leadership and the VUCA environment. For the authors of this publication, the VUCA environment has become an implication for taking up the issue of determinants which affect the manager's competencies as one of the elements of the 5.0 Leadership ecosystem. The aim of the research was to learn the determinants of a manager's competencies in Leadership ecosystem 5.0.

2. The essence of competency

There is no doubt that the concept of competency, at the same time, is one of the most commonly used and one of the most controversial concepts in the modern management language (Nicolini et al., 2006, Ruzzarin et al., 2002).

The analysis of the essence of the manager's competencies is proposed to begin with the etymology of the term competencies. In the source literature, there are two concepts of competence: "competency" and "competence". These terms are often used interchangeably, while the difference in their meanings may lead to numerous misunderstandings. The term "competency" denotes soft skills. Woodruffe (1991) defined them as employees' skills related to their behaviour, emphasizing that behaviour is the foundation of competent actions. In this sense, competencies are also referred to as behavioural traits. "Competence", in turn, denotes hard skills. Woodruffe linked them to work areas in which the skills of a given employee are adequate for the position. Therefore, it is assumed that a competent person meets the expectations related to the results of their work. Competences determine the skills of employees that guarantee the fact of being effective. In addition, they signify the ability to make use of the resources of their knowledge at various levels of the tasks performed to achieve the intended goals work.

In the *Dictionary of the Polish Language*, competencies are described as the scope of someone's knowledge, skills, and experience (sjp, 2023). A similar understanding is given by Spencer (1993), according to whom the term "competences" is a combination of three attributes: skills, attitude, and knowledge. They define a person who carries out the tasks efficiently and effectively, according to the quality-oriented expectations of the organization.

Some researchers omit the characteristics of a competent person as a significant part affecting competencies. Competencies are defined as a body of knowledge, skills, and attitudes which affect work to the greatest degree and remain related to its performance. Competencies can be measured using the approved tools and improved by training and development, but traits cannot. Such an attitude is also presented by Cooper (2000). However, Whiddetta and Hollyforde (2003) claim that competencies are exactly a set of personality traits characteristic of a specific employee (manager). Among them, we can point out skills, knowledge, motivation, and the ability to self-evaluate.

In the management science literature, we deal with many proposals of competency models and, more specifically, models of competency profiles. The proposal of Lucia and Lepsinger (1999) presented in Figure 1 presents a very general model which fits into one of the broader definitions of competency.

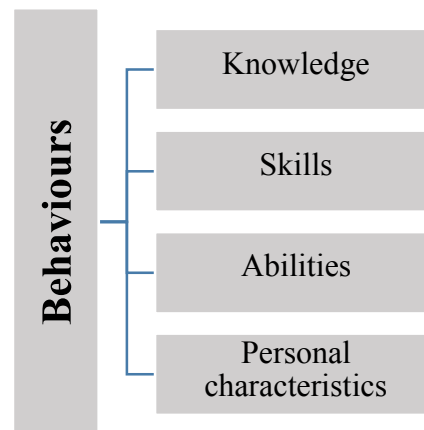


Figure 1. Competency model.

Adapted from: Lucia, Lepsinger, 1999.

The behaviour of a person is of key significance in the competencies according to the model above. They are presented as a base consisting of personal character traits, abilities, skills, and, of course, knowledge. Many researchers base their studies on the search for traits, skills, and behaviours that prove the effectiveness of a manager, leader, or commander (Balcerzyk, 2017, 2018). It should be noted that the spectrum of competencies and roles of managers and leaders cited in the literature largely depends on the perspective of the research conducted by an author of a given publication (Balcerzyk, 2021, 2023; Czaińska, 2021; Simerson, Venn, 2010; Sylwestrzak, Rzepecka, 2023). Largely, the variety of approaches results from the specificity of research areas and the breadth of management science which allow for describing this issue.

3. Clarification of the concepts of manager – leader – commander

Both in colloquial language as well as in the literature, the terms "manager", "superior", "leader", and "commander" are used interchangeably (Wojciechowska, 2019). Undoubtedly, these concepts have evolved, and researchers propose many definitions describing them as separate beings. Due to the variety of the fields of knowledge in which these concepts appear, there is no consensus on this issue.

A manager is a person who manages the work of other people within an organization's established structure (Penc, 1997, p. 188). A manager is the person responsible for the implementation of the management process. Within this process, they are responsible for implementing management functions: planning, organizing, leading, and controlling (Griffin, 2005, p. 7). A manager should also be considered as a person who holds an executive position regardless of the organizational tier (Kozuch, 2004).

In order to define the term "commander", *General Rules and Regulations of the Polish Army Soldier* (2023, p. 10) was used, according to which a superior in a military organization exercises command (executive), management, instructional, and educational functions over their subordinates. They are responsible for the organizational efficiency and service (work) of subordinates and is also obliged to create conditions ensuring adherence to the law and discipline by their subordinates.

According to Kopertyńska (2015, p. 257), a leader "...is someone who primarily inspires, motivates, convinces and influences other people and paves the way for change". Blanchard (2018) defines leadership in more detail as the ability to effectively influence people by unleashing energy and potential in them to enable them to strive for the greater good.

A comparison of the relations between the manager, the leader, and the commander indicates that the importance of the leader's role is growing. However, the roles of the commander and manager are very similar. The list of elements of individual roles is presented in Table No. 1.

Table 1.

Comparison of activities: manager, leader, and commander

Manager	Leader	Commander
Administers	Innovates	Commands
Accepts <i>the status quo</i>	Negates the status quo	Accepts <i>the status quo</i>
Controls	Inspires, motivates, inspires trust	Controls
Plans and budgets	Introduces changes	Plans and evaluate
Focuses on systems	Focuses on people	Focuses on tasks
Uses formal structures	Uses informal structures	Uses formal structures
Has a short-term thought horizon	Has a long-term thought horizon	Has a short-term thought horizon
Imitates	Creates	Recreates

Source: the authors' own development (based on: Balcerzyk, 2017, 2018; Tomaszuk, 2009; Sylwestrzak, 2023).

The current models match McClelland's (1967) concept, according to which a person influences the context in which they act only through their behaviour. In the discussions on the topic of leaders, in addition to the features possessed, the importance of the competencies possessed by a leader, which are the determinant of their position, is emphasized. By becoming aware of the nature of leadership, you can develop leadership qualities through appropriate training. A manager aspiring to the role of a leader must skilfully and coherently combine activities and functions from the sphere of leadership, management and command. These key activities include creating: models of personal role, values and culture, guarantees of trust, planning, organizing, motivating, knowledge and innovation management, etc. (Balcerzyk, 2021, 2023).

Mintzberg proposes blurring the lines between the roles of leader and manager. He believes that instead of separating, for example, management from leadership, we should treat managers as leaders, and leadership as well-executed management (Wrona, 2016). Undoubtedly, managerial skills are conducive to acting as both a commander and leader.

4. Research methodology

The search for a solution to the research problem required the use of the literature analysis method and the survey method (Cooper, 2000; Nicolini et al., 2006; Ruzzarin et al., 2002; Spencer, 1993; Whiddetta, Hollyforde, 2003; Woodruffe, 1991). In order to obtain the respondents' opinion, a questionnaire with detailed questions was used in the research. This study presents a fragment of broader research on the issue of leadership. The issues presented concern the most important areas of a leader's competencies and the criteria for distinguishing leaders.

Problem questions: Which area of a leader's competencies is the most important? What criteria distinguish a leader from people performing managerial duties?

The research was carried out in 2022-2023 in the Lower Silesia region. 340 questionnaires were analysed. The characteristics of the sample included: age, gender, size of the organization in which the respondents work, and the position held by them. The highest percentage of 48% of respondents are very young people from the age range of 19 to 25 years. Subsequently, 28% of the respondents were between the ages of 26 and 35. People from the age group of 36 to 45 years account for 15% of the respondents. People over 55 years of age account for 6% of the respondents. Respondents aged 46 to 55 constituted the lowest percentage share of 4%.

The distribution of gender in the sample was even. Women constituted 51% of the study group, and men 49%. Another variable taken into account in the research was the size of the organization in which the respondents work. Data obtained from surveys indicates that 49% of the respondents work in a company with more than 100 employees. The remaining respondents work in smaller companies employing: from 51 to 100 employees - 12% of the respondents, from 21 to 50 employees 11% of the respondents, from 11 to 20 employees 7% of the respondents, from 6 to 10 employees 10% and in a company employing up to 5 employees 11% of the respondents.

An important variable that was taken into account in the research was also the position held in the company. The results indicate that 22% of respondents hold the position of a middle-level executive (manager). The position of a junior manager was indicated by 12%. The least respondents - only 5% - occupy the position of senior manager. A large group of respondents - as high as 61% - are persons occupying a position other than the above-mentioned ones, i.e. a regular employee.

The characteristics of the research sample allow us to assess that these are mainly young people at the beginning of their professional career and few of them are senior managers. They probably play the role of supporters rather than leaders.

5. Research results

Referring to the literature review (Cooper, 2000; Nicolini et al., 2006; Ruzzarin, et al., 2002; Spencer, 1993; Whiddetta, Hollyforde, 2003; Woodruffe, 1991), it should be noted that there are many definitions and categories of competencies. The research undertaken was based on the authors' original set of competency categories. It was decided that five key areas can be distinguished in the set of competencies:

1. Interpersonal skills including: communication skill, inspiring and motivating a team, shaping trust, relationships and cooperation with people.
2. Personal predispositions, which may include: specialist and expert competencies. Problem-solving skills, taking initiative and personal development are also important here.
3. Focus on outcomes. The implementation of this area requires the ability to set ambitious goals, take initiative, but also take responsibility for the results obtained.
4. Mastery of change, which includes skills to develop a strategic perspective, connecting the group with the external world, also including its cultural aspect. In addition, they are characterized by the ability to update activities to take into account changing needs and expectations.
5. Character, which is understood here as being characterized by honesty and integrity.

The respondents were asked to assess the competency areas of a leader proposed in the multiple-choice answers. A five-point Likert scale was used for the assessment, in which 1 was the most important and 5 the least important. The data obtained from the respondents' answers is presented in Table 2.

Table 2.

The most important competency areas of a leader in the opinion of the respondents

No.	Categories		Scale					Weight
			1	2	3	4	5	
1.	Interpersonal skills: communication skills, inspiring and motivating, building trust, cooperation with people	n	150	86	60	30	14	1348
		%	44,12	25,29	17,65	8,82	4,12	
2.	Personal predispositions: specialist and expert competencies, problem-solving skills, taking initiatives, personal development	n	56	114	77	59	34	1119
		%	16,47	33,53	22,65	17,35	10,00	
3.	Focus on outcomes: setting high goals, taking initiative, but also taking responsibility for the team's results	n	26	58	76	106	74	876
		%	7,65	17,06	22,35	31,18	21,76	
4.	Master of change: developing a strategic perspective, connecting the group with the external and cultural world, updating measures taking into account the needs of the organization	n	31	29	68	96	116	783
		%	9,12	8,53	20,00	28,24	34,12	
5.	Character: being characterised by honesty and integrity	n	78	52	60	48	102	976
		%	22,94	15,29	17,65	14,12	30,00	

Source: Own research.

The analysis took into account both the percentage distribution of responses and the weight for individual categories was calculated. When calculating the weight, level 1, which was considered the most important, was assigned a weight of 5, for the other levels accordingly less, until level 5, which was assigned a weight of 1. The results of the research show that in the opinion of the respondents, the first of the above-mentioned areas is the most important one in the area of competencies, i.e. competencies including *interpersonal skills*. This area achieved the most of all categories, as 44.12% of the respondents awarded it level 1 on the scale. In this area, a group of 42.94% of the respondents indicated together significant levels 2 and 3 on the scale. This category gained the most weight (see Table 2).

Personal predispositions were ranked second in the weight ranking, as the most important area of competencies. The most important level 1 was indicated by 16.47% of the respondents, level 2 by 33.53%, and level 3 by 22.65%. In the third place in the ranking according to the weight of the most significant competency area, the respondents indicated the *character of a leader*. Nearly 23% of the respondents assessed this area at level 1. A total of 32.28% of the respondents assessed this area at level 2 and 3.

The focus on outcomes was in fourth place in the weight ranking. In this area, 7.65% of the respondents awarded the highest level 1, 17.06% awarded level 2, and level 3 was awarded by 22.35% of the respondents. In the last, fifth place in the weight ranking, the respondents rated the competency area related to the skills helping one to adapt to change, i.e. the *master of change* as the least important.

Many discussions in the management literature concern the differences between a manager and a leader. In the survey, respondents were asked to choose the most accurate statement in the question about the criteria distinguishing a leader from people performing managerial duties. The data obtained from the respondents' answers is presented in Table 3.

Table 3.

Criteria that distinguish a leader from a manager in the opinion of respondents

No.	Categories	n	Percent
1.	They have special skills to deal with the conflicting needs of different components of the organization.	70	20.59
2.	They attach great importance to vision, values and motivation.	72	21.18
3.	They do not limit their interests to the scope of the organizational unit they direct.	40	11.76
4.	They think in a long-term perspective, going far beyond current problems and the horizon of the quarterly report.	146	42.94
5.	I do not accept the current state of affairs.	12	3.53
Total		340	100

Source: Own research.

The highest percentage share of the respondents, i.e. 42.94% concluded that the most important criterion distinguishing a leader from a manager is the fact that *a leader thinks in a long-term perspective, going far beyond current problems and the horizon of the quarterly report*. Almost half of the respondents, i.e. 21.18%, considered that such a criterion is contained in the statement - *a leader attaches great importance to vision, values and motivation*. Slightly fewer, namely 20.59%, believe that a leader has *special skills to deal with the conflicting needs of various components of the organization*. Only 11.76% of the respondents indicated that a leader *does not limit their interests to the scope of the organizational unit they manage*. A negligible figure of 3.53% indicated, on the other hand, that a leader *does not accept the current state of affairs*.

It is also worth quoting, at this point, the results of the study, which referred to the factors determining the effective role of a leader (Balcerzyk, 2021). According to 38% of respondents, the role of a leader largely *depends on their experience and other members of the organization*. Other factors determining effective performance of a leader's role are: the situation in which the relationship between a leader and the members of the organization occurs (18%), the type of tasks that need to be performed (18%), the organizational environment (14%), and the abilities and expectations of the subordinates (12%).

6. Discussion and conclusions

The main challenge of the Leadership 5.0 is to function in a turbulent reality environment, and therefore in a VUCA environment. The environment was recognized as one of the elements of the 5.0 Leadership ecosystem. The 5.0 Leadership ecosystem is also described by Industry 5.0 and, in particular, the challenges it poses for leaders. The organizations which have adopted Industry 4.0 (Adel, 2022; Wolniak, 2023) are flexible and ready to make data-driven decisions. Industry 5.0 means that people and machines work together. In order to adopt Industry 5.0, an adequate personnel interaction is required between machines (robots) and operators (Adel, 2022; Nahavandi, 2019). Competencies in areas such as robotics or artificial intelligence will be required. Artificial intelligence is already recognized as part of the 5.0 Leadership ecosystem.

Leadership, as a relation of influence, must achieve synergy of individual elements of the ecosystem. In Figure 2, a synergy model of the 5.0 Leadership ecosystem is proposed.

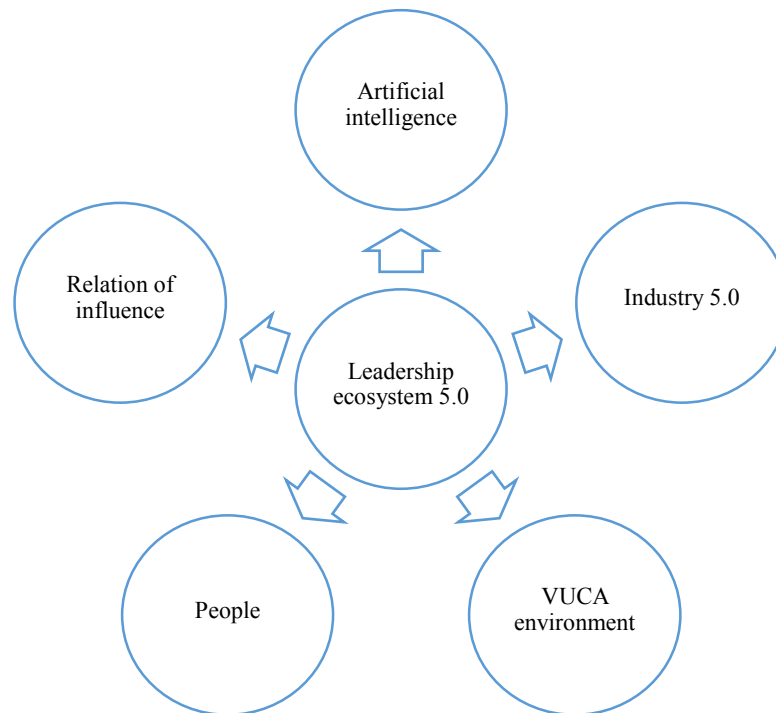


Figure 2. Leadership ecosystem 5.0 synergy.

Source: The author's own compilation.

It can be assumed that the elements which build the 5.0 Leadership ecosystem are the factors which hinder a stable development of the organization. A VUCA environment, i.e.:

- fast pace of change - variability,
- lack of predictability - uncertainty,
- interrelationships, their impact and the strength of impact – complexity,
- and a large spectrum of possible misinterpretations – ambiguity.

Features of a VUCA environment affecting changes in the business environment may also generate pitfalls for leaders. The problems seem obvious, but we do not just notice them. Namely, we see them as an opportunity to be seized.

The role of leaders will be to identify challenges. The environment creates unique situations; it does not create examples that leaders could duplicate or use. The terms variability, uncertainty, complexity, ambiguity generate completely different and difficult situations. Hence, it is from the competencies of a leader that the success of the organization is derived.

Another element of the Leadership 5.0 - artificial intelligence, entering reality without a question, poses new challenges and opportunities for leaders. Industry 5.0 are technologies based on cloud computing, blockchain technology, big data analysis, IoT, 6G networks. Industry 5.0 and artificial intelligence provide people with benefits such as technical precision, performing critical tasks, or application in human security situations, etc.

It was assumed that the elements indicated as components of the Leadership 5.0 are not separate entities but interweave each other. The relation of influence is, among others, a kind of bond between individual entities, a person – the leader, people – their supporters,

the environment – surroundings, people and technology - represented by Industry 5.0 technologies and artificial intelligence. The synergy of such different elements will make the total effect of their interaction greater than the effects of their separate impacts.

The research conducted in the social reality described above indicates that the respondents indicated interpersonal skills as the most important area of a leader's competencies. Therefore, communication skills, inspiration, motivation, building trust, and cooperation are more important in the opinion of the respondents than expertise. Personal predispositions: specialist and expert competencies, problem-solving skills, taking initiatives, and personal development came second. It may be disturbing that the skills facilitating adaptation to changing conditions, allowing for the development of a strategic perspective, the ability to update activities taking into account the changing needs and expectations of the organization were underestimated by the respondents. On the other hand, the most important criteria distinguishing the leader from the manager in the opinion of the respondents included the ability to think in a long-term perspective, which goes far beyond current problems and the horizon of the quarterly report. The conclusion from the results presented may be captured by a statement according to which people have stopped at strategic thinking and interpersonal relationships despite serious changes that the Leadership 5.0 brings about.

Competency determinants that can be adapted to the 5.0 Leadership ecosystem are proposed:

The ability to select the right people and to give them freedom afterwards. Providing one's own people with a place to work and space to develop.

Shaping a culture of responding - creating, shaping and transforming the culture of the organization so that it is more responsive. This feature means that it is tailored to the needs, responsive and reacting to the actions of fellow participants.

Formulating and sharing the values of the organization - using these values in decision management, in personnel management and development processes. Specific values ensure that all organizational systems are aligned and synchronized to embody the culture of the organization. Leaders should be the main relays of the organization's values, ones who strengthen them by personal example and ensure their cascade spread in the organization's structure.

Building an appropriate culture (Rzepecka, 2023) based on constant values (Balcerzyk, 2023), may be the key in the competencies of the 5.0 Leadership ecosystem. Building an appropriate atmosphere, responsive narrative both inside and outside the organization.

The 5.0 Leadership ecosystem brings about many benefits, such as increased efficiency, cost reduction, and sustainability. According to the author, the 5.0 Leadership ecosystem, as a complex but also a new category, implies the need for in-depth research on a larger scale, which she intends to undertake.

Despite the above conclusions, the research has some limitations. The author would like to mention that the research conducted was based on an interpretive paradigm, particularly valid in the study of the relationship between an individual and its ecosystem, focused on the future. The presented analysis and research results have significant implications for management theory.

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IMPACT OF SOCIAL RESPONSIBILITY STRATEGIES ON THE PERCEPTION OF THE EXEMPLARY ORGANISATION IN GLOBAL FASHION INDUSTRY

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Purpose: Determining and discussing various strategies on social responsibility and their influence on the image of organization.

Design/methodology/approach: The research method used in the paper is mainly a standardized survey conducted on the basis of a questionnaire containing closed and open questions carried out in two exemplary enterprises. The research process was also accompanied by analysis of source documentation.

Findings: Research results verify research hypotheses formulated on basis of the paper's objectives, enabling general conclusions.

Research implications: Future research directions should focus on further, expanded research exploration in the area, taking into account various industries.

Practical implications: The results of the research discussed in the paper have a number of practical implications mainly for the management staff in terms of use of social responsibility strategies.

Social implications: Building awareness of social responsibility.

Originality/value: The paper has cognitive value for the development of knowledge, science and quality in terms of social responsibility.

Keywords: social responsibility, strategic management, image creation.

Category of the paper: research paper.

1. Introduction

The paper focuses on analyzing the social responsibility strategy of H&M Hennes & Mauritz. H&M is a global fashion brand known for its wide range of clothing products for women, men and children. However the company is also recognized for its commitment to social responsibility activities. The aim of this paper is to examine how H&M's social responsibility strategy influences the company's image and evaluates the effects of these actions on customer relations and local communities.

The paper formulates ten specific research hypotheses that are subject to analysis based on available sources such as H&M's CSR reports, market research and customer opinions. The paper examines the objectives and assumptions of H&M's CSR strategy, including the promotion of sustainable development, ethical business practices as well as charitable and social initiatives. Additionally it investigates how these actions are perceived by customers and their impact on the company's image and customer loyalty.

This research holds crucial significance for both management theory and practice, as it contributes to a better understanding of the relationship between CSR strategy and corporate image. Furthermore the research findings can contribute to the development of recommendations for effective social responsibility practices for companies operating in the fashion industry.

The main objective of the paper is to examine the effectiveness of H&M's corporate social responsibility strategy in shaping a positive company image among consumers. This research topic is of significant importance as CSR has become increasingly important in the business landscape and understanding its impact on consumer perceptions can provide valuable insights for companies like H&M.

To address the main research problem, the paper identifies specific research questions. These questions are aimed to explore various aspects of H&M's CSR strategy, including its goals, actions, effects, customer awareness and the relationship between CSR and customer loyalty. The research also investigates the extent to which H&M's CSR actions align with customer expectations and whether there is a discrepancy between the company's image as presented in CSR reports and customers' opinions.

By addressing these specific research questions, the work aims to provide a comprehensive understanding of H&M's CSR strategy and its impact on consumer perceptions. The findings from this research can contribute to enhancing H&M's CSR initiatives, improving customer engagement and shaping a positive company image. Additionally, the study can provide insights for other companies seeking to develop effective CSR strategies and establish a strong reputation among their target audience.

In conclusion a comparative analysis of the company's image based on CSR reports and consumer opinions is conducted. This comparison aims to identify the alignment between the official image of the company and its perception by consumers.

2. The outline of the study

For the purposes of the research one main problem and eleven specific problems have been identified. The main research problem is: What is the effectiveness of H&M's corporate social

responsibility strategy in shaping a positive company image in the eyes of consumers? Ten specific problems have been identified for the research, including:

1. What are the goals and assumptions of H&M's corporate social responsibility strategy?
2. What actions does H&M take as part of its corporate social responsibility strategy and what are their effects?
3. In which aspects of CSR are H&M's actions most known among respondents?
4. What is the relationship between the frequency of shopping and the importance of CSR values for customers?
5. Do positive opinions about H&M's CSR actions support customer loyalty?
6. Are H&M customers aware of the company's CSR actions and how do they learn about them?
7. What are the most common problems related to clothing production and how does H&M effectively address these problems?
8. What are the most important goals that customers have for H&M's CSR actions?
9. Is there a discrepancy between H&M's image resulting from CSR reports and customers' opinions?
10. Is H&M perceived as a socially responsible company in the eyes of customers?

The above research problems have led to the formulation of the hypotheses. The main and overall hypothesis is as follows: H&M's social responsibility strategy is effective in shaping a positive image of the company in the eyes of consumers, resulting from positive opinions about the company's actions, such as investing in sustainable development, social campaigns and charitable activities, and the identification with the values that the company represents.

For the specific problems formulated above, the hypotheses are as follows:

1. The objectives and assumptions of H&M's social responsibility strategy aim to strengthen the company's positive image and increase consumer engagement by promoting sustainable development, ethical and responsible business practices, as well as charitable and social activities. The aim of this strategy is also to build lasting relationships with customers, employees, and the communities in which the company operates, by demonstrating commitment to solving social and environmental problems.
2. H&M undertakes various activities as part of its social responsibility strategy, such as investing in sustainable development, social campaigns, charitable and social activities, and environmental protection programs. These activities contribute to improving the company's image and increasing consumer engagement, which can lead to revenue growth. At the same time, the effects of these actions may vary depending on their credibility and effectiveness in solving real environmental and social problems.
3. Among the respondents, the most well-known CSR actions of H&M are those related to ecology and sustainable development, such as recycling programs, campaigns to reduce water and energy consumption, as well as investments in sustainable materials and production processes.

4. There is a positive relationship between the frequency of shopping in a store and the importance of CSR values for customers. Customers who are more aware of a company's social responsibility and more interested in its actions towards environmental and societal protection are more likely to shop there and do so more often. In contrast, customers who do not attach such importance to CSR values may be less loyal to the brand.
5. Positive opinions about H&M's CSR actions can positively impact customer loyalty. Customers who perceive H&M's social responsibility actions as authentic and valuable may be more likely to identify with the brand and shop at H&M. Positive opinions about H&M's CSR actions can also contribute to recommending the brand to other customers, which may bring benefits in the form of increased sales and market share.
6. Not all H&M customers are aware of the company's CSR actions, and not all perceive them in the same way. Customers most commonly learn about H&M's CSR campaigns from the internet.
7. The production of clothing is associated with many issues, such as the use of child labor and illegally employed workers, low wages, lack of workplace safety, and environmental impact. H&M takes many actions to address these issues, such as monitoring working conditions in factories, reducing greenhouse gas emissions, promoting recycling, and using renewable materials.
8. Customers expect H&M to act in a socially, environmentally, and ethically responsible manner. In terms of CSR activities, customers expect H&M to reduce greenhouse gas emissions, use environmentally friendly materials, provide safe and fair working conditions for their employees, and monitor their suppliers to ensure that they adhere to similar standards. Customers expect H&M to be transparent in their CSR actions and to keep them informed about progress and results. In addition, customers expect H&M to be actively engaged in social and charitable activities and to support local communities.
9. There is a possibility of a discrepancy between H&M's image resulting from CSR reports and customer opinion. Although H&M may present its CSR activities in a positive light in its CSR reports, customer opinions may be diverse and not necessarily reflect the same positive image. Customers may have different expectations and criteria for evaluating CSR activities, and they may also have different experiences related to the H&M brand, which can affect their opinion of the company's CSR activities. Additionally, customers may be more inclined towards criticism and negative opinions than companies, which can further contribute to the occurrence of discrepancies between H&M's image resulting from CSR reports and customer opinion.

10. Consumer opinions on H&M as a socially responsible company may be diverse. Some customers may believe that H&M is taking sufficient CSR actions and is socially responsible, while others may believe that the company should do more. Moreover, customers may have different concepts of what it means to be socially responsible and what actions should be taken by companies in this regard. Some customers may also base their opinion on positive or negative experiences related to the H&M brand. Therefore, it is difficult to unequivocally state whether in the opinion of consumers, H&M is a socially responsible company.

The research was conducted using a self-administered online survey as well as analyzing the published reports of the examined company (hmgroup.com, 2023) The research was conducted in April 2023. A total of 200 individuals participated in the survey

3. Theoretical background

Social responsibility is increasingly important for today's consumers. Nowadays, customers expect companies not only to make money but also to participate in solving social, environmental and economic problems (Lindgreen, Swaen, 2010). Social responsibility strategy can help a company build a positive brand image by demonstrating that the company is committed to improving people's lives and the environment (Wickert, Risi, 2019). Customers often choose brands that show social responsibility because they feel that their purchases have a positive impact on the world (Maury, 2022). In addition, a positive reputation based on CSR can attract new customers, increase the loyalty of existing customers, attract investors, and attract talented individuals to work for the company (O'Brien, Jarvis, Soutar, Ouschan, 2018).

Many authors describe the role of social responsibility strategy in building a brand image (Emmanuel, Priscilla, 2022). The authors argue that organizations that implement effective corporate social responsibility strategies can gain a competitive advantage by improving their brand image, building customer engagement, and increasing social trust (Lee, Lee, 2018). They emphasize that effective CSR strategies must be integrated with the overall business strategy (Grayson, Hodges, 2017). They should encompass the entire organization from human resources management through the supply chain to customer and community relations (Kotler, Lee, 2008) and (Skowron-Grabowska, 2016).

It is also pointed out that effective CSR strategies should be authentic and aligned with the organization's values to avoid accusations of hypocrisy and criticism from society (Bhattacharya, Smith, Vogel, 2004). An effective CSR strategy can contribute to increased customer engagement, improved brand image, and increased social trust, ultimately leading to improved financial performance and competitive advantage for the company (Kotler, Lee, 2008).

Different models of corporate social responsibility and their impact on brand reputation are analyzed in literature. The authors note that organizations can use CSR as a tool to build a positive brand image, but at the same time warns of possible limitations and pitfalls associated with this approach (Vogel, 2005).

It is often observed that on the one hand, CSR can help build a positive brand image by increasing customer engagement and perception of the organization as socially responsible. On the other hand, the CSR approach may become a source of criticism from society if the organization fails to meet its promises or uses CSR solely for marketing purposes without truly engaging with the community (Vogel, 2005).

Theory notes that not all CSR models are the same and that some models may be more effective than others in building a positive brand image. For example a CSR approach focused on reducing negative impacts of the company's activities such as reducing greenhouse gas emissions, may be more effective in building a positive brand image than an approach focused on supporting social and charitable activities that are not directly related to the company's operations (Werther, Chandler, 2005). Overall some authors emphasize that CSR can be an effective tool for building a positive brand image, but also warns of the pitfalls and challenges in achieving true social responsibility in business (Vogel, 2007).

In turn some authors describe the role of corporate social responsibility strategy as a tool for building reputation and social trust (Singh, Misra, 2022). According to them companies that implement effective CSR strategies gain competitive advantage by improving brand image and increasing customer loyalty (Safeer, Liu, 2023). CSR strategy can help companies build a positive image through engaging in social activities, reducing negative impacts of business operations and developing positive relationships with stakeholders (Freeman, Moutchnik, 2013).

The authors also note that an effective CSR strategy must be integrated with the overall business strategy and consider the needs and expectations of different stakeholder groups such as employees, customers, local communities, investors and suppliers (Vuong, Bui, 2023). It is emphasized that an effective CSR strategy should be authentic and aligned with the organization's values rather than just serving as a marketing tool. Companies that implement effective CSR strategy should strive to achieve a balance between financial gains and social impact to avoid accusations of hypocrisy and build a sustainable reputation as responsible organizations (Wang, Tong, Takeuchi, George, 2016).

Another theoretical approach describes the role of CSR strategy as a key element of economic and social transformation that can contribute to solving global problems (Lindgreen, Swaen, Maon, 2009). CSR can help companies transform their activities in a more sustainable and socially responsible way by incorporating issues related to environmental protection, social responsibility and ethics in their business strategies (Werther, Chandler, 2005). The authors emphasize that effective CSR strategy should be integrated with the overall business strategy

and consider the needs and expectations of different stakeholder groups such as employees, customers, local communities, investors and suppliers (Singh, Misra, 2022).

It is noted that effective CSR strategy can bring financial benefits by increasing employee engagement, improving the company's image, and increasing customer loyalty. Additionally CSR can contribute to the development of new products and services that meet social needs and sustainable development. It is also pointed out that effective CSR strategy must take into account changing social and economic conditions, as well as developing tools and standards in the field of CSR (Kotler, Lee, 2008). The companies are encouraged to collaborate with other stakeholders such as non-governmental organizations, governments or academics to create more effective social and economic solutions (Wickert, Risi, 2019).

CSR strategy is also understood as a process of engaging customers and local communities. Companies should take into account the needs and expectations of their customers and local communities in which they operate and take responsibility for the impact of their actions on these groups. As part of the CSR strategy, companies should operate in a sustainable manner, caring for the natural environment, ethical business practices and including social initiatives in their activities such as supporting local communities or charitable actions (Wickert, Risi, 2019).

It is suggested that companies engage their customers and local communities in decision-making processes, allowing for a better understanding of the needs and expectations of these groups and proposing actions that will be most beneficial to them. For example companies can conduct public opinion research and consultations to learn about the needs and expectations of their customers and local communities and implement appropriate actions (Grayson, Hodges, 2017).

The CSR concept in line with the above proposal can bring many benefits to companies, including a positive image, increased customer loyalty and increased employee engagement. The positive impact of CSR actions on local communities can also translate into better relations with local authorities and increased consumer trust in the brand.

Some authors emphasize that implementing a CSR strategy is essential for any company that wants to achieve long-term success because corporate social responsibility is becoming an increasingly prioritized issue for consumers, employees, investors, and public institutions, which in turn affects the reputation and market position of the enterprise (O'Brien, Jarvis, Soutar, Ouschan, 2018). It is described that a CSR strategy should be an integral part of a company's business strategy, and its objectives should be to minimize the negative impact of the company's actions on society and the environment, maximize the benefits for stakeholders, including employees, customers, local communities, the natural environment, etc. and also create value for the company such as improving its image, building customer loyalty, increasing business efficiency or accessing new markets (Quiles-Soler, Martínez-Sala, Monserrat-Gauchi, 2023).

The authors note that a CSR strategy requires not only the implementation of socially responsible actions but also dialogue with stakeholders and the internal engagement of employees in CSR objectives. The implementation of a CSR strategy should also be based on the definition of measures and indicators that will enable the measurement of the effectiveness of actions and their impact on stakeholders and the environment (SanMiguel, Pérez-Bou, Sádaba, Mir-Bernal, 2021).

According to some authors, the role of a CSR strategy is to integrate socially responsible actions with the business objectives of the enterprise and to create value for stakeholders. The implementation of a CSR strategy requires dialogue with stakeholders and employee engagement and its effectiveness should be measured using appropriate measures and indicators.

The role of corporate social responsibility strategy is described as crucial for sustainable development of companies and society as a whole. The authors emphasize that CSR is an approach aimed at integrating business objectives with social and environmental goals (de Bakker, 2016) and (Skowron-Grabowska, Nowakowska-Grunt, 2017). In this context the CSR strategy is used to establish goals, actions, and processes that enable the company to achieve a balance between business requirements and social requirements.

CSR strategies can take various forms, depending on the context in which the company operates. Examples of strategies include minimizing the negative effects of business activities, implementing principles of ethical business, creating benefits for society and the environment, and striving to address systemic social and environmental problems. According to the authors, an effective CSR strategy requires collaboration with various stakeholders, such as employees, customers, suppliers, non-governmental organizations, governments, and local communities. Through this, the company can increase its reputation and social engagement, which positively affects its image and financial results (Cleff, van Driel, Mildner, Walter, 2018).

CSR strategies are also described as a key element of effective corporate social responsibility management. The authors emphasize that a CSR strategy is a plan of actions aimed at integrating business goals with social and environmental goals. This strategy enables a company to use its resources and competencies to create value for society, the environment and its stakeholders. It is suggested that an effective CSR strategy should be integrated with the business strategy and take into account the goals, values and needs of all stakeholders of the company. Within the framework of the CSR strategy, a company should undertake actions that allow for the minimization of negative impacts of business activity and the creation of benefits for society and the environment (Dhyani, Sharma, 2022).

Some authors stress that an effective CSR strategy requires setting goals and evaluation indicators that enable the company to monitor and assess the effectiveness of its CSR actions (de Bakker, 2016). As part of the CSR strategy, a company should also involve its employees in social programs and implement ethical standards and principles of good business practice.

The literature also points to practices related to corporate social responsibility such as sustainable development reporting, investing in local communities and engaging in social initiatives. The authors point out that these practices allow a company to achieve a balance between business requirements and social requirements as well as increase its reputation and social engagement (Martinuzzi, Krumay, 2013).

Summarizing a CSR strategy is a key element of effective corporate social responsibility management. With this strategy, a company can use its resources and competencies to create value for society and the environment and achieve a balance between business requirements and social requirements.

On the other hand it is argued that CSR strategy is described as a key element of integrated reporting (Mamun, Shaikh, 2018). The authors emphasize that integrated reporting is a reporting process aimed at presenting comprehensive and integrated information on both financial results and other aspects of a company's activities such as corporate social responsibility, the environment, quality, health, and safety (Lindgreen, Swaen, Maon, 2009). In the context of integrated reporting, CSR strategy plays a crucial role as it allows for the integration of business goals with social and environmental goals as well as the consideration of the impact of a company's activities on stakeholders and the environment (O'Brien, Jarvis, Soutar, Ouschan, 2018).

4. Summarized and selected research results

According to the study it turns out that 48.5% of the respondents evaluate the image of H&M company as definitely positive or rather positive. The responses are presented in Figure 1 below.

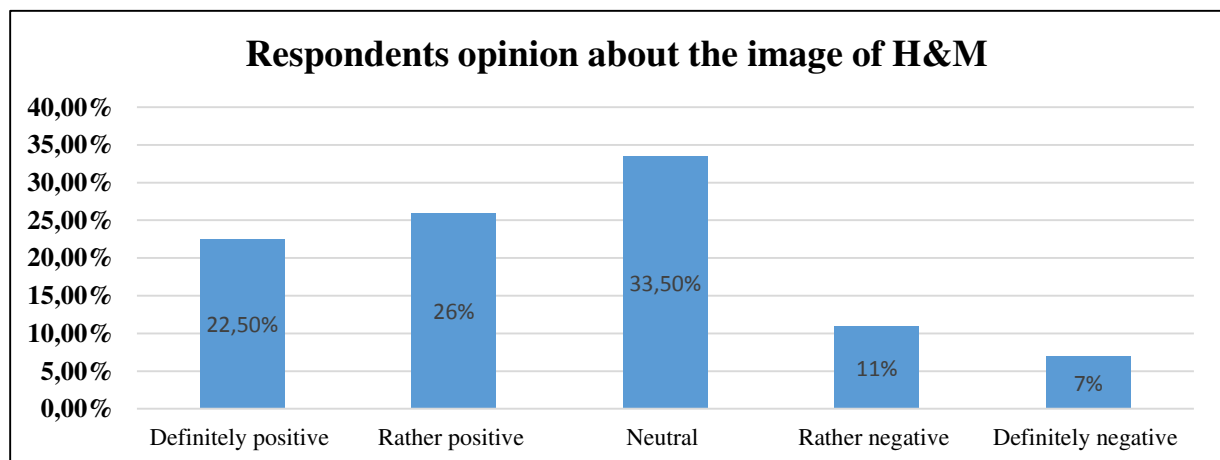


Figure 1. Opinions about the image of H&M.

Source: own study

Hence it can be concluded that the majority of respondents hold a positive perception of H&M's image. This finding provides support for the research hypothesis, suggesting that H&M's social responsibility strategy is indeed effective in shaping a positive image among consumers. This positive image is likely influenced by the company's actions, such as its investments in sustainable development, engagement in social campaigns and charitable activities, as well as the alignment of its values with those of the consumers. Therefore, it can be inferred that H&M's social responsibility initiatives have a favorable impact on consumer perceptions and contribute to the overall positive image of the company.

The first research hypothesis: Based on the research findings, it can be concluded that the hypothesis has been confirmed. H&M's reports confirm that the company focuses on promoting sustainable development, ethical business practices and charitable and social activities as part of their social responsibility strategy. H&M's reports provide information on actions taken in environmental protection, such as CO₂ emissions reduction, sustainable resource management, and recycling initiatives. Ethical aspects are also addressed, including responsible supply chain management, workers' rights and initiatives promoting fairness in the workplace. Additionally, the reports reflect H&M's involvement in local communities through support for social, educational and charitable projects. Consequently it can be stated that H&M's reports confirm the company's focus on promoting sustainable development, ethical business practices and charitable activities, which align with the goals and assumptions of their social responsibility strategy. These actions contribute to building a positive company image, increasing consumer engagement and fostering lasting relationships with stakeholders such as customers, employees, and local communities.

The second research hypothesis: Based on the analysis of H&M's CSR reports, it can be confirmed that the hypothesis is supported. The reports provide evidence of H&M's involvement in a range of activities related to sustainable development, social campaigns, charitable initiatives and environmental protection (hmgroup.com, 2023). These actions align with the objectives of their social responsibility strategy and demonstrate the company's commitment to addressing environmental and social challenges. Furthermore the reports highlight the positive impact of these activities on the company's image and consumer engagement. They showcase H&M's efforts in implementing sustainable practices, promoting social causes and contributing to community development. By investing in these initiatives, H&M aims to build a positive reputation, enhance brand loyalty and attract socially conscious consumers. However it is important to consider the credibility and effectiveness of these actions in solving real environmental and social problems. While the reports provide information about H&M's initiatives, further analysis and evaluation are needed to assess the actual outcomes and impacts of these activities (hmgroup.com, 2023). In conclusion, the analysis of H&M's CSR reports confirms the second research hypothesis by demonstrating the company's engagement in various activities related to sustainable development, social campaigns, charitable and social initiatives and environmental protection. These actions contribute to improving the company's

image, increasing consumer engagement, and potentially driving revenue growth. However, further investigation is required to assess the credibility and effectiveness of these actions in addressing environmental and social issues.

The third hypothesis: The information is supported by the findings, as 75% of the respondents confirmed their awareness of CSR actions undertaken by H&M. This indicates that a significant majority of the respondents were familiar with the company's CSR initiatives in the realm of ecology and sustainable development. The respondents' recognition of H&M's activities in areas such as recycling, water and energy conservation campaigns, and investments in sustainable materials and production processes suggests that the company's efforts in promoting environmental sustainability have resonated with the public. H&M's communication and promotion of these initiatives have evidently reached a considerable portion of the surveyed population. In the subsequent part of the survey, respondents indicated their awareness of H&M's campaigns as follows in Figure 2.

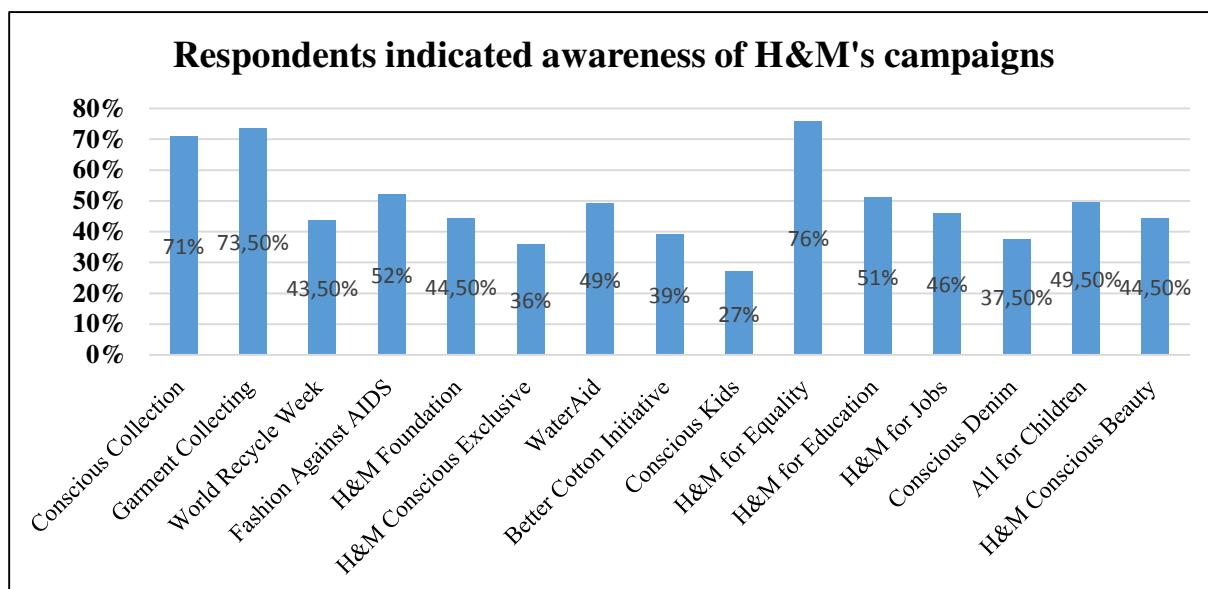


Figure 2. Awareness of H&M campaigns.

Source: own study.

Overall, the results confirm the third hypothesis indicating that the respondents' awareness of H&M's CSR actions is primarily centered around ecology and sustainable development initiatives. This recognition underscores the effectiveness of H&M's communication and engagement strategies in promoting their ecological endeavors and fostering public awareness and appreciation for their sustainability initiatives.

The fourth hypothesis: The hypothesis is supported by the findings of the study. The results indicate that customers who attach greater importance to CSR values are more likely to shop at H&M and do so with higher frequency. This suggests that the level of awareness and interest in the company's social responsibility initiatives positively influences customer behavior and loyalty. Customers who recognize and appreciate H&M's efforts in areas such as environmental protection, sustainability, and societal impact are more likely to align their shopping preferences

with their values. The positive relationship between the frequency of shopping and the importance of CSR values implies that customers who prioritize social responsibility are more likely to choose H&M as their preferred shopping destination. On the other hand, customers who do not place a high level of importance on CSR values may be less likely to exhibit loyalty to the brand and may not shop at H&M as frequently. This further supports the hypothesis suggesting that the level of customer engagement and loyalty is influenced by their perception of a company's commitment to social responsibility (Figure 3).

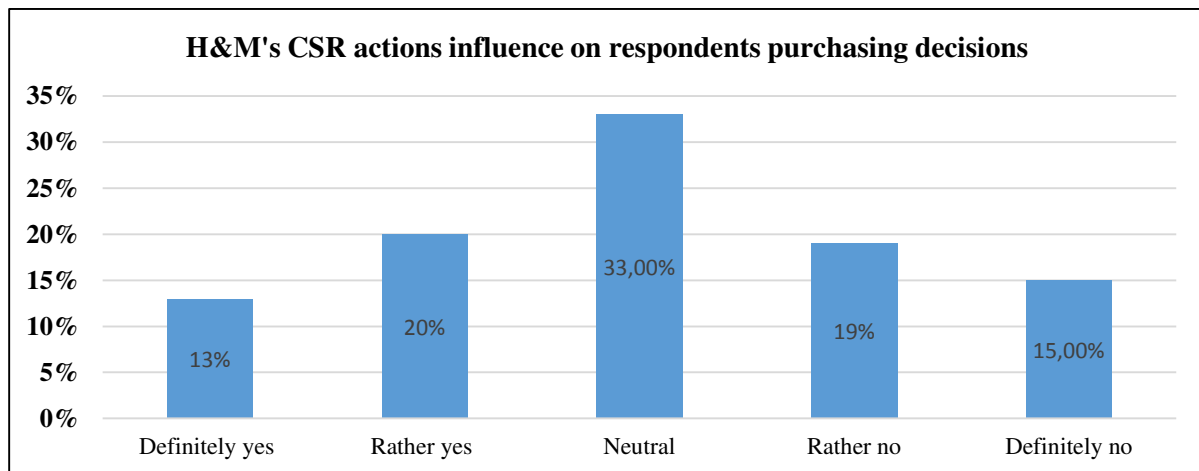


Figure 3. H&M's CSR actions influence on respondents purchasing decisions.

Source: own study.

In conclusion, the results confirm the fourth hypothesis, indicating a positive relationship between the frequency of shopping in a store and the importance of CSR values for customers. Customers who are more aware of and interested in H&M's social responsibility actions exhibit higher shopping frequency and are more likely to remain loyal to the brand.

The fifth hypothesis: The hypothesis is supported by the findings of the study. The results indicate that positive opinions about H&M's CSR actions have a positive impact on customer loyalty which is presented in Figure 4.

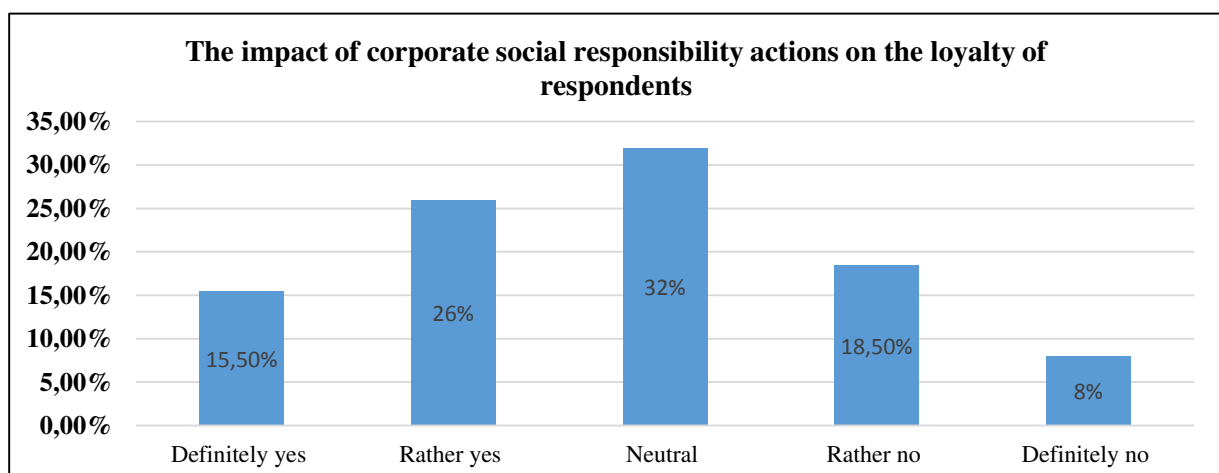


Figure 4. The impact of corporate social responsibility actions on the loyalty of respondents.

Source: own study.

Customers who view H&M's social responsibility actions as authentic and valuable are more likely to develop a stronger identification with the brand. They perceive H&M as a responsible and trustworthy company, which influences their purchasing behavior and fosters customer loyalty. Moreover, positive opinions about H&M's CSR actions can also lead to positive word-of-mouth recommendations. Satisfied customers who appreciate the company's commitment to social responsibility are more likely to share their positive experiences with others, promoting the brand and potentially attracting new customers. This positive word-of-mouth can contribute to increased sales and market share for H&M. In conclusion, the results confirm the fifth hypothesis, demonstrating that positive opinions about H&M's CSR actions have a positive impact on customer loyalty. Authentic and valuable CSR actions enhance customers' identification with the brand and their likelihood of shopping at H&M. Additionally positive opinions can stimulate positive word-of-mouth recommendations, further benefiting the company's sales and market position.

The sixth hypothesis: The hypothesis is supported by the findings of the study. The results indicate that 52% of the respondents have heard about H&M's CSR actions, suggesting that a significant portion of the customers are aware of these initiatives (Figure 5).

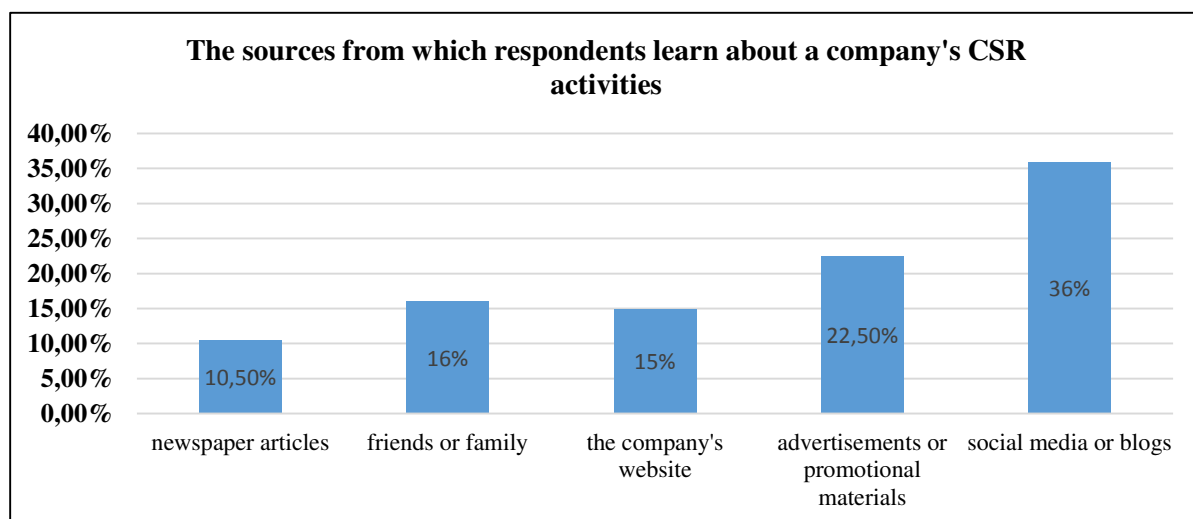


Figure 5. The sources from which respondents learn about a company's CSR activities.

Source: own study.

However, it also implies that a considerable number of customers might not have knowledge about the company's CSR actions. Furthermore, among those who are aware of H&M's CSR actions, 36% reported learning about them from the internet. This suggests that the internet plays a significant role in disseminating information about H&M's CSR campaigns to customers. It indicates that online platforms, such as H&M's official website, social media or online news sources are crucial channels for communicating the company's CSR initiatives to the public. In summary, the findings confirm the sixth hypothesis. While a majority of the respondents have heard about H&M's CSR actions a significant portion may still lack awareness. Additionally the internet emerges as the primary source of information for

customers to learn about H&M's CSR campaigns. These findings emphasize the need for effective communication strategies to ensure a broader reach and awareness of H&M's CSR actions among its customers.

The seventh hypothesis stated that the production of clothing is associated with various issues, including the use of child labor and illegally employed workers, low wages, lack of workplace safety and environmental impact. It further proposed that H&M takes multiple actions to address these issues such as monitoring working conditions in factories, reducing greenhouse gas emissions, promoting recycling, and using renewable materials. Analysis of H&M's CSR reports confirms the validity of this hypothesis (hmgroup.com, 2023). The reports provide substantial evidence that H&M is actively engaged in addressing the issues associated with clothing production (hmgroup.com, 2023). The company's efforts to monitor working conditions in factories demonstrate a commitment to ensuring fair labor practices and the avoidance of child labor and illegal employment. Moreover, H&M's initiatives aimed at reducing greenhouse gas emissions, promoting recycling, and utilizing renewable materials align with addressing the environmental impact of clothing production. The reports highlight specific measures and targets undertaken by the company to minimize its ecological footprint and foster a more sustainable fashion industry. By acknowledging these issues and implementing corresponding actions, H&M demonstrates a recognition of the challenges within the clothing industry and a commitment to mitigating their negative effects. Thus, based on the analysis of H&M's CSR reports we can conclude that the seventh hypothesis holds true (hmgroup.com, 2023).

The eighth hypothesis stated that customers expect H&M to act in a socially, environmentally and ethically responsible manner. It further proposed that customers expect H&M to engage in specific CSR activities, such as reducing greenhouse gas emissions, using environmentally friendly materials, providing safe and fair working conditions for their employees, and monitoring suppliers to ensure adherence to similar standards. Additionally, customers expect H&M to be transparent in their CSR actions, keep them informed about progress and results, and actively engage in social and charitable activities while supporting local communities. Based on the survey results this hypothesis holds true. The areas highlighted by the respondents as requiring improvement align with the expectations outlined in the hypothesis. Customers expressed a desire for H&M to focus on reducing greenhouse gas emissions, utilizing environmentally friendly materials and ensuring safe and fair working conditions for their employees. Transparency was also emphasized, with customers expecting H&M to provide clear and accessible information about their CSR initiatives, progress and outcomes. This aligns with the expectation for H&M to be accountable and communicative in their efforts. Furthermore, customers emphasized the importance of H&M's active engagement in social and charitable activities, along with their support for local communities. This indicates a desire for H&M to contribute positively to society beyond its core business operations. In conclusion the survey results confirm the validity of the eighth hypothesis, as the areas

identified by the respondents align with the expectations customers have regarding H&M's CSR activities (Figure 6).

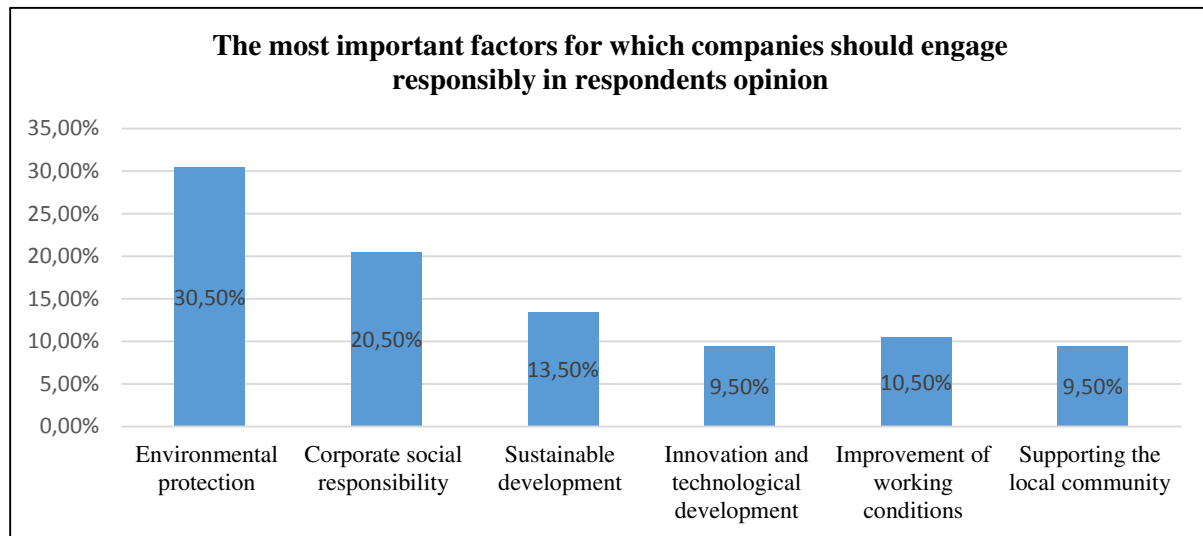


Figure 6. The most important factors for which companies should engage responsibly in respondents opinion.

Source: own study.

These insights provide valuable guidance for H&M in terms of addressing customer expectations and further enhancing their social, environmental, and ethical responsibilities.

The ninth hypothesis suggested the possibility of a discrepancy between H&M's image resulting from CSR reports and customer opinions. It acknowledged that while H&M may present its CSR activities positively in its reports, customer opinions can vary and may not necessarily align with the same positive image. Customers may have different expectations and criteria for evaluating CSR activities, as well as diverse experiences related to the H&M brand, which can influence their opinions of the company's CSR efforts. Furthermore customers may be more inclined towards criticism and negative opinions compared to companies which can contribute to the occurrence of discrepancies between H&M's CSR image and customer opinions. Upon analysis of the survey data it can be concluded that this hypothesis holds true. A portion of the respondents agree with the positive image presented by H&M's CSR reports, indicating alignment between the company's communication and customer perception. However, there are also respondents who hold differing opinions, indicating a discrepancy between H&M's CSR image and their perception. The diverse opinions among customers can be attributed to various factors such as individual values, personal experiences and different interpretations of CSR actions. Some customers may have higher expectations or different criteria for evaluating H&M's CSR activities, leading to varying opinions. It is important for H&M to recognize this discrepancy and consider the diverse perspectives of its customers. By understanding the range of opinions and addressing potential areas of improvement, H&M can work towards narrowing the gap between its CSR image and customer opinions. This may involve enhancing communication, seeking feedback from customers and actively

addressing concerns and suggestions related to CSR practices. In conclusion, the survey results confirm the existence of a possibility for a discrepancy between H&M's image resulting from CSR reports and customer opinions. While some respondents align with the presented image, others hold differing opinions, emphasizing the importance for H&M to engage with customer feedback and continuously improve their CSR practices to bridge this gap. However it can be concluded that the image presented by H&M in its CSR reports is rather aligned with consumer opinions. A significant majority of respondents expressed positive views regarding H&M's actions in the areas of environmental protection, ethics, and supporting local initiatives (Figures 7-9).

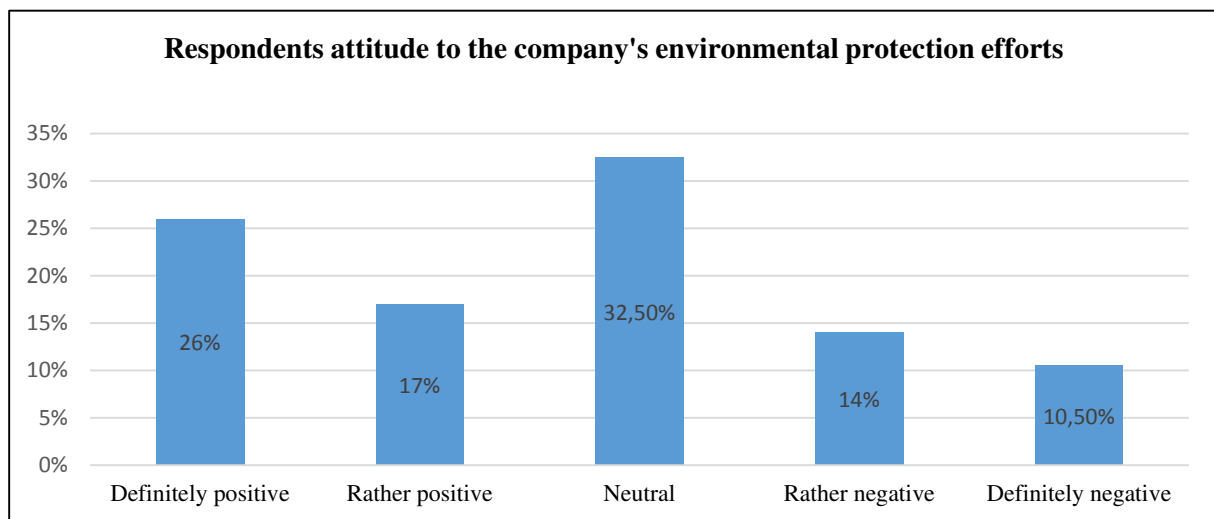


Figure 7. Respondents attitude to the company's environmental protection efforts.

Source: own study.

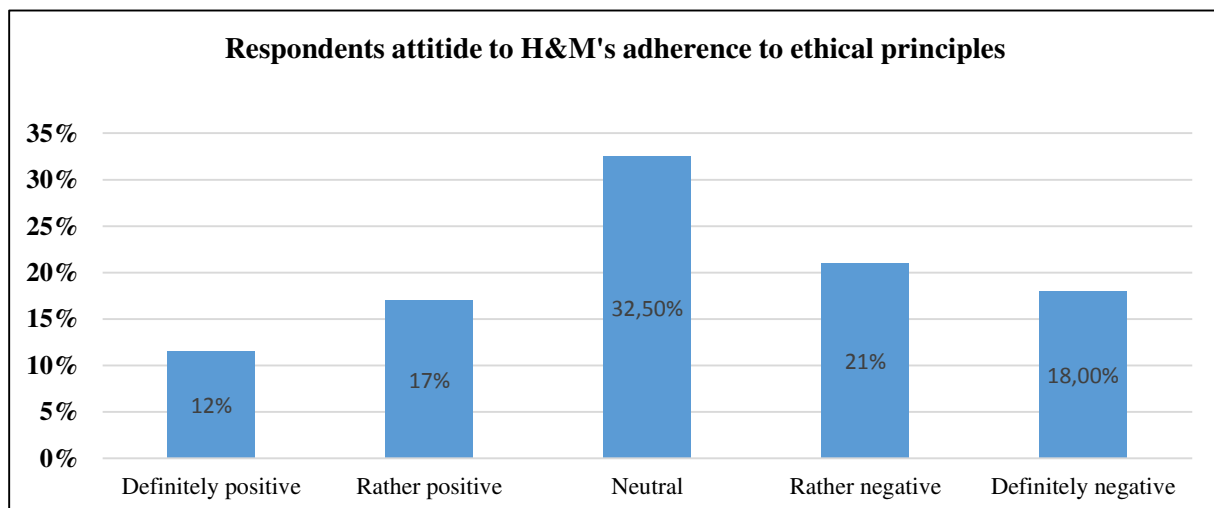


Figure 8. Respondents attitude to H&M's adherence to ethical principles.

Source: own study.

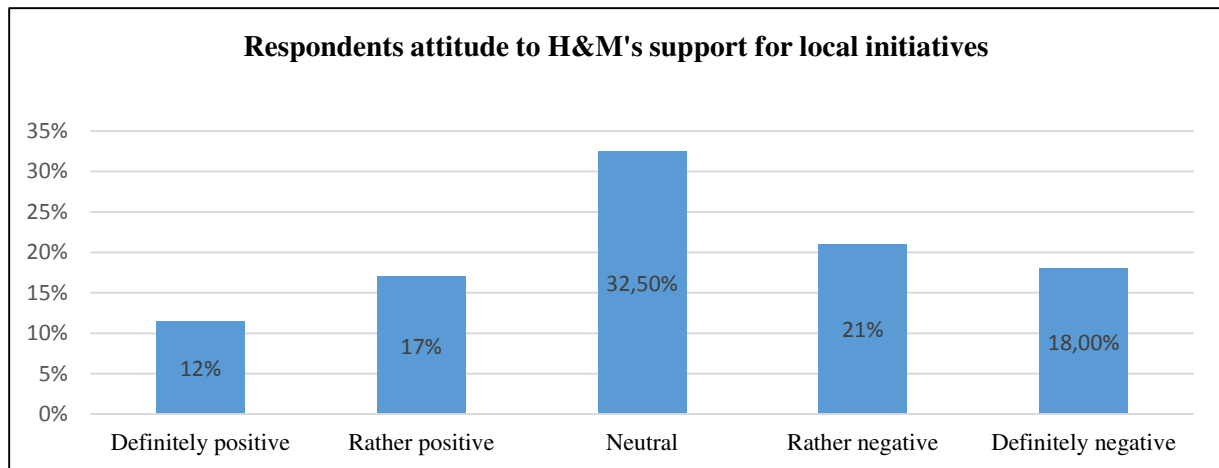


Figure 9. Respondents attitude to H&M's support for local initiatives.

Source: own study.

The tenth hypothesis stated that consumer opinions on H&M as a socially responsible company may be diverse. It acknowledged that some customers may perceive H&M as taking sufficient CSR actions and being socially responsible while others may believe that the company should do more in this regard. Additionally, customers may have different understandings of what it means for a company to be socially responsible and what specific actions they expect from H&M. Individual experiences, both positive and negative with the H&M brand can also influence customer opinions (Figure 10).

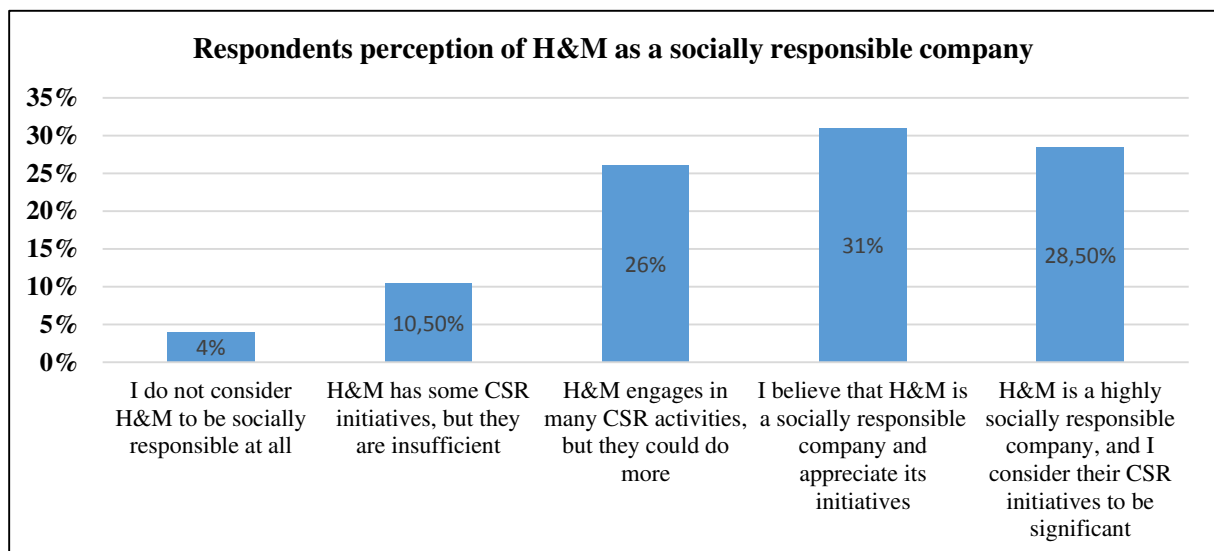


Figure 10. Respondents perception of H&M as a socially responsible company.

Source: own study.

Consequently it is challenging to definitively determine whether consumers consider H&M to be a socially responsible company. Based on the survey results it can be concluded that this hypothesis holds true. The findings indicate a range of opinions among respondents regarding H&M's social responsibility. Some customers perceive H&M as actively undertaking CSR actions and view the company as socially responsible. They acknowledge the efforts made by

H&M in areas such as sustainable practices, ethical sourcing and community engagement. On the other hand there are customers who believe that H&M should do more in terms of social responsibility. They may have higher expectations or different criteria for evaluating the company's CSR actions. These customers may express a desire for H&M to address specific issues, increase transparency or prioritize certain aspects of social responsibility. The diversity of opinions on H&M's social responsibility is influenced by individual perspectives, values, and experiences. Customers' understanding of what constitutes social responsibility can vary leading to different assessments of H&M's efforts. Given the varied responses it is important for H&M to consider the range of opinions and feedback from customers. The company can use this information to continuously improve its CSR practices align with customer expectations and address any concerns or areas for enhancement. In summary the survey results support the validity of the tenth hypothesis, highlighting the diverse consumer opinions regarding H&M's social responsibility. Acknowledging this diversity and actively engaging with customer feedback can assist H&M in further strengthening its CSR initiatives and meeting the expectations of its customer base. The analysis of results indicates that H&M shapes its CSR activities well, contributing to a positive company image and customer engagement. The company focuses on promoting sustainable development, ethical business practices as well as charitable and social initiatives.

5. Conclusion

The following conclusions have been reached from the analysis and research.

- The findings provide support for the assumption, suggesting that H&M's social responsibility strategy is indeed effective in shaping a positive image among consumers.
- H&M's reports confirm the company's focus on promoting sustainable development, ethical business practices and charitable activities, which align with the goals and assumptions of their social responsibility strategy. These operations significantly contribute to creation of a firm's positive image, increasing consumer engagement as well as fostering lasting relationships with stakeholders such as customers, employees and local communities.
- The research demonstrates the company's engagement in various activities related to sustainable development, social campaigns, charitable and social initiatives, and environmental protection. These actions contribute to improving the company's image, increasing consumer engagement and potentially driving revenue growth.
- Respondents' awareness of H&M's social responsibility actions is primarily centered around ecology and sustainable development initiatives.

- The results indicate that customers who attach greater importance to CSR values are more likely to shop at H&M and do so with higher frequency.
- Positive opinions about H&M's CSR actions have a positive impact on customer loyalty.
- While a majority of the respondents have heard about H&M's CSR actions a significant portion may still lack awareness.
- The reports provide substantial evidence that H&M is actively engaged in addressing the issues associated with clothing production.
- The survey results confirm the assumption that the areas identified by the respondents align with the expectations customers have regarding H&M's CSR activities.
- The survey results confirm the existence of some possibility for a discrepancy between H&M's image resulting from CSR reports and customer opinions to some extent.
- The analysis results indicate that H&M shapes its CSR activities well contributing to a positive company image and customer engagement. The company focuses on promoting sustainable development, ethical business practices as well as charitable and social initiatives. H&M's CSR reports confirm that the company takes concrete actions to address social and environmental issues.

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ANALYSIS OF THE POTENTIAL OF THE VISEGRAD GROUP COUNTRIES IN SELECTED AREAS OF THEIR ACTIVITIES

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Purpose: The aim of this article was to assess the potential of the Visegrad Group countries in terms of conditions determining the readiness for cooperation between science, business, and administration sector.

Design/methodology/approach: The article uses qualitative and quantitative research methods. The article presents a review of Polish and foreign literature and an analysis of desk research based on public statistical data (Eurostat, OECD, The World Bank) covering 2017-2022. A statistical method in data mining was used to make statistical observations using diagrams called classification trees. To assess the countries' potential for readiness to develop cooperation, the Potential Index (PI) was calculated.

Findings: The influence of variables determining the level of countries' potential was selected and their classification was made.

Originality/value: The research results indicate a high degree of differentiation in the potential of the Visegrad Group countries and point out that it is an essential factor positively influencing their development.

Keywords: Visegrad group, potential level, gender pay gap, cooperation of science, business and administration, human resources in science and technology.

Category of the paper: research paper.

1. Introduction

The conditions for the functioning and development of modern enterprises are diverse and multidimensional, resulting from, among others, the ongoing globalization process, the dynamic development of ICT technologies, socio-cultural transformation, and changes in the methods of organizing and conducting resource management processes. The freedom of movement of human, material, financial and information capital that accompanies the globalization process significantly influences the transformation of the economic, socio-cultural, political, and legal spheres, contributing to the development of many countries worldwide.

Economic growth and technological progress cause specific consequences that should be considered and assessed from different perspectives. Wide possibilities of access to modern tools, devices, and technologies constitute a means of providing society with high comfort in work, living, and traveling (Motowidlak, 2017). In another approach, it is a consequence of civilization development, based, among others, on consumerism, is the deterioration of the natural environment, posing a threat to current and future generations (Kielczewski, 2008). The increase in social awareness of the positive and negative consequences of economic development emphasizes the need to ensure consensus between the implementation of economic, social, and environmental goals.

The idea and principles of cooperation between actors of innovative processes in the context of society's expectations and the challenges of the modern economy are explained by various models, including the triple helix and quadruple helix models (Łącka, 2018). The concept of the Triple Helix model developed by L. Leydesdorff and H. Etzkowitz (2001) is a model of innovation covering the relationships occurring in the process of knowledge transfer between three separate environments - science, industry, and administration. The Triple Helix model is generated in the knowledge infrastructure in relation to overlapping institutional spheres, each of which plays its role and, at the same time, enters into relationships with other entities (Etzkowitz, Leydesdorff, 2000). The cooperation between the university and the business community is crucial. It influences the development of innovation, knowledge transfer, and the development of countries. On the other hand, the government plays a crucial role in developing financing policies and leveraging these relationships to increase capacity (de Lima Figueiredo, Fernandes, Abrantes, 2023).

Based on economic changes and the changing expectations of stakeholders, the quadruple helix model was proposed. The fourth element in this model is a civil society with a media and culture-based community (Carayannis, Campbell, 2012). The quadruple helix model draws attention to the fact that the science, business, and administration environment, while creating conditions for introducing innovations, should be open to broadly understood social needs. In other publications, some disputes can be found regarding the validity of creating a quadruple helix model because civil society is not an institutional sphere at the same level as universities, industry, or government (Cai, Lattu, 2022).

Based on socio-economic changes, the issue of social responsibility is increasingly and more strongly emphasized, meaning the responsibility an organization bears for the impact of its decisions and activities on society and the natural environment (Pfajfar, Shoham, Małecka, 2022). This responsibility is ensured by transparent and ethical behavior that contributes to sustainable development, considers stakeholder expectations, is consistent with applicable law, integrated with the organization's activities, and practiced in its relationships (Anam, Zygiel, Saczuk, 2020).

Corporate social responsibility is implemented through various activities, both in the codification of legal provisions and practices used by individual organizations. It is believed that corporate social responsibility is the manufacturing sector's response to the challenges

posed by the principles of sustainable development (Gadomska-Lila, Wasilewicz. 2016). According to J. Adamczyk, sustainable development and corporate social responsibility were created as two independent concepts; however, in the implementation of the principles of social responsibility and sustainable development recommendations, there is a process of their diffusion. It is possible to observe the process of interpenetration of principles, goals, areas of implementation, instruments, and measures for assessing these two concepts (Adamczyk, 2017). Corporate social responsibility can be treated as a tool for implementing sustainable development (Płachciak, 2015).

2. Characteristics of the Visegrad Group (Group V4)

In the face of profound political and economic changes taking place in the early 1990s in the countries of the former communist bloc, an initiative was created to establish a forum for regional cooperation between Poland, Czechoslovakia, and Hungary. On 15th February 1991, the Visegrad Declaration was signed by the Presidents of the three countries, inaugurating the Visegrad Triangle (Kuzelewska, Bartnicki, 2017). On 1st January 1993, as a result of the breakup of Czechoslovakia, the name was changed to the Visegrad Group (V4), bringing together four sovereign states: the Czech Republic, Poland, Slovakia and Hungary (Jankiewicz, Pietrzak, 2020). Member states initially initiated the V4 group to increase security and stability in the region (Braun, 2020). The factors positively influencing the development of cooperation within the Visegrad Triangle and then the Visegrad Group include similar potential and level of economic development of the member states, advancement of economic changes, universality of democratization processes, geographical proximity, common civilizational roots, similarity of the latest historical experiences, common priorities in foreign policy (Kupich, 1993/1994). Over several decades of operation, the Visegrad Group has proven its usefulness in influencing the decision-making process in the European Union, and the V4 format has become embedded in the political space and practice of the countries of the region and the opinion of Western politicians (Czyż, 2018).

The Visegrad Group countries have been an essential point on the map of Central and Eastern European countries for over thirty years (Grodzicki, 2023). The collapse of real socialism and the departure from the centrally planned economy initiated a number of profound changes in the Group V4 countries, resulting in new paths of social, political, and economic development. The economic and political transformation that took place after 1989 in Poland, the Czech Republic, Slovakia, and Hungary enabled the construction of democratic state structures, the creation of a free market economy, as well as an orientation towards increasing national security and European integration (Jasiecki, 2020).

The Visegrad Group countries are similar in many economic and social respects (Kochanek, 2021). This fact is influenced by the similar structure of the economies of the V4 countries and the historical and economic conditions of their cooperation and development. On the other hand, the economies of these countries are interconnected, both in terms of trade and ownership, with enterprises of the leading economies of the European Union (Samborski, 2019).

Economic models shaped by over three decades of transformation in the V4 countries have contributed to a high and stable pace of economic development in these countries. Poland, the Czech Republic, Slovakia, and Hungary have managed to build economies with similar characteristics, such as a high level of openness industrialization, as well as solid and stable economic connections – both mutually and with the German economy. This allowed the V4 group to become a place of dynamic economic growth, high international competitiveness, and low debt levels (Popławski, 2021).

3. Research methods

To assess the potential of the Visegrad Group countries in terms of conditions conducive to cooperation between science, business, and administration, a statistical method was used in data mining, i.e. classification trees. To assess the potential of the V4 countries for readiness to develop cooperation, was calculated the *Potential Index* (PI). The authors were inspired by the *Human Development Index* (HDI).

Three variables were used to construct the Potential Index:

1. *GDP per capita (current US\$)* – GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. Data are in U.S. dollars (The World Bank, 2023)
2. *Human resources in science and technology* – as a share of the active population aged 25-64. The data shows the active people in the age group 25-64 that is classified as HRST (i.e., having completed an education at the third level or being employed in science and technology) as a percentage of the total active population aged 25-64. HRST is measured mainly using the concepts and definitions in the Canberra Manual, OECD, Paris, 1995 (Eurostat, 2023).
3. *New businesses registered (number)* - the number of new limited liability corporations (or its equivalent) registered in the calendar year.

The potential Index was calculated by creating indexes for each of the three indicators.

The values of each indicator were normalized to an index value from 0 to 1. Taking into account the actual value for a given country as well as the maximum and minimum, the index value for each variable was calculated as:

$$\text{Potential Index} = \frac{\text{current value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

The dimension index is 1 for the country that reaches the maximum value and 0 for the country that gets the minimum value. To interpret the classification trees, the target variable was a potential index higher than 0.5. The values of the variables used to build the potential index are presented in Table 1.

Table 1.
Indicators characterizing the Visegrad Group countries in 2017-2022

	2017	2018	2019	2020	2021	2022
Slovakia						
GDP per capita (current US\$)	17585,2	19486,39	19383,48	19545,74	21391,93	21258,1
Human resources in science and technology	35,2	36,9	38,1	39,7	41,9 b	42,8
New businesses registered (number)	19813	19723	20566	18969	*	*
Poland						
GDP per capita (current US\$)	13815,62	15504,58	15699,91	15816,99	17999,91	18321,3
Human resources in science and technology	44	45,2	46	46,6	47,0 b	47,4
New businesses registered (number)	38 903	36 879	40 248	41 143	*	*
Hungary						
GDP per capita (current US\$)	14621,24	16425,1	16782,95	16120,99	18728,12	18463,2
Human resources in science and technology	36,5	37,3	38,2	39,9	41,7	42,0
New businesses registered (number)	22783	24252	25376	25608	*	*
Czech Republic						
GDP per capita (current US\$)	20636,2	23424,48	23664,85	22992,88	26821,25	27638,4
Human resources in science and technology	39,6	39,9	39,8	40,6	42,0	41,9
New businesses registered (number)	31 195	30 336	28 758	26 024	*	*

* - No available data.

Source: own study based on: Eurostat database: <https://ec.europa.eu/eurostat/data/database>, OECD database: <https://data.oecd.org/>, The World Bank database: <https://data.worldbank.org/>, 20.10.2023.

Table 2.
The dynamics of changes in the values of potential indicators for the Visegrad Group countries

	Wskaźniki potencjału	2018/2017	2019/2018	2020/2019	2021/2020	2022/2021	2022/2017
Slovakia	GDP per capita (US\$)	110,81	99,47	100,84	109,45	99,37	120,89
	Human resources in science and technology	104,83	103,25	104,20	105,54	102,15	121,59
	New businesses registered	99,55	104,27	92,23	*	*	*
Poland	GDP per capita (US\$)	112,22	101,26	100,75	113,80	101,79	132,61
	Human resources in science and technology	102,73	101,77	101,30	100,86	100,85	107,73
	New businesses registered	94,80	109,14	102,22	*	*	*
Hungary	GDP per capita (US\$)	112,34	102,18	96,06	116,17	98,59	126,28
	Human resources in science and technology	102,19	102,41	104,45	104,51	100,72	115,07
	New businesses registered	106,45	104,63	100,91	*	*	*
Czech Republic	GDP per capita (US\$)	113,51	101,03	97,16	116,65	103,05	133,93
	Human resources in science and technology	100,76	99,75	102,01	103,45	99,76	105,81
	New businesses registered	97,25	94,80	90,49	*	*	*

* - No available data.

Source: own study based on: Eurostat database: <https://ec.europa.eu/eurostat/data/database>, OECD database: <https://data.oecd.org/>, The World Bank database: <https://data.worldbank.org/>, 20.10.2023.

For the Visegrad Group countries, the *GDP per capita* dynamics indicator calculated in the period 2022/2017 reached the highest value in the Czech Republic (133.93%) and Poland (132.61%), while the lowest value was in Hungary (126.28%) and Slovakia (120.89%). In 2017-2022 year-over-year, the dynamics indicator showed an increasing tendency only in Poland, ranging from 100.75% to 113.80%.

The second indicator included in Table 2 for the V4 countries was the *Human Resources in Science and Technology* dynamics indicator, which in three countries (Slovakia, Poland, Hungary) in 2017-2022 year-over-year, showed a slow increasing tendency. The highest increase in the value of the index calculated for 2022/2017 was observed in Slovakia at 121.59%. In the Czech Republic, as the only country in the V4 Group, in the period 2017-2022 year-over-year, the dynamics of the *Human Resources in Science and Technology* indicator reached values below 100% twice.

The third indicator in Table 2 for the Visegrad Group countries was the *New businesses registered* dynamics indicator. Due to information gaps for 2021 and 2022, only three values were calculated. Among the four countries of the V4 Group, the dynamics rate of *New businesses registered* achieved an upward trend calculated in the period 2017-2020 year-over-year only in Poland and Hungary. A decreasing dynamic of this indicator in the same period was observed in the Czech Republic and Slovakia.

When presenting the dynamics of the indicators mentioned above for the Visegrad Group countries (Table 2), the causes of fluctuations in the values of these indicators were not analyzed due to their diverse micro- and macroeconomic background. The social and economic policy pursued by the governments of the V4 countries and the occurrence of the COVID-19 pandemic undoubtedly have a significant impact on the value of the indicators mentioned above, which should be the subject of further research on this issue.

Variables based on the Eurostat database were used to analyze and prepare classification tree No. 1 <https://ec.europa.eu/eurostat/data/database>, OECD <https://data.oecd.org/>, The World Bank <https://data.worldbank.org>:

1. Research and development expenditure (% of GDP).
2. Patent applications, residents.
3. Graduates by education level, program orientation, completion, sex, and age.
4. School enrollment, tertiary (% gross).
5. Research and development expenditure, by sectors of performance, percentage of gross domestic product (GDP).
6. Human resources in science and technology, percentage of the population in the labor force, From 25 to 64 years, sex: total.
7. Share of mobile students from abroad enrolled by education level, sex and country of origin, Tertiary education, sex total, d - definition differs (see metadata), in %.
8. Employment rates of recent graduates in the country.

Among the variables listed above, the predictors that explain the dependent variables to the greatest extent were distinguished (they had the highest percentage of correctly classified cases). Based on the data obtained, classification tree No. 1 was constructed. The dependent variable is a high potential index set higher than 0.5. The first division was made according to the variable countries: Czech Republic, Poland, Hungary, and Slovakia. The second division distinguished predictors: variables that explain the values of the dependent variable to the greatest extent. The first classification tree is Human Resources in Science and Technology, while the second is the *GenderPay Gap*. In both classifications were estimated risk and standard error. The predictive accuracy measure of a classification tree represents the percentage of cases misclassified by the proposed type. The presented classification trees have a zero rate of misclassified cases, meaning the percentage of correctly classified cases is 100%. The classification trees were constructed using the CHAID method¹. At each step, CHAID selects the independent variable that has the strongest interaction with the independent variable. Chi-square values show the strength of the association between the predictor and the dependent variable (Kass, 1980).

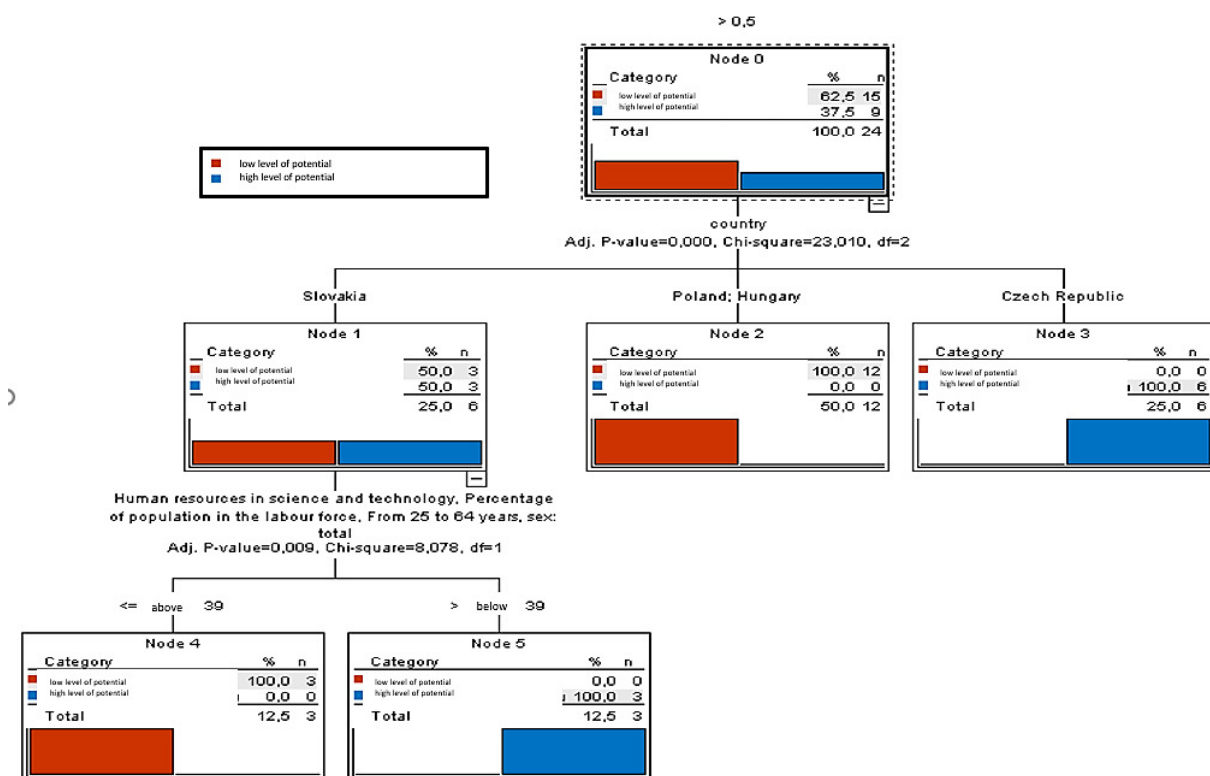


Figure 1. Classification Tree No. 1.

Source: own study.

¹ CHAID - Chi-squared Automatic Interaction Detector. Author: Kass, 1980.

Among the Visegrad Group countries, the Czech Republic has the highest potential (1.0), Hungary and Poland have low potential. At the same time, Slovakia is characterized by high or low potential due to the level of *Human Resources in Science and Technology* indicator. This depends on the independent variable level, which is above the value of 39 positioning Slovakia at a high level of potential, and below the value of 39 positioning Slovakia at a low level of potential².

Variables based on the Eurostat database were used to analyze and prepare classification tree No. 2 <https://ec.europa.eu/eurostat/data/database>, OECD <https://data.oecd.org/>, The World Bank <https://data.worldbank.org>:

1. The minimum wage (EURO).
2. Labor force.
3. General government expenditure by function (COFOG).
4. Graduates by education level, program orientation, completion, sex, and age.
5. Share of mobile students from abroad enrolled by education level, sex, and country of origin.
6. Tertiary education, sex total, in %.
7. Annual enterprise statistics for special aggregates of activities.
8. Manufacturing, value added (% of GDP).
9. Cost of business start-up procedures (% of GNI per capita).
10. Gender pay gap (in %).

The second division distinguished the predictor, which is the level of the *Gender Pay Gap* index. This allowed for classification into countries with low or high potential. The level of the *Gender Pay Gap* index in the Visegrad Group countries is presented in Table 3.

Table 3.

The level of the Gender Pay Gap index (in %) in enterprises employing at least 10 employees in the V4 countries in the period 2017-2021

V4 Group countries	2017	2018	2019	2020	2021
Slovakia	20,1	19,8	18,4	15,8	16,6
Poland	7	8,5	6,5	4,5	4,5
Hungary	15,9	14,2	18,2	17,2	17,3
Czech Republic	21,1	20,1	19,2	16,4	15

Source: Eurostat database, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Gender_pay_gap_statistics, 22.10.2023.

² Ranked quantitative variables were used for the classification trees, i.e. the quantitative variable was transformed into a nominal variable according to the Ntyle method. In the Ntyle method, ranks are assigned based on percentile groups, with each group containing approximately the same number of observations. For example, a value of 4 Ntyle (quartiles) assigns a rank of 1 to cases below the 25 percentile, a rank of 2 to cases between the 25 and 50 percentile, a rank of 3 to cases between the 50 and 75 percentile, and a rank of 4 to cases above the 75 percentile. Result: each variable was assigned 4 levels (ranks), where 1 - means the lowest level, 4 - the highest level.

Table 4.*Dynamics of changes in the level of the Gender Pay Gap index in the Visegrad Group countries*

V4 Group countries	2018/2017	2019/2018	2020/2019	2021/2020	2021/2017
Slovakia	98,51	92,93	85,87	105,06	82,58
Poland	121,43	76,47	69,23	100,00	64,28
Hungary	89,31	128,17	94,51	100,58	108,80
Czech Republic	95,26	95,52	85,42	91,46	71,09

Source: Eurostat database, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Gender_pay_gap_statistics, 22.10.2023.

The Gender Pay Gap index determines the difference between the average gross hourly wages women and men receive for their work (Parlament Europejski, 2020). Based on the data in Table 3, the Gender Pay Gap index among the four Visegrad Group countries is the lowest in Poland, and its value in 2021 was 4.5%. In the V4 countries, the dynamics of the Gender Pay Gap indicator calculated for 2021/2017 decreased in three countries - Poland, the Czech Republic, and Slovakia. In Hungary, the Gender Pay Gap dynamics index calculated during the same period increased and reached 108.8%. The analysis of the data contained in Table 4 indicates that in Poland and Czech Republic, there was a tendency to reduce the level of the pay gap, while only in Hungary, among the other V4 countries, the disproportions in the earnings of women and men are becoming more significant, reaching the level of the wage difference amounting to 17.3% in 2021. The gender pay gap is a common phenomenon. Statistical data indicate that in many European Union countries, the average salary of women is significantly lower than that of men (Eurostat, 2021). The occurrence of the pay gap is influenced by many factors relating to objective differences about human capital, such as employees' skills, profession, employee involvement in their work, and length of service (Blau, Kahn, 2017), as well as stereotypes regarding women in the labor market (Lips, 2013). Due to the number and diversity of factors influencing the size of the Gender Pay Gap in individual countries of the Visegrad Group, this article only shows the course of changes in the wage gap in the period 2017-2021.

Many factors determine the changes taking place in the economy of many countries. One of them is the level of the pay gap, which allows us to classify countries into those with a low or high level of potential.

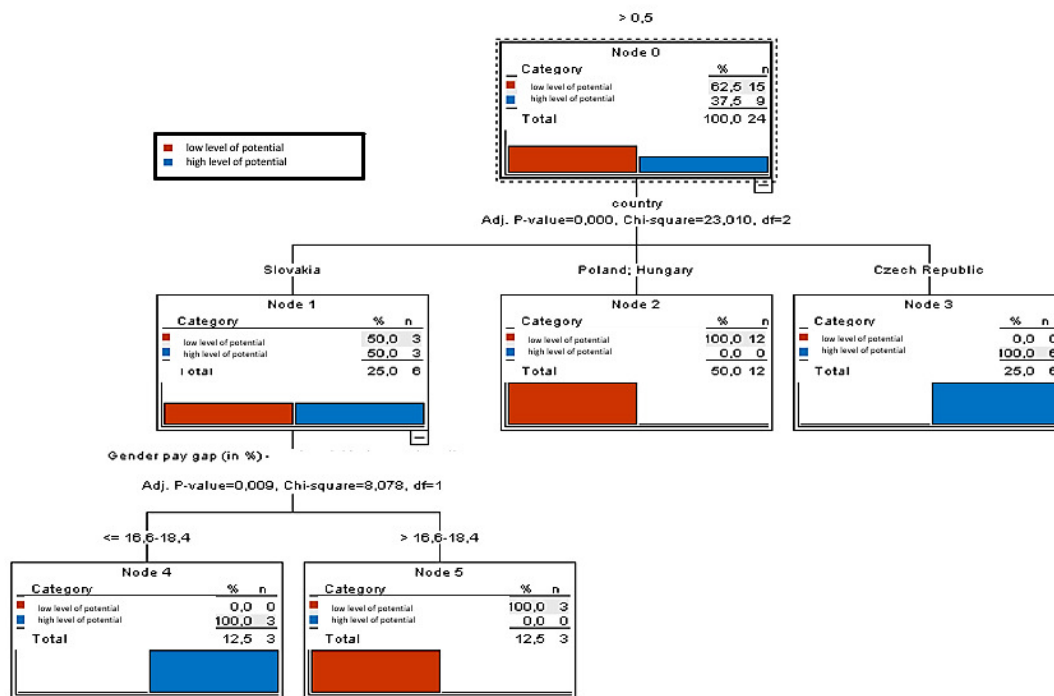


Figure 2. Classification Tree No. 2.

Source: own study.

Among the Visegrad Group countries, the Czech Republic has the highest potential (1.0), Hungary and Poland have low potential. At the same time, Slovakia is characterized by high or low potential due to the level of the Gender Pay Gap. This depends on the level of the independent variable, which in the range of values of the content ($\leq 16.6-18.4$) places Slovakia at a high level of potential, and above the value of the content ($16.6-18.4$)³ places Slovakia at a low level of potential.

4. Conclusions

The conducted research enabled the analysis of the potential of the Visegrad Group countries in selected areas in the period 2017-2022. Due to the orientation of the conducted research on stakeholders such as government, science, and administration, the focus was on analyzing the potential of the Visegrad Group countries related to indicators from these areas. Authors used to analyze the factors that determine the readiness for cooperation between science, business, and administration have been identified as GDP per capita, Human resources in science and technology, and New businesses registered. Due to the differences in potential in

³ Ranked quantitative variables were used for the classification trees, i.e. the quantitative variable Gender Pay Gap was transformed into a nominal variable according to the Ntyle method. 4 compartments have been created: 1 – less than 10; 2 – 10-16,6; 3 – 16,6-18,4; 4 – over 18,4.

these economies, the complexity of micro and macroeconomic conditions affecting their potential should be emphasized. One of the variables that determine the level of potential index is the level of human resources involved in developing science and technology. On this basis, it can be concluded that among the Visegrad Group countries, the Czech Republic has the highest potential index, while Hungary and Poland have the lowest potential. The same dependence occurs when taking into account the pay gap index. The Czech Republic has the highest potential index, while Poland and Hungary have the lowest potential index. Among the Visegrad Group countries, Slovakia is characterized by a heterogeneous classification, strictly dependent on the level of the independent variable. The results of the conducted research indicate a high degree of differentiation in the potential index of the Visegrad Group countries. They also prove that it is an essential factor positively influencing their economic development. Individual stakeholders involved in the cooperation process should ensure the development and use of appropriate instruments that would increase the level of potential of the V4 countries and their use.

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SPATIAL DIFFERENTIATION OF THE LEVEL OF ECOLOGICAL DEVELOPMENT OF POLISH VOIVODESHIP

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Purpose: The aim of the research is the evaluation of the ecological state of development based on statistical data from voivodeships in Poland.

Design/methodology/approach: The research uses selected methods of multivariate comparative analysis, in particular, linear ordering. The analysis of the differentiation of the level of ecological development by voivodeships in Poland made it possible to order the provinces according to the indicators that represent the state of the environmental situation. After the process of ordering, the process of grouping voivodeships was possible. The relevant calculations were made using QGIS and Statistica software.

Findings: The result of the analysis presents a tree main cluster with similar voivodeships according to ecological situation.

Practical implications: The presented methods enable continuous monitoring and control of progress in the implementation of the assumed ecological goals. Green development assessment methods can also help monitor progress towards the Sustainable Development Goals over time. This can help identify trends and patterns and provide feedback on the effectiveness of policies and programs. The results of the analyses may be a useful tool for monitoring and evaluating Poland's progress in achieving the assumed ecological goals of the European Union by 2030.

Originality/value: These studies are a very useful tool in identifying the ecological situation and directing administrative activities to the appropriate regions in the country.

Keywords: spatial analysis, sustainable development, classification.

Category of the paper: research paper.

1. Introduction

Economic development, which enables an increase in the quality of life in society, has a negative impact on the condition of the natural environment.

The level of environmental degradation is one of the most important aspects of sustainable development. The countries of the European Union show great commitment to the implementation of environmentally friendly initiatives and their protection. The presented article deals with the issue of measuring and monitoring the progress of countries or their regions in ecological activities. The authors of the article answer the question of how to measure and evaluate ecological development in a given administrative area. The level of ecological development is a multidimensional phenomenon; therefore, the article presents the chosen method of linear ordering for ranking voivodships in Poland according to the level of ecological development and then grouping voivodeships according to the degree of development. As a result of the research, it is possible to present the results on a map in spatial terms of the level of ecological development of the examined regions of Poland.

2. Literature review

The ecological aspects of the state of the natural environment are issues of the utmost importance for the development of society today and in the future. Progressive degradation of the environment should be stopped and subject to control and monitoring. In practice, there are many voluntary initiatives serving this purpose, and more and more environmental standards are being developed that put limits on further uncontrolled pollution of the environment (Ranosz et al., 2020). The popularization of this topic in the literature deepens the awareness of society about ecological issues, which has measurable benefits for caring for the condition of the environment. Environmental aspects are of great importance to today's society (Manowska et al., 2017), as they affect our health, well-being, and even the survival of our species. The Earth's climate is changing rapidly due to human activities such as the burning of fossil fuels, deforestation, and industrialization. Climate change leads to rising sea levels, extreme weather events, and the loss of biodiversity, which can have devastating effects on ecosystems and human communities (Bluszcz, Manowska, 2021). Environmental pollution, including air and water, can have harmful effects on human health (Bluszcz et al., 2023). Poor air quality can lead to respiratory problems, and contaminated water can cause diseases such as cholera and dysentery. Natural resources, such as water, soil, and minerals, are essential for human life and economic development. However, their availability is limited, and increasing demand for them could lead to their depletion, which could have serious consequences for future generations.

Biodiversity is important to the functioning of ecosystems, including the provision of food, clean air, and water. However, human activities such as deforestation, habitat destruction, and climate change are leading to biodiversity loss at an alarming rate. Environmental aspects are important to achieving sustainable development, which means meeting present needs without detracting from the ability of future generations to meet their needs. Sustainable development requires balancing economic, social, and environmental factors. In summary, environmental aspects are crucial to today's society because they affect our health, well-being, and the survival of our species. Protecting the environment is not only a moral obligation but also necessary to ensure a sustainable future for all. Environmental degradation is the dominant problem of today's generations. The idea of sustainable development implies that our generation should use natural resources in a sustainable manner to enable future generations to have access to them. The concept promotes a precautionary approach aimed at using natural resources efficiently today so that the natural process of ecosystem renewal can take place, thereby protecting sustainability for future generations.

In the literature, it is possible to find a great variety of methods for measuring the use of the environment (Jonek-Kowalska, 2022; Manowska, Nawrot, 2019; Burchart-Korol et al., 2014) and there is no one universal method. Among the very popular methods are multivariate analyses (Gajdzik, 2012; Kijewska, Bluszcz, 2016; 2017; Brodny, Tutak, 2020), which allow the evaluation of the problem under study on the basis of many diverse evaluation criteria.

Therefore, the subject of research in the article is the evaluation of the ecological state of development based on statistical data from voivodeships in Poland. The research uses selected methods of multivariate comparative analysis, in particular, linear ordering. The analysis of the differentiation of the level of ecological development by voivodeships in Poland made it possible to order the provinces according to the indicators that represent the state of the environmental situation. After the process of ordering, the process of grouping voivodeships was possible. The relevant calculations were made using QGIS and Statistica software. The analyses refer to statistical data from 2021, which were published on the webpage of the Central Statistical Office in Poland. The results of the analyses provide a useful tool for monitoring the state of the environment in the assumed time intervals, considering the selected evaluation criteria, as well as a very useful tool for monitoring situations in the spatial chart.

3. Methodology

This phenomenon Consumerism is a megatrend that characterizes today's times. This phenomenon significantly increases the consumption of natural resources and energy, which causes a dynamic trend of environmental pollution. To slow down the impact of the negative effects of consumerism on humans, there is a need for global environmental

awareness. Currently, the world has become one "ecological village," and as a result, decisions made in business entities or consumers' homes are now global, not just local (Mirski, 2017).

The Sustainable Development Goals (SDGs) are a set of 17 global goals adopted by the United Nations General Assembly in 2015 as part of the 2030 Agenda for Sustainable Development. The SDGs aim to end poverty, protect the planet, and ensure peace and prosperity for all people. The 17 SDGs are: No Poverty, Zero Hunger, Good Health and Well-being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals. Each goal has specific targets and indicators to measure progress towards achieving the SDGs by 2030. The SDGs are interconnected and require collaboration and cooperation among all countries and stakeholders, including governments, civil society, the private sector, and individuals, to ensure a sustainable future for all (Nur Suhaili Mansor et al., 2014). Ecological development refers to the process of economic development that is environmentally sustainable and considers the impacts of economic activities on the natural environment. It is a concept that promotes economic growth while also ensuring that the natural environment is protected and preserved for future generations. Ecological development emphasizes the use of renewable resources, reducing waste and pollution, and implementing sustainable practices in industries such as agriculture, energy, and transportation. It also involves the protection of biodiversity, the preservation of ecosystems, and the reduction of greenhouse gas emissions to mitigate climate change. The concept of ecological development is closely related to the idea of sustainable development, which recognizes that economic growth must be balanced with social and environmental considerations. It seeks to promote a more harmonious relationship between economic activities and the natural environment by prioritizing the protection of natural resources and the health of ecosystems. Ecological development requires a shift in the way we think about economic growth and development, and it requires the cooperation of governments, businesses, and individuals to promote sustainable practices and protect the environment.

The article uses the methodology of linear ordering of objects, which are administrative units of Poland, into voivodships according to a synthetic measure describing the level of ecological development of a given voivodship in relation to others.

Multidimensional analysis is a method used to assess ecological development by considering multiple dimensions of ecological development. This approach recognizes that ecological development is a complex and multi-faceted issue and that progress towards sustainability must be evaluated across multiple dimensions and factors.

It should be noted that there is no one universal method for measuring the level of sustainable development or green development due to the limited access to data for selected areas and the wide range of potential variables describing specific aspects of the analysis.

Sustainable development covers a wide range of social, ecological, and economic aspects (Bluszcz, 2018; Mansor et al., 2019). The authors of this article will focus primarily on environmental aspects. The main aim of the article will be to measure and evaluate the ecological development situation. An example of the analysis will be the regions of Poland in terms of administration by voivodeships. The analysis was made on the basis of data available on the website of the Central Statistical Office of Poland, divided into voivodeships. Data on the ecological situation in terms of provinces in Poland were selected for analysis and included the following five diagnostic variables: emission of air pollutants in thousand tones particulates, emission of air pollutants in thousand tones gases (excluding carbon dioxide), industrial and municipal wastewater requiring treatment total in hm³, waste generated (during the year, excluding municipal waste) total in thousand tones, area of special nature value under legal protection per capita in m². The comparative analysis was carried out in several stages:

- selection of variables for analysis,
- division of selected variables into stimulants and destimulants,
- normalization process of the selected variables,
- aggregation process of a result into a synthetic indicator,
- linear ordering according to the level of ecological development indicators,
- division into similar groups of voivodeships in Poland according to ecological situation,
- data mapping in the QGIS program according to the level of ecological development of the provinces of Poland.
- interpretation of the results and final conclusions from the analysis.

4. Results

The first stage of the analysis was the selection of diagnostic variables for analysis.

Characteristics of voivodeships according to the ecological situation can be carried out according to various evaluation criteria. The choice of evaluation criteria for this article was dictated by the availability of statistical data published on the website of the Central Statistical Office in the system for each voivodeship. The second process of dividing variables into stimulants and destimulants is based on a substantive assessment of the variable's impact on the ecological situation. As a result of the interpretation of the variables, one variable was indicated as having a positive impact on the ecological situation and was assessed as a stimulant. The final division of variables is presented in Table 1.

Table 1.*A set of diagnostic variables*

	variables	type of variable
1	emission of air pollutants in thousand tones particulates,	destimulant
2	emission of air pollutants in thousand tones gases (excluding carbon dioxide)	destimulant
3	industrial and municipal wastewater requiring treatment total in hm ³	destimulant
4	waste generated (during the year, excluding municipal waste) total in thousand tones	destimulant
5	area of special nature value under legal protection per capita in m ²	stimulant

Source: own elaboration based on website of the Central Statistical Office in Poland <https://stat.gov.pl/>**Normalization process**

The available statistical data have different units, so in order to start the process of comparing variables, a normalization process should be carried out, which is used to bring the data to one measurement scale. The data normalization process is carried out according to formulas (Strahl, 1984):

-for destimulants (D):

$$z_{ij} = \frac{\min_i\{x_{ij}\}}{x_{ij}} \quad x_{ij} \neq 0, \quad (1)$$

- for stimulants (S):

$$z_{ij} = \frac{x_{ij}}{\max_i\{x_{ij}\}} \quad \max_i\{x_{ij}\} \neq 0 \quad (2)$$

where:

 x_{ij} - the value of the diagnostic variable Z_{ij} - the normalized value of x_{ij}

The matrix of the data normalized in accordance with the formulas (1) and (2) is presented in the table 2.

Table 2.*A set of normalized diagnostic variables*

	Variable X1	Variable X2	Variable X13	Variable X4	Variable X5
malopolskie	0.41667	0.124595	0.159574	0.142073	0.294718
slaskie	0.11628	0.013354	0.103781	0.022000	0.076233
wielkopolskie	0.33333	0.252459	0.204978	0.189556	0.315022
zachodniopomorskie	0.33333	0.432584	0.385675	0.121904	0.370578
lubuskie	0.83333	0.987179	1	1	0.651844
dolnoslaskie	0.35714	0.259259	0.22412	0.017447	0.160563
opolskie	0.41667	0.179487	0.675241	0.516923	0.333458
kujawsko-pomorskie	0.26316	0.262799	0.307918	0.399177	0.352516
warmińsko-mazurskie	0.83333	0.740385	0.810811	0.540333	1
pomorskie	0.71429	0.455621	0.306569	0.334721	0.320752
lodzkie	0.31250	0.067367	0.433884	0.079528	0.183483
swietokrzyskie	0.38462	0.115616	0.526316	0.119965	0.781141
lubelskie	0.41667	0.48125	0.546164	0.112312	0.342053
podkarpackie	0.55556	0.647059	0.551181	0.845770	0.472845
podlaskie	1	1	0.985915	0.685634	0.682362
mazowieckie	0.25000	0.120313	0.148305	0.097139	0.533508

Source: own elaboration.

After a normalization, aggregation was introduced. The values $\max_i\{x_{ij}\}$, $\min_i\{x_{ij}\}$ used for the normalization specify the coordinates of the so-called model object with optimum values of the examined diagnostic variables. The normalized data have undergone the process of aggregation by means of the calculation of the value Z_i ($i = 1, \dots, m$) of the synthetic variable Z (indicator of an ecological situation). The following multidimensional object with the standardized coordinates: $Q_0 = [z_{01} z_{02} \dots z_{0k}]$.

Where the coordinates of the model object z_{0j} ($j = 1, \dots, k$) take the form of

$$z_{0j} = \begin{cases} \max_i\{z_{ij}\} & \text{dla } j \in S \\ \min_i\{z_{ij}\} & \text{dla } j \in D \end{cases} \quad (3)$$

At the same time $\{X\} = \{S\} \cup \{D\}$ (the sum of the sets of all stimulants and destimulants is the set of all the diagnostic variables). Where S means a set of stimulants and D – a set of destimulants for normalized variables of the observation matrix X . where ($i = 1, \dots, m$; $j = 1, \dots, k$). the value of the diagnostic variable j in the object i (province). In this way, all diagnostic variables are treated as equally important when constructing the synthetic measure of development. For the assessment of the ecological situation of voivodships of Poland the synthetic measure calculated in accordance with the formula was used (Strahl, 1984):

$$z_i = 1 - \frac{d_{i0}}{d_o} \quad (i = 1, \dots, m) \quad (4)$$

d_{i0} – the distance between the object Q_i ($i = 1, \dots, m$) and the hypothetical (abstract) model object Q_0 calculated in accordance with the formula:

$$d_{i0} = \left[\sum_{j=1}^k (z_{ij} - z_{0j})^2 \right]^{0,5} \quad (i = 1, \dots, m) \quad (5)$$

The Euclidean distance d_{i0} constructed this way was used to compare the level of ecological situation of the examined objects (voivodships). The interpretation of the scale d_{i0} is as follows: the smaller the value of the distance d_{i0} the higher the level of development has been achieved by a given object (voivodships).

The value d_o is expressed by means of the formula:

$$d_o = \bar{d}_o + 2s_o \quad (6)$$

where:

$$\bar{d}_o = \frac{1}{m} \sum_{i=1}^m d_{i0} \quad (7)$$

$$s_o = \left[\frac{1}{m} \sum_{i=1}^m (d_{i0} - \bar{d}_o)^2 \right]^{0,5} \quad (8)$$

The next stage of the research is ordering object. The ranking of voivodships in Poland in accordance with the synthetic ecological indicator has been presented in table 3.

Table 3.

The ranking in accordance with the synthetic ecological indicator

	synthetic ecological indicator
lubuskie	0.8384
podlaskie	0.8130
warmińsko-mazurskie	0.7553
podkarpackie	0.6200
pomorskie	0.4446
opolskie	0.4393
lubelskie	0.4031
świętokrzyskie	0.3785
zachodniopomorskie	0.3641
kujawsko-pomorskie	0.3593
wielkopolskie	0.3049
małopolskie	0.2699
mazowieckie	0.2641
łódzkie	0.2544
dolnośląskie	0.2477
śląskie	0.1258

Source: own elaboration.

The result of the analysis is, among others, a ranking of voivodships according to the level of ecological development and based on a synthetic indicator. Based on the analysis, it can be concluded that the voivodeships with the highest level of the indicator are characterized by the best condition of the natural environment in the country. In 2021, the voivodship with the highest rate is Lubuskie (0.8384), and the lowest is Śląskie (0.1258).

The next stage of the analysis was to group voivodeships and present the results on a spatial map. The division into similar groups of objects was made using the Ward method for the square of the Euclidean distance. The results of the analysis are presented in the tree diagram in Figure 1, which shows the result of the analysis from the Statistica program. The spatial presentation on the map was made in the QGIS program.

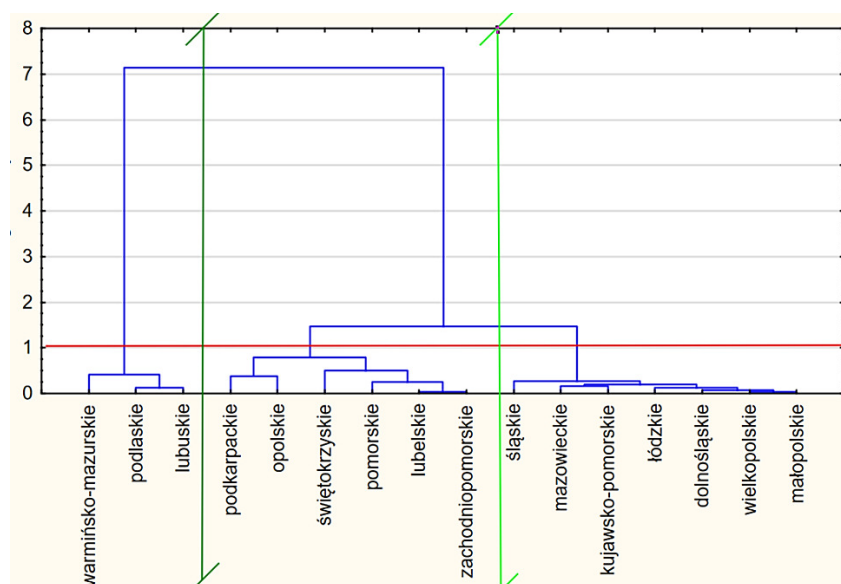


Figure 1. Selection of groups of voivodeships with a similar level of ecological development.

Source: own elaboration.

The first group consists of voivodeships with the best ecological situation: lubuskie, podlaskie, and warmińsko-mazurskie. The second group of similar voivodeships are: podkarpackie, opolskie, świętokrzyskie, pomorskie, lubelskie, and zachodniopomorskie. The third group of voivodeships with a relatively unfavorable ecological situation are: śląskie, mazowieckie, kujawsko-pomorskie, łódzkie, dolnośląskie, wielkopolskie, and małopolskie.

The results of the analysis indicated three groups of voivodeships, which were presented on the map in the QGIS program (fig. 2).

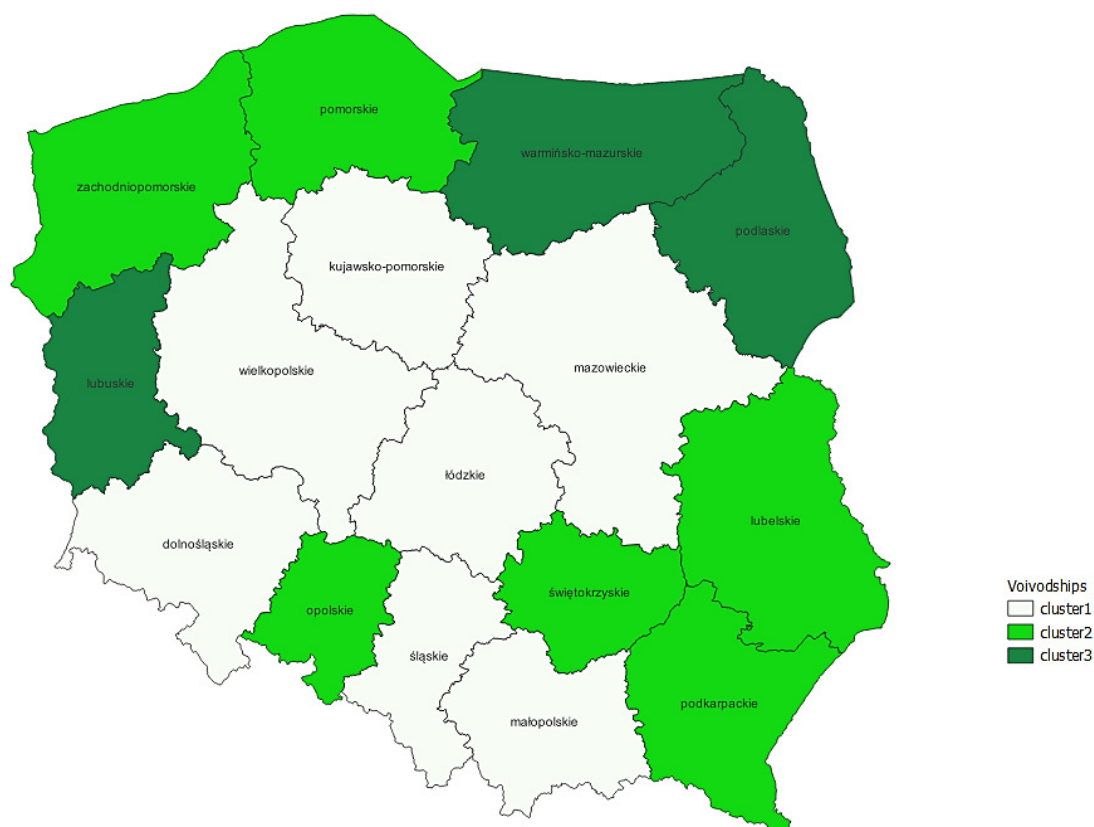


Figure 2. Selection of groups of voivodeships with a similar level of ecological development.

Source: own elaboration.

Figure 2 presents the tree main cluster with similar voivodeships according to ecological situation. The green color shows the most ecological voivodeships, and the white color on the map shows the voivodeships with the most unfavorable ecological situation. These studies are a very useful tool in identifying the ecological situation and directing administrative activities to the appropriate regions in the country. The results of the analyses may be a useful tool for monitoring and evaluating Poland's progress in achieving the assumed ecological goals of the European Union by 2030.

5. Discussion

The degradation of the natural environment requires constant monitoring and control. Therefore, there is a need to measure the condition of the natural environment with appropriate methods and tools.

The article addresses the important issue of answering the question of how to effectively measure and monitor the progress and effects of actions taken by national institutions to improve the ecological situation of voivodships.

The implementation of the sustainable development goals requires the implementation of adequate methods of measuring progress in achieving the assumed goals.

The article presents one of the many methods of multidimensional comparative analysis, which is perfect for assessing phenomena described by many diagnostic variables. The presented solution is not ideal or the best solution because the quality of the obtained results depends primarily on the quality of the available statistical data. Many phenomena or aspects related to sustainable development can be described by various variables but accessing them can be difficult. Therefore, the authors, using the available statistical data for each voivodeship, present the popular methodology as a model that can be successfully used in practice to assess the level of ecological development of the surveyed areas in the country as well as in other European Union countries.

6. Conclusions

The article presents an example of multidimensional analysis and linear ordering, which can be used in practice to control the ecological situation for any area. The article uses the assessment of the level of ecological development for voivodeships in Poland for data from 2021. Monitoring may apply to any selected time intervals for which relevant statistical data are known. These methods are a very valuable tool for several reasons such as: identify areas for improvement: green development assessment methods can help identify areas where improvements are needed, such as reducing carbon emissions, improving air and water quality, and protecting biodiversity. This information can be used to develop targeted regional or global policies and strategic programs to address these challenges. The presented methods enable continuous monitoring and control of progress in the implementation of the assumed ecological goals. Green development assessment methods can also help monitor progress towards the Sustainable Development Goals over time. This can help identify trends and patterns and provide feedback on the effectiveness of policies and programs.

An innovative aspect of the article is the presentation of the results of the statistical analysis and the grouping carried out into sets of voivodships similar in terms of ecological situation, and the presentation of these results in spatial terms. A clear presentation of the studied phenomena on spatial charts is currently a rapidly developing trend that is conditioned by the dynamic development of the functionality of the QGIS software.

Acknowledgements

The publication is financed from statutory funds 06/030/BK23/0078.

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HAZARD ANALYSIS AND RISK ASSESSMENT ON LASER CLEANING WORKSTATIONS

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Purpose: The purpose of this article is to present the type of hazards, to study their impact on human safety, to carry out an occupational risk assessment at the laser metal cleaning station, and to establish corrective activities for the safety condition.

Design/methodology/approach: an analysis of the problem of the occurrence of nuisance and hazardous factors during the use of lasers in the technology of machine parts is presented, in the case-study part, the identification and analysis of factors affecting the health risk is carried out, a risk assessment is carried out at the laser cleaning station using the five-step method according to PN-N-18002, the results obtained are discussed, technical and organizational solutions necessary to achieve an acceptable risk condition are presented.

Findings: the developed list of hazards and the risk assessment sheet indicate the need to take measures to minimize the risk. The collected information on working with lasers can be used in the future for job training, creating a safety culture at the plant and reducing the negative impact on the health of employees.

Research limitations/implications: the analysis carried out has made it possible to develop recommendations in the context of safe work at a workstation designed for laser cleaning of metal surfaces. In the future it is possible, following the example shown, to develop risk cards for laser processing of other types performed on different materials.

Practical implications: The results of the analysis and the developed recommendations for improving the organization of the machining station can be used in other companies in the context of the correct equipment of workstations, selection of individual and collective protective equipment, workstation training, risk management, etc.

Social implications: the article will enable the dissemination of information about the specifics of metalworking with lasers and the promotion of a culture of work safety and good practices at workstations with lasers.

Originality/value: The content presented in the article complements the research on the implementation and use of laser techniques in modern companies with knowledge and practical guidelines in the area of occupational health and safety management. The added value of the article is the reference to laser workstations, which have become increasingly common in recent years and are replacing previous, sometimes obsolete technologies, as well as the possibility of applying methods of analysis and assessment of occupational risk in work with lasers in practice.

Keywords: laser cleaning, hazard, occupational risk, five-step method.

Category of the paper: research paper, case study.

1. Introduction

Occupational risk is the possibility that an employee may lose his or her life or suffer an injury while performing tasks on the job (Kowalczyk, 2010). Health damage or loss of life can occur at the workplace during the performance of work tasks, as a result of work-related processes or adverse events (Klaus-Rosińska, 2023).

Risk can be defined in various ways, such as (Dębiec, 2008) defines it as the chance of loss, the possibility of loss, uncertainty or danger.

Risk is inherent in human life and activity, in its various forms of activity. The characteristics of risk include uncertainty, probability, variability, variation of consequences or undesirable effects (Laska, 2015). According to the standard (ISO 45001:2018), risk is the impact of uncertainty, which is a state of lack of information as to understanding or knowledge of an event, its consequences or probability. Risk is often characterized by reference to potential events and their consequences. In the context of occupational safety, the standard specifies health risk as the combination of the probability of a hazardous work-related event or exposure and the severity of injury and ill-health that may be caused by the event or exposure (prolonged exposure to harmful or hazardous factors) (Pacana, 2019).

An occupational risk assessment is understood as a detailed examination and evaluation of what in the workplace can harm or cause harm to employees. Then, thanks to such an assessment, the employer can check whether the measures used to reduce or eliminate risks are sufficient, and determine whether there is still something that can be done to make the risk as small as possible. An additional reason for conducting an assessment is to eliminate financial losses, organizational problems in the event of an accident at work or as a result of occupational disease, and possible downtime and the need to establish replacements (Kowalczyk, 2010; Dul, 2023).

Risk assessment can be carried out in different ways. Two groups of methods for estimating the level of risk are commonly known:

- quantitative methods - for which data on the number of accidents, occupational diseases, hazardous incidents, employed workers and other statistical data are required to enable reliable analysis;
- qualitative methods - used when there is a lack of data or the use of numbers is not justified; however, detailed identification of hazards is required, due to the fact that risk assessment is performed for each hazard separately. This is a subjective assessment, so the amount of information collected about the position, the activities performed, the materials used and the environment of the position is crucial to the reliability of such an assessment (Pacana, 2019);

- risk assessment methods can be divided into inductive (based on premises in specific cases; from the particular to the general) and deductive (based on logical reasoning over consequences; from the general to the particular) (Rzepecki, 2002).

In turn, from the point of view of evaluation methodology, methods can be distinguished:

- matrix, table-based, e.g. PHA, JSA, risk matrix according to PN-ISO 45001:2018-06,
- indicator-based, e.g. Risk Score, Five Steps,
- graphs,
- others, such as FMEA (Pacana, 2019; Ulewicz et al., 2015).

A number of popular methods for risk assessment are listed in works (Pacana, 2019; Laska, 2015; Romanowska-Słomka, 2008). These include:

- risk matrices, e.g. according to (PN-N-18002) for non-measurable and for measurable work environment factors,
- Preliminary Hazard Analysis (PHA),
- Fault Tree Analysis (FTA),
- Job Safety Analysis (JSA),
- WHAT-IF Analysis,
- Checklist Analysis,
- Hazard and Operability Study (HAZOP),
- Failure Modes and Effects Analysis (FMEA),
- Event Tree Analysis (ETA),
- Risk Score,
- Five Steps to Risk Assessment (5 Steps),
- Safety Review (SR),
- graphs and risk calculators,
- others.

Safety at work is influenced by various primary factors:

- technical factors - the type of means of work, the size and shape of work objects, the technical efficiency of the workplace and equipment at the workplace,
- organizational factors - technologicality of construction, methods and methods of execution, space at the workstation, time standards, interconnection of workstations with each other, transportation, work breaks,
- material environmental factors - microclimate, lighting, noise, vibration, air pollution, radiation, harmful substances

and secondary factors:

- physical load - static, dynamic and monotypic muscles,
- mental load - monotony, intensive thinking, decision-making, information stream,
- occupational safety - general health and safety conditions, protection from hazards, safeguards used (Kawecka-Endler, 1998).

Providing safe working conditions and minimizing risks is a fundamental task of the employer regulated by law. This aspect according to the Labor Code (Code, 2022) is formulated specifically that the employer on duty to protect the health and life of employees by ensuring safe and hygienic working conditions with appropriate use of the achievements of science and technology (Hess, 2023). Those who direct the work of other employees under Article 212 have the duty to (Muszalski, 2007):

- organize workplaces in accordance with the regulations and principles of occupational safety and health,
- take care of the efficiency of personal protective equipment and its use as intended,
- organize, prepare and conduct work, taking into account the protection of employees against accidents at work, occupational diseases and other diseases related to the conditions of the working environment,
- take care of the safe and hygienic condition of work premises and technical equipment, as well as the efficiency of collective protection measures and their use as intended,
- enforce compliance by employees with the rules and principles of work safety.

These provisions are consistent with the Constitution of the Republic of Poland, international agreements of the European Union (Directive), recommendations of the International Labor Organization.

2. Methods

A newly created workstation for fiber laser cleaning of the surfaces of products made of various metal alloys was analyzed. Consideration was given to the requirements of the material working environment - the room, the materials used, the tools, the organization and course of the technological process and the way of organizing work. Hazards were identified according to the recommendations described in (Kowalczyk, 2010; Romanowska-Słomka, 2008; Wieczorek, 2009), among others. When characterizing the position, the following were taken into account:

- planned location of the site,
- the initial phase of use of the stand,
- tasks implemented at the stand resulting from the technological process,
- activities, methods of execution, time of execution of production tasks,
- description of planned tools and equipment,
- qualification requirements (training and authorizations),
- the expected number of people at the position and the presence of people in the vicinity of the position,

- legal requirements and standards in relation to the position,
- probable hazards and their sources,
- possible effects of hazards,
- probable accidents or occupational diseases,
- selected work clothing, personal protective equipment or other means of protection against hazards.

In order to gather information, technical data of the laser device (Laser, 2023), regulations and guidelines of standards, (PN-EN ISO 12100:2012; PN-EN 60825-1:2014), safety data sheets of substances used during the process (Acethone, 2017), scientific and technical literature (Barat, 2008; Chryssolouris, 2013; Sliney, 2013; Weber, 2018) and also interviews and discussions with specialists during external training (Owczarek, 2023) were used. A job description was drawn up for the position, in which the presence of hazards was verified:

- mechanical hazards - related to the impact of physical factors on the worker, the possible consequences of the occurrence of mechanical hazards can be crushing, pulling, hitting, cutting,
- electrical hazards - associated with live parts of the equipment, the possible consequences of the occurrence of electrical hazards are electrocution due to contact or proximity to live parts,
- thermal hazards - associated with parts or tools heated to high temperatures, the possible consequences of the occurrence of thermal hazards are burns, burning of fragments of the human body due to contact with hot surfaces and initiation of fire,
- noise hazards - caused by harmful sound, as a result of which auditory fatigue, headaches, irritability, decreased attention and concentration during work, difficulty in communicating by voice and lack of response to voice signals may occur,
- radiation hazards - related to the specifics of the work of the device: laser radiation and electromagnetic radiation, possible due to, for example, the lack of a procedure for starting the station,
- hazards of materials and substances used at the workplace, touched or inhaled, liquids, dust, gases; as a result of exposure to this type of hazard, it is possible to develop occupational diseases, such as pneumoconiosis, allergies, as well as other diseases,
- hazards associated with the lack of rational organization of the workplace and ergonomics, causing physiological, psychophysical effects, such as strain on the skeletal system, muscles, stress, work under time pressure, etc.,
- hazards caused by the improper condition of surfaces, resulting in slips, falls, injuries.

The classical method on a five-grade scale (PN-N-18002) was used to assess risks. According to the five-grade scale method, risk valuation is carried out according to the degrees given in Table 1.

Table 1.*Risk valuation according to PN-N-18002 on a five-grade scale*

Probability of event	Severity of consequences		
	Small	Medium	Large
Unlikely	Very low risk 1	Low risk 2	Medium risk 3
Likely	Low risk 2	Medium risk 3	High risk 4
Highly likely	Medium risk 3	High risk 4	Very high risk 5

Source: PN-N-18002.

Low severity of sequelae refers to injuries and illnesses that do not cause long-term discomfort and absenteeism from work. It is a temporary deterioration of health, such as: minor bruises and injuries, eye irritation, symptoms of minor poisoning, headaches.

Medium severity of sequelae refers to injuries and illnesses that cause minor but prolonged or recurring periodic discomfort and are associated with periods of absenteeism. These include, for example: injuries, second-degree burns on a small area of the body, skin allergies, uncomplicated fractures, musculoskeletal overload syndromes.

High severity of sequelae refers to injuries and diseases that cause severe and permanent discomfort and/or death. These include, for example, second-degree burns of a large area of the body, amputations, complicated fractures with limb dysfunction, cancer, toxic damage to internal organs and the nervous system as a result of exposure to chemical agents, vibration syndrome, occupational hearing damage, asthma, cataracts.

Events, on the other hand, are characterized as, respectively:

- unlikely - the consequences of hazards should not occur during the entire period of a worker's professional activity,
- probable - consequences of hazards that may occur no more than several times during the period of the employee's professional activity,
- highly probable - consequences of hazards that may occur repeatedly during the employee's professional activity.

Recommendations in the context of the activities are given in Table 2.

Table 2.*Measures for risks identified on a five-grade scale*

Level of risk	Type of risk	Recommendations
Very high – 5	Unacceptable	Work should not be started or continued until the occupational risk is reduced to an acceptable level.
High – 4		If the occupational risk is related to work, which is already performed, action to reduce it should be taken immediately. Planned work should not begin until the occupational risk is reduced to an acceptable level.
Medium – 3	Acceptable	It is recommended to plan and take activities aimed at reducing occupational risks.
Small – 2		It is recommended that consideration be given to further reducing the level of occupational risk or ensuring that occupational risk remains at least at the same level.
Very small – 1		No action is necessary.

Source: PN-N-18002.

The severity of the harmful consequences of the hazard and the probability of their occurrence were determined using the following guidelines (Laska, 2015):

- low-harm consequences include those injuries and diseases that do not cause long-term discomfort,
- medium-harm sequelae include those injuries and illnesses that cause minor but long-lasting or periodically recurring discomfort and are associated with short periods of absenteeism,
- consequences of high harm include those injuries and illnesses that cause severe and permanent ailments and/or death,
- unlikely include those consequences of hazards that are not expected to occur during the employee's entire working life,
- probable include those consequences of hazards that are likely to occur no more than several times during an employee's working life,
- highly probable include those consequences of hazards that may occur repeatedly during the period of an employee's professional activity.

There is a requirement to define the boundaries of the workstation and list the identified risks, this information was collected at the initial stage of risk estimation.

The analysis was conducted during the start-up phase in a situation where the existing workstation was replaced by a laser.

3. Results

The cleaning operation of materials made of steel has so far used a sandblaster and mechanized equipment with embankment tools (hand grinders, sandpaper). The significant inconvenience and labor intensity of the process led to the decision to change the technology and use a laser device. As a result of the analysis of the new situation, a job guideline was developed along with an occupational risk assessment.

1. Workstation characteristics and location

The laser cleaning station consists of a workbench with a laser device placed on it. The device consists of a workbench on which the parts to be cleaned are placed, a galvo head connected to a resonator, a guide along which the head and resonator move, and a separately standing power supply unit with a generator. The power supply and resonator are connected by a flexible fiber optic cable. Next to the laser device is a desktop for a computer with software controlling the device. On either side of the table there are elements of the workstation equipment - a desktop for depositing finished products and a tool cabinet. The worker uses his hands to move the products into the machining zone himself, and after finishing the machining, he puts them back on the pallet.

The position is planned to be located in place of the previous locksmith position under an outside window, within the production hall adjacent to other positions (Figure 1), on the first floor, in one of the plant buildings. Both operators of other machine tools and customers can enter the production hall to consult orders.

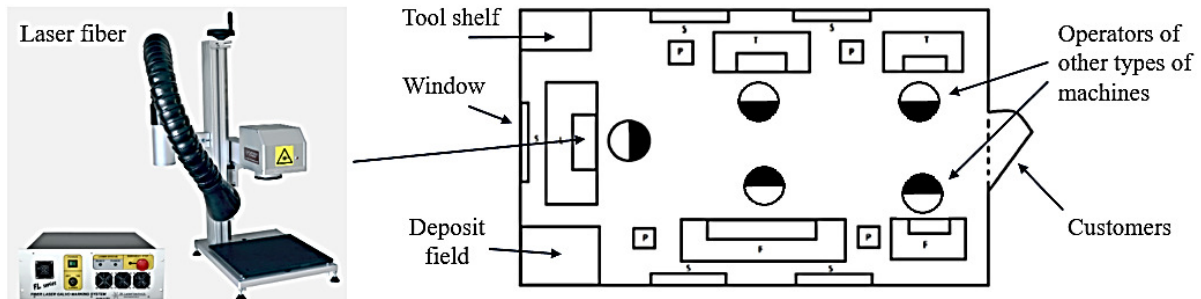


Figure 1. Scheme of the location of the laser station.

Source: own.

2. Characteristics of a laser device

The fiber laser used for cleaning metal surfaces from layers of corrosion, old paint, varnish, glue residues and other layers is a class 4 laser. The device is equipped with a second, additional 2 class laser.

The machining laser is characterized by the following parameters: wavelength of 1064 nm (Ytterbium), power of 20W, pulse frequency in the range of 1÷4000 kHz, maximum pulse energy up to 5 mJ, pulse duration of 2 ms, air cooling, power consumption of maximum 350W, power supply 230V-50Hz, operation at a temperature of 10÷35°C (Laser, 2023).

3. Materials and work resources

The operator performs work operations using a laser and a computer with a screen monitor; work is performed standing or sitting at a work table. Parts to be cleaned are brought in by forklift on a pallet and stored near the operator's seat. The operator uses acetone to pre-clean the surface of the product.

4. Qualification requirements

Expected to have at least secondary technical education, no medical contraindications to work in a laser workstation.

Initial health and safety training on admission to work, periodic training, workstation training.

5. List of hazards and their analysis

Class 4 lasers are defined as dangerous to the eyes and skin, including when interacting with scattered radiation. The radiation from this laser is invisible. Class 4 lasers are those with a power of more than 0.5 watts and are also a fire hazard (PN-EN 60825-1:2014). An additional, so-called guiding laser, is a class 2 laser. A laser of this class is defined as safe during momentary exposure, looking into the beam is a danger to the eye. It is a low-power laser (up to 1 mW) (Owczarek, 2023).

Based on the analysis of the class of lasers and the specifics of the workstation according to the above description, risks were identified:

- eye palsy and possible eye disease of the operator, as a result of exposure to laser radiation directly and as a result of reflection from smooth and shiny surfaces (walls, desktops, floors) and as a result of the passage of the beam through unprotected windows,
- paralysis of the eyes of bystanders in the vicinity or directly on the job stand,
- photochemical aging of the skin and/or burns as a result of direct exposure of the beam, e.g., to the hands of the operator, and to a lesser extent, to the body of other people in the vicinity of the working device,
- chemical agents - inhalation of acetone fumes during preparatory work,
- inhalation of fumes and dust during laser processing,
- fire hazard due to thermal effects of the laser beam,
- electric shock,
- work under stress due to the position of the body - the employee remains with his back to other people in the hall,
- work under time pressure in a situation of accumulated orders,
- microclimate - work in the vicinity of other jobs - dustiness, high temperature, lack of ventilation,
- biological factors - contact with people from inside and outside the plant,
- possibility of burns in contact with hot objects.

6. Occupational risk assessment

An occupational risk assessment card was developed for the analyzed position using the five-step method shown in Table 3.

Table 3.
Risk assessment sheet for the designed laser station

No.	Type of hazard	Source of danger	Possible consequences (severity of consequences)	Probability	Risk
1.	Direct laser radiation	Device on the workstation	Eye burns, retinal damage, corneal charring (<i>medium</i>)	Small	Small (2)
			Skin burn, skin breakage (due to shock wave) (<i>medium</i>)	High probable	Large (4)
2.	Reflected laser radiation	Device on the workstation	Eye damage, glare effect (<i>medium</i>)	High probable	Large (4)
			Skin photoaging (<i>small</i>)	Probable	Small (2)

Cont. table 3.

3.	Chemicals - acetone	Preparatory work on the station	Eye irritation (fumes, blurring), pain, tearing, redness (<i>medium</i>)	Probable	Medium (3)
			Skin irritation, allergic rash, dryness, cracking (<i>small</i>)	Probable	Small (2)
			Due to inhalation of vapors: nausea, vomiting, drowsiness, fatigue, dizziness, loss of consciousness (<i>large</i>)	High probable	Very large (5)
			Due to ingestion: irritation of mouth, throat, stomach (<i>medium</i>)	Low probable	Small (2)
			Fire and explosion hazard (<i>large</i>)	Low probable	Medium (3)
4.	Metallic dust and fumes during laser processing	The process of metal laser cleaning	Respiratory problems, throat irritation, asthma (<i>large</i>)	High probable	Very large (5)
			Chronic problems due to particles entering the bloodstream, possible carcinogenic effects, internal organ disorders (<i>large</i>)	High probable	Very large (5)
5.	Electric shock	Working with the device under voltage	Tissue burn, pain, muscle spasm, disturbance of vision, hearing, sense of balance, loss of consciousness, cardiac arrest (<i>large</i>)	Low probable	Medium (3)
6.	Fire, explosion	Beam interaction with the material	Burn (<i>large</i>)	Low probable	Medium (3)
7.	Working with a screen monitor	Computer on the stand	Eye strain (<i>small</i>)	Probable	Small (2)
8.	Stress	Work organization and workplace location	Headache, fatigue, irritability, distractibility (<i>small</i>)	Probable	Small (2)
9.	Unfavorable microclimate (mainly dustiness)	Neighboring stands	Fatigue, irritation of the respiratory system, coughing (<i>small</i>)	High probable	Medium (3)
10.	Hot surfaces of the product	Holding the product after processing	Redness, burning of the skin (<i>small</i>)	Probable	Small (2)
11.	Static load	Long-term work in a sitting position	Fatigue, muscle pain, back pain (<i>small</i>)	Low probable	Very small (1)
12.	Dynamic load	Long-term work in a standing position	Fatigue, muscle pain, back pain (<i>small</i>)	Low probable	Very small (1)
13.	Biological factors	People in the close vicinity of the stand	Seasonal infectious diseases (<i>small</i>)	Probable	Small (2)

Source: own.

4. Discussion

Special care should be taken when working with a laser. The laser, as a source of light, differs from typical surrounding sources. The radiation beam is coherent, monochromatic, characterized by significant energy per pulse and power density (in the context of the fiber laser under review). The hazards are not only related to the radiation of the beam, but there are other hazards, such as electrical or from the interaction of energy with materials (such as vapors and gases).

As a result of the analysis, it was concluded that the stand in its current state could not be used. Of the twelve types of hazards for which twenty possible effects were identified, high and very high risk levels (2 and 3, respectively) were established for five situations. Work on the post must not be undertaken, and corrective action must be initiated immediately if the post is to be used in the near future. Work can be started after the risk is reduced to an acceptable level. Five risk situations are rated at medium risk level, it is admittedly acceptable, but measures are recommended to reduce the negative impact on health. It should be noted additionally that the problems of high and very high risk concerned the newly implemented laser cleaning technology and the use of a chemical substance.

From the analysis of hazards, there are specific tasks directed to the employer, who is responsible for safe working conditions. The protection of the worker directly on the job, but also of other people who may be exposed to the impact of various factors associated with the switched-on laser, requires consideration of a number of aspects. The first aspect relates to the device, which in principle should be safe. The metal cleaning zone should be shielded by an enclosure and equipped with a filtration system. The benefits will be manifold: the shielding will prevent the beam from affecting the operator's body, the risk of eye and skin problems will be reduced. Filters and exhausts will prevent harmful particles from being emitted into the environment, from entering the human body or settling on workplace equipment. The risk of chronic and dangerous diseases and environmental pollution will be eliminated. The use of chemicals in connection with activities performed in the technological process poses an additional risk. The combination of two hazard factors, that is, the laser beam and a readily flammable substance, can cause an escalating event, such as a fire or explosion. It is not uncommon for sparks to occur in the laser cleaning process, hot metal particles can adhere to and thermally affect other objects. It can additionally be concluded that both the health risk to the operator and bystanders is associated with the need to start organizational work.

The aforementioned chemicals, which cause health and fire exposure, require the use of proper packaging, the implementation of storage rules within the workplace, as well as explosion-proof ventilation and emergency equipment. Mention should be made of properly selected fire extinguishing agents, face and eye washers located in the immediate vicinity of the station. Organizational issues also apply to elements of the device's surroundings: to minimize

the risk of the beam bouncing or exiting through windows, remove shiny surfaces, paint the walls with light matte paint, cover the windows, use impermeable screens or partitions, and use high-intensity lighting. Then the risk of the beam penetrating the eyes of the operator and bystanders will be minimized. The rules for working with lasers indicated in PN-EN 60825-1:2000 standard, among others, additionally talk about marking the entrance to the place where the laser is working, so in the case under study it will be recommended to separate the laser cleaning station from the other stations, and to make the recommended installations and markings.

The final element in improving working conditions (after the protected equipment and collective protection devices) is personal protective equipment. It should be recommended to use protective goggles adapted to the wavelength of the laser beam, gloves, protective clothing and a respirator when working with chemicals prior to cleaning. Then you can expect to minimize the risk of harm to the health of all people in the vicinity of the site.

In the case of the investigated position, musculoskeletal loads, working under time pressure and possible transmission of pathogenic germs are of lesser importance, one can consider rationalization of the activities performed, division of activities into work for several employees or variation and variety over time.

5. Summary

The results of performed analysis can be used in various ways. In the first place, paying attention to issues of risk minimization can be used to gain knowledge about the specifics of working with lasers, develop sensitivity to new processing technologies and the ability to identify various hazardous factors. It should also be noted that in the case of the use of class 4 lasers, there is an obligation to appoint a laser safety inspector at the plant. So, issues of safe working conditions go beyond the position and also involve personnel matters. This aspect can also be enriched by the results of the analysis, you can use the described issue for job instruction and training. Choosing to deal with unacceptable risks, the decision to improve working conditions, supports proactive management and helps prevent losses. In the long run, not only will working conditions improve, but also employee awareness will increase, a proper work culture will be created, and the number of accidents or near misses may decrease.

Acknowledgements

The research leading to these results has received funding from the commissioned task entitled “VIA CARPATIA Universities of Technology Network named after the President of the Republic of Poland Lech Kaczyński” contract no. MEiN/2022/DPI/2578 action entitled “In the neighborhood – inter-university research internships and study visits”.

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SOCIAL INNOVATION – A CASE STUDY

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Purpose: The purpose of this paper is to present a practical example from the field of social innovation implementation.

Design/methodology/approach: The results of the analysis of scientific publications in the field of management science indicate the need to continue research in the field of social innovation. The studies are part of the research area related to social entrepreneurship. The studies were conducted using desk research, interview and observation methods. The study covered an association – an organization belonging to the third sector of the economy. The organization adopts goals of a social nature, and at the same time operates according to market rules. It uses multiple sources of income.

Findings: The effects of implementing the innovation include the development of the organization socially and financially. The innovation affects the improvement of the competence of employees, contractors, interns, trainees, volunteers in the field of functioning of senior citizens, draws their attention to the problems of the elderly. The innovation is also an important element in the economization of the Association's activities. It is part of a strategy to diversify the organization's sources of funding.

Originality/value: The results of the analysis of scientific publications in the field of management science indicate the need to continue research in the field of social innovation. The studies are part of the research area related to social entrepreneurship. Research results may be interesting for scholars exploring social innovations, management students, and non-governmental organizations.

Keywords: social innovation, organization development, case study.

Category of the paper: Research paper.

1. Introduction – social innovation

Modern innovation is characterized by an interdisciplinary approach and high dynamics of change resulting from transformations taking place in all areas of the economy (Olejniczuk-Merta, 2013). The literature distinguishes, for example, product innovation, process innovation,

organizational innovation, social innovation. Olejniczuk-Merta (2013) points out that the distinction of the different types should not be considered as the result of separate independent processes – they rather determine and complement each other. Changes in one area affect the process of change in other areas: technology, engineering, organization or in the social sphere.

Social innovations are of interest to many areas of science, among others: economics, management, sociology, politics, anthropology (Hilarowicz, 2016; Kowalewski, 2014). They are classified as open innovation (Majchrzak, 2018). They can be micro- or macro-structural, local or entrepreneurial innovations (Michna, Męczyńska, 2016).

The purpose of social innovations is to improve the quality of life of society and/or isolated social groups. Their effect is *to provide a significant part of society with specific results of activities and the forms that these results take, in accordance with its demand determined "tailor-made" for a narrower or wider group of addressees* (Olejniczuk-Merta, 2013). They also result in changes in social attitudes, behavior or lifestyles (Baran, 2016; Majchrzak, 2018; Baran, 2020; Olejniczuk-Merta, 2013) emphasizes that *social innovation is expressed in the changes taking place in the social structure of the population, in the patterns of customs, human attitudes, and even the general culture of the nation.*

The special importance of social innovation is pointed out, for example, by the Polish Agency for Enterprise Development (INNOES). From the documentation of the INNOES project ("Grant program for social innovation in the area of accessibility", co-funded by the European Social Fund under the Operational Program Knowledge Education Development 2014-2020) it follows that social innovation can be understood as "new, more effective methods and tools for solving social problems in the area of accessibility for older people with limited mobility or perception and people with disabilities, consisting of creating and testing new solutions or improving existing ones, while taking care to optimize them, according to the idea of 'more for less' ". In addition, it is stressed that *the result of a social innovation does not necessarily have to be a new technological product; instead, it can be a new value for the customer that is designed to improve the quality of his or her life. Social innovation is the result of a learning process rather than the result of invention* (INNOES).

The main features of social innovations include: their innovative nature, taking equal forms (product, service, process), having a positive impact on society, combining social and economic goals. Social innovations are promoted and developed by various groups of entities (companies, public institutions, NGOs) (Wronka-Pośpiech, 2015, 2015b; INNOES; Furmańska-Maruszak, Sudolska, 2016).

Publications found in the Scopus database were analyzed in an attempt to identify the research gap. Publications containing the phrases *innovation* or *social innovation* in the title, abstract or keywords were searched. The results were limited to English-language articles from scientific journals. More than 263,000 results were obtained this way. The analysis of publications by year of publication indicates a very high interest of researchers in the area in question (Table 1) and an increase in this interest in the analyzed period (2015-2022).

Table 1.

Number of searched publications in Skopus database by year of publication

	The range of keywords searched for	2015	2016	2017	2018	2019	2020	2021	2022
1	<i>innovation or social innovation</i>	11484	12571	13500	14863	17375	20033	22390	28594
2	<i>social innovation</i>	128	152	232	225	301	377	373	481

The results were then limited to 2022 open access publications from the area of *Business, management and accounting*, yielding 7238 results. Finally, 2000 publications were analyzed in VOSviewer (due to the limitations of the program). In order to increase the readability of the map, it was limited to keywords occurring a minimum of six times. The main keyword was *innovation* (Figure 1) - links (number of links to other keywords): 224, total link strength (strength of links): 353, occurrences (number of occurrences of the keyword): 421. In contrast, the issue of *social innovation* was a rather infrequently addressed area compared to *innovation*: links (number of links with other keywords): 37, total link strength (strength of links): 41, occurrences (number of occurrences of the keyword): 14.

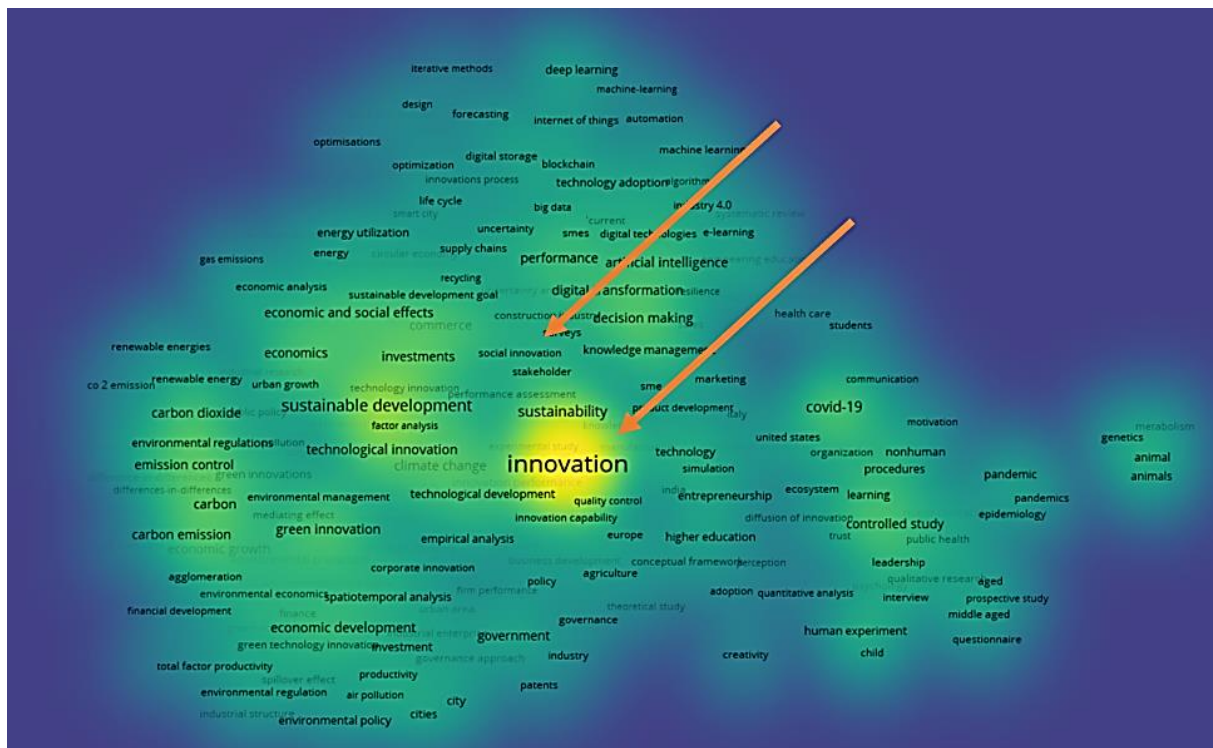


Figure 1. Result from VoSviewer (innovation and social innovation).

The preparation of the database for the *social innovation* issue was then repeated. The procedure as before was adopted. Figure 2 presents the connections occurring between the social innovation issues and other keywords. Three main research areas (thematic clusters) were identified and color-coded in the figure: related to entrepreneurship, sustainability and social impact (in conjunction with the issue of higher education – (Belcher et al., 2022; Greene, 2022; Otten et al., 2022). Keywords such as third sector, social capital, social entrepreneurship, social

enterprise appeared in the field of entrepreneurship. The number of occurrences of a given keyword and the strength of its associations are included in Table 2.

Based on the analysis, we can conclude that:

- The issues of innovation and social innovation are topical matters.
- The issue of innovation is a concept more often analyzed by researchers than social innovation.
- Currently, the issue of social innovation is analyzed within the framework of three main research areas: entrepreneurship, sustainable development and social impact (in conjunction with the issue of higher education).

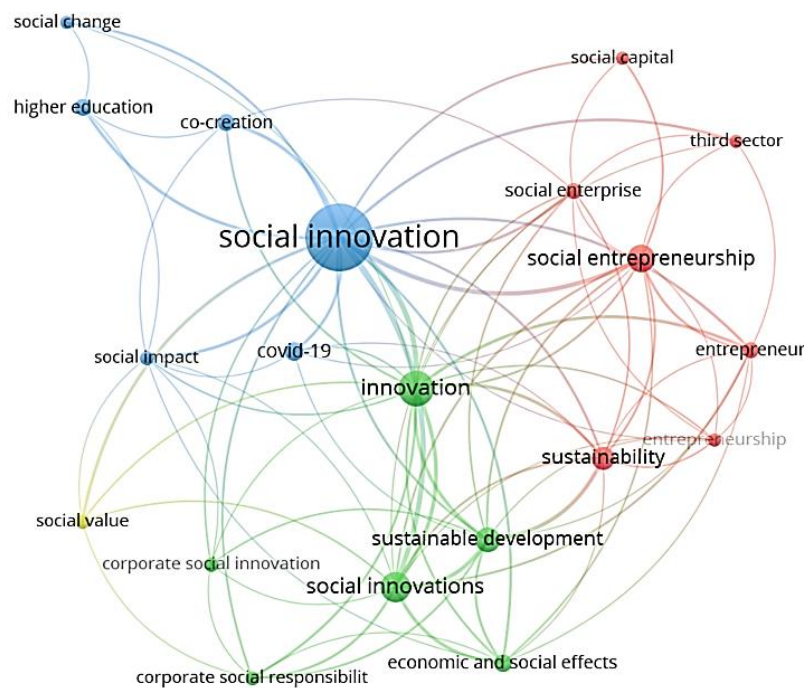


Figure 2. Result from VoSViewer (social innovation).

Table 2.

Number of occurrences of a keyword and the strength of its links by thematic clusters

Name of thematic cluster	Keyword	Number of occurrences	Strength of links
Entrepreneurship	Social entrepreneurship	21	37
	Sustainability	15	32
	Entrepreneur	7	23
	Social enterprise	7	17
	Entrepreneurship	5	10
	Third sector	5	9
	Social capital	5	7
Sustainable development	Social innovation	126	113
	Innovation	36	70
	Sustainable development	18	46
	Economic and social effects	9	24
	Corporate social responsibility	6	17
	Corporate social innovation	6	8

Cont. table 2.

Social impact	Social innovations	25	59
	Social impact	6	15
	Co-creation	8	13
	Covid-19	10	11
	Higher education	8	9
	Social change	5	6

Table 3 shows selected publications in the field of entrepreneurship. The analysis of the publications shows the diversity of the methodology of the research conducted. The authors perform quantitative research using a survey questionnaire (Sanzo-Pérez et al., 2022; Zajda, 2022), but also qualitative research based on case studies (Sacchetti, 2022; Scuotto et al., 2022). The authors focus on NGOs (Morrar, Baba, 2022) or social enterprises (Scuotto et al., 2022), or their partnerships (Sanzo-Pérez et al., 2022; Sacchetti, 2022).

Scuotto et al. (2022) investigate how social entrepreneurship organizations adapt their business model to develop social innovation. Sanzo-Pérez et al. (2022) noted "the barriers social enterprises face to gain access to traditional sources of funding are pushing them to reinforce their business models and rely more on commercial activities". Sacchetti (2022) and Tuckerman et al. (2022) pay attention to the problem of development of the organization in social and financial terms. Sacchetti (2022) indicated that organizational capabilities enable social enterprises to pursue social objectives and sustainable sources of revenue. Tuckerman et al. (2022) pointed that "sharing social innovation information across organizational boundaries are complicated by the dual bottom line of social impact and financial sustainability".

Table 3.

Selected research results from the field of entrepreneurship

Authors	Methodology/approach	Purposes/main findings
Kusioi, Kudelko, Borges, Delic, Stroila (2022)	Comparative analysis (multi-case method) in five European rural regions: Croatia (Slovenia), Germany (Münsterland, Saxony-Anhalt), Poland (Małopolska), and Portugal (Alto Minho).	The aim of the article is to investigate societal and economic challenges and their innovative solutions. The comparative analysis reveals that most essential activities aimed at alleviating the development problems of rural areas include education of local communities, improvement of economic and digital infrastructure, activities supporting production and promotion of local products, promotion of cooperation between local communities and producers, and stronger orientation of local policy towards financial support of production enterprises and farms.
Morrar, Baba (2022)	Qualitative research. 24 semi-structured interviews with Palestinian NGOs.	The authors focus their discussion on the challenges that social innovators are facing in their endeavor of solving wicked social problems within an extreme institutional environment. The authors theorize three barriers that hinder social innovation in such contexts: institutional trap, effectiveness trap and sustainability trap.

Cont. table 3.

Sacchetti (2022)	Case study analysis: consortium of 22 organizations that operate under the umbrella of Harmony, the fictional name of a WISE founded in Veneto, Italy.	This study investigates which organizational capabilities (OC) enable Work Integration Social Enterprises (WISEs) to pursue both social objectives and sustainable sources of revenue. It does so by focusing on the nature and use of OC that support both the social and the economic sustainability of this type of enterprise.
Sanzo-Pérez, Rey-García, Álvarez-González (2022)	Survey: a sample of 80 social enterprises partnering with nonprofits in Spain.	The barriers social enterprises face to gain access to traditional sources of funding are pushing them to reinforce their business models and rely more on commercial activities. Authors attempt to analyze whether partnerships between social enterprises and nonprofits strengthen accountability to beneficiaries without hindering accountability to other stakeholders, thus allowing both social and economic objectives to operate together.
Scuotto, Cicellin, Consiglio (2022)	Multiple comparative case studies and narrative analysis. Social entrepreneurship organizations in Italy.	This paper analyses how social entrepreneurship organizations adapt their business model to develop social innovation. By developing a conceptual framework, the paper enhances current understanding of the social dimensions of social entrepreneurship organizations' business model.
Tuckerman, Roberts, Whittam (2022)	Qualitative case studies with Scottish social enterprises. The researcher undertook participant observation for a year as well as conducting interviews and reviewing documents of the case study organizations.	Authors found that the approaches of sharing social innovation information across organizational boundaries are complicated by the dual bottom line of social impact and financial sustainability. While sharing for free can escalate social impact, sharing for a fee can bring much needed income but restrict access to knowledge.
Zajda (2022)	Survey of 400 rural NGOs from Poland.	What features distinguish NGOs that are experienced in implementing social innovation? NGOs implementing social innovation are distinguished by: <ul style="list-style-type: none"> • cooperation with other organizations and public institutions; • human and financial resources.

2. Research methodology

The results of the analysis of scientific publications in the field of management science indicate the need to continue research in the field of social innovation. The research is part of the study area related to social entrepreneurship. The purpose of this paper is to present a practical example from the field of social innovation implementation. The study was conducted by desk research, interview and observation. The analysis of the documentation of the studied organization included the Articles of Organization, the completed *Competition Form*, the *Implementation Agreement* and project documentation. Information contained in the National Court Register, the Association's website and social media was analyzed. In July 2022, an unstructured interview was conducted with members of the Board of Directors regarding the

goals of innovation implementation and the Association's development directions. In September 2022, an open observation was carried out to identify how the geriatric simulator works. An interview was conducted with a user (a volunteer teenager) regarding his feelings and impressions of using the product.

3. Characteristics of the organization and its activities

Association

The Stowarzyszenie na Rzecz Rozwoju Społeczności Lokalnej “Mocni Razem” (Association for Community Development "Strong Together") obtained entry in the Register of Associations in 2012. It bases its activities on the community work of the Association's members and volunteers, it also employs employees and contractors (Articles of Association).

The vision of the organization is contained in the phrase: "The Association supports and develops pro-social attitudes and civic activity. It creates change and gives COLOR to local communities." The mission is: "Supporting individuals and communities to develop, create reality, change themselves and the world for the better" (Own website...).

The association's statutory objective is *cultural, physical culture and sports, charity, health care and social welfare activities*. The statutory objectives include *assisting residents in acquiring knowledge and qualifications to perform social and professional functions in society, activating and integrating the local environment, supporting the social activity of residents, including, inter alia, such social groups as the disabled, the unemployed, children and youth, seniors and other social groups requiring support due to difficult life or material circumstances*. The association pursues its goals by, among other things: *creation and implementation of programs, activities aimed at the needs of residents, education and improvement of social skills, cooperation with local government institutions, social and economic entities, implementation of projects financed from domestic and foreign sources*. (Articles of Association).

Sources of funding

The association conducts unpaid and paid public benefit activities, as well as business activities (Table 1). In 2021, it obtained registration in the Register of Entrepreneurs. The Association's sources of funding are: membership fees, donations, bequests, inheritances, funds from public generosity and sponsorship and public collections, grants, deposits, subsidies, and income from paid and business activities. Paid activities include, among others, organization of fairs, exhibitions, congresses, staging of artistic performances, production activities related to films, videos. Economic activities include, among others, extracurricular

forms of education, activities of tourism organizers, publishing of books. The provisions of the organization's charter do not allow for the distribution of income from economic activities among members. The surplus of income over expenses is allocated to public benefit activities (Articles of Association; Financial statements; Czerwińska-Lubszczyk, 2022).

On the basis of the income statement for 2019 to 2021, a summary of the share of each funding source in the Association's total revenue was prepared. Income from unpaid activities accounts for the largest share. Grants from European funds are the most important in the financing of the Association. In 2021, funds from grants from the budget of the municipality - the City of Katowice, as well as from business activities appeared (Financial Statements).

Table 4.
Selected data from the Association's financial statements

Item		Share in total revenue		
		2019	2020	2021
1.	Revenue from unpaid public benefit activities, including:	98,36	96,75	98,35
	Grants from the municipal budget	-	-	0,26
	Grants from European funds	97,65	93,59	95,72
	Donations from individuals	0,11	0,31	0,03
	Donations from legal entities	0,47	2,72	2,16
	Membership fees	0,13	0,13	0,18
2.	Revenues from paid public benefit activities	1,64	3,25	0,18
3.	Revenues from economic activity	-	-	0,91
4.	Other revenues	0,00	0,00	0,56
Total		100 %	100 %	100 %

Activity

Over the ten years of its activity, the Association has implemented 19 projects, including eight from EU funds and one from the EEA Funds, targeting the needs of Katowice residents.

Since 2016, the Association has been active in Katowice's Zawodzie district, where it has its headquarters. In the district, in cooperation with the city of Katowice, EU projects are implemented, as well as its own original activities. Together with the residents, the Path of Good Thoughts (opposite the Transfer Center), the Sports Pedestrian Street for Children (next to the Sports Center), three murals were prepared in Zawodzie, and a Christmas tree appeared, which had never been present in the district before. Many intergenerational events were organized. A Moms' Club, a Volunteer Club and a Resident's Club were run. The association supports residents in writing local initiatives (Press materials...).

Since its inception, the association has also been associated with Szopienice. In 2019, the Youth Animation Center was launched. A space for the development of meetings, events. The Center was created through cooperation with the city of Katowice, using EU funds and the association's own funds. It hosted a Moms' Club, a Teenager's Club, an advice point for parents and young people. Many events were organized. In recent years, young people from the Center have carried out as many as 10 initiatives for the benefit of the local environment. In Szopienice, among others, a heart for caps, a motivational ladder, a mural of wings (on the

facade of the school building) were created on their initiative, and the Festival of Crazy Raccoons was held (Press materials...).

The Association directs a lot of activities to young people by engaging in volunteerism, implementing youth initiatives, trainings, workshops. In 2022 alone, as many as 56 volunteers worked with the Association, and this has been the case continuously since the association's inception. For many years, a fire dancing youth group was active at the association, with volunteers (Press materials...).

The association is oriented towards sharing knowledge and experience. In 2018, the seminar Strongmen with Strong Together - about making changes in oneself, in people and in local communities was organized in cooperation with the National Forum of Local Community Organizers and the Center for Supporting Local Activity - CAL from Warsaw. Study visits are received, trainings are conducted, meetings with students, internships and apprenticeships are carried out (Press materials...).

4. Social Innovation

Funding

The innovation was financed within the framework of the "Competition for the implementation of an innovation, improving work in a non-governmental organization" addressed to NGOs from the Silesian province. The organizer was the Forum of Non-Governmental Organizations of the Western Subregion and the ASK Cultural Association. The Forum of Non-Governmental Organizations of the Western Subregion is a voluntary agreement of autonomous NGOs. It has legal personality as a Union of Associations (Statut Federacji...). It is engaged in supporting NGOs, educating on the functioning and management of organizations, promoting their activities and representing them before the public administration (Rewolucja technologiczna w...). The activity was carried out as part of the project "Technological Revolution in the 3rd Sector" funded by the National Institute of Freedom – Center for Civil Society Development within the framework of the NOWE FIO Civic Initiatives Fund Program for 2021-2030. The project aims to "increase the level of knowledge and skills among representatives of Silesian NGOs in the use of new technologies, new tools and new methods to improve the quality of management and functioning of the organization - thus increasing the efficiency of work and institutional stability". A minimum of 50 people representing a minimum of 30 organizations should be directly supported. As part of the project, workshops were held to improve competencies and skills, counseling was offered, and educational and informational campaigns were conducted. In addition, an e-book will be

developed including recommendations and know-how on modern organizational management (Rewolucja technologiczna w...).

For the purposes of the competition, innovation was defined as *changes in the way the NGO operates, its products and services; changes in work organization, management, communication. These changes are intended to rationalize the functioning of the organization, adapt to changing legislation, requirements from customers, the market, etc.* The purpose of the Competition was to select the most interesting innovation that improves work in a non-governmental organization from the Western subregion of the Silesian Voivodeship. The main prize was the implementation of an innovation worth a maximum of PLN 15,000 (Rewolucja technologiczna w...).

The concept of innovation

The Association's goal was to "introduce a social innovation, one that brings about a change in people's thinking, their perception of reality, changes their social attitudes towards the elderly" (Formularz konkursowy...). In its resources, the organization has psychologists, educators with experience in conducting educational meetings, which are the practical part of the innovation.

The concept of the innovation is based on bringing the world of senior citizens closer to young people, including groups of volunteers, interns, students, through the purchase of an old age simulator and conducting educational meetings.

Faced with the problem of an aging population, understanding the functioning of this age group determines the creation of optimal forms of support adapted to their needs and limitations. The innovation is part of the activities that the Association has been carrying out for many years in the field of activating seniors and the local community, emphasizing intergenerational activities. From 2014 to 2022, the Association implemented 4 projects whose beneficiaries were seniors. Young people, among other volunteers, are involved in activities for people 50+. Caregivers describe to them the functioning of the elderly, their limitations and possibilities. However, "description is not the same as opportunity to experience", especially in the form of play. The innovation will allow those working with seniors to "understand" and adapt forms of support to their needs.

Implementation of innovation and its impact on the development of the organization

The stages of implementation of the innovation included: purchase of old-age simulators, development of a scenario for educational meetings on the specifics of senior age with the use of old-age simulators, training with the use of old-age simulators of the association's staff and volunteers, information (promotional) campaign. Activities were implemented from June 2022.

A geriatric simulator (old-age simulator) was purchased. Equipment of this type is used by universities and medical industry organizations. The simulator replicates the changes associated with old age. The equipment comes with solutions for adjusting the simulator or using its parts to the physical conditions of the participant. The set allows adapting its elements to the weight, height and age of the user, which makes it possible to be operated by children, adolescents, adults and even seniors. Elements of the simulator allow one to feel the dysfunctions afflicting the elderly. The kit consists of, among other things: goggles that limit vision, earmuffs that limit hearing, a collar that reduces neck mobility, arm and leg weights, elbow and knee joint braces, and prosthetic limbs that limit mobility.

The effects of implementing the innovation include the development of the organization in the following dimensions:

Social: improving the competence of employees, contractors, interns, trainees, volunteers in the field of functioning of senior citizens.

The Association hires employees and contractors. It cooperates with Universities by acquiring interns and trainees. It brings together volunteers (56 people in 2022). The Association extends support to the local community in its projects (171 people in 2020-2022). The innovation will influence the worldview of the people involved, draw their attention to the problems of the elderly.

Financial: expanding service offerings to include educational meetings using an old-age simulator.

The most important source of funding for activities in 2019-2022 was public funds (from EU funds). Paid and economic activities accounted for a small share of the organization's total revenue (less than 5%). The innovation is an important element in the economization of the Association's activities. A service will be prepared, the revenues from which will feed the organization's budget. This will be one of the elements of the strategy to diversify the organization's sources of funding in 2023 and beyond.

5. Summary

The results of the analysis of current scientific publications in the field of management science indicate the need for continued research in the field of social innovation. The present work is an attempt to respond to this need. The publication is part of the research area related to entrepreneurship associated with issues such as the third sector, social capital, social entrepreneurship, social enterprise. The study covered an association - an organization belonging to the third sector of the economy. The association adopts goals of a social nature, and at the same time functions in accordance with market rules, conducting paid and economic activities in addition to unpaid activities.

The purpose of the study was to present a practical example from the field of social innovation implementation. The effects of implementing the innovation include the development of the organization socially and financially. The innovation will contribute to increasing the competence of people associated with the organization: employees, contractors, interns, trainees, volunteers in the field of functioning of senior citizens. The innovation is also an important aspect in the economization of the Association's activities as part of a strategy to diversify the organization's funding sources.

Limitations of the conducted research may concern both literature analysis and empirical research. Limitations of the literature analysis may be related to the assumptions made, e.g.: the analysis included English-language publications only from the Scopus database, the results were limited to open access publications. Finally, due to the limitations of the VOSviewer program, 2000 selected publications were analyzed. In turn, the empirical research was carried out with the help of a qualitative method - a case study. The results of the research are related to the specifics of the operation of the particular entity studied.

The conducted literature analysis opens the possibility of conducting in-depth research in the field of bibliometric analysis in the area of social innovation. An interesting direction of empirical research seems to be to conduct quantitative research in the field of social innovation and its impact on the development of organizations.

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THE IMPACT OF HOSPITAL MATERIAL INFRASTRUCTURE ELEMENTS AND HOSPITALIZATION QUALITY IN THE OPINION OF PATIENTS

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Purpose: Identification of infrastructure attributes that are crucial for achieving patient satisfaction.

Design/methodology/approach: Based on a literature review, an initial set of infrastructure elements (attributes) determining the level of patient satisfaction with hospitalization was identified. In the empirical part, these attributes were verified in two ways: through surveys conducted in a selected hospital and through research based on the Kano methodology (CAWI method).

Findings: It was found that the availability and cleanliness of sanitary rooms, markings of hospital units and communication routes, and facilities for people with disabilities significantly influence the level of satisfaction with hospitalization. There were indicated some areas in which the managers of the studied hospital could make some improvements. For example, an attribute where changes could be recommended is I5 - facilities for people with disabilities.

Research limitations/implications: The publication presents the results of the literature review, which can be expanded in further research on the topic discussed. However, this study is limited to the relatively small group of patients and respondents who participated in surveys. These limitations concern also the geographical area and the number of hospital facilities, which suggest possible directions for future research.

Practical implications: The results of the study may have practical applications in the area of hospital management. Satisfaction surveys completed by patients from various hospitals will identify the infrastructure elements with the lowest patient satisfaction. Therefore, they may constitute the basis for developing guidelines to improve satisfaction with hospitalization. Additionally, the Kano methodology indicates which attributes are most important to patients.

Social implications: Introducing changes in the areas of infrastructure elements indicated in the study may result not only in increased patient satisfaction with the hospitalization process, but also in a real improvement in the conditions in which patients stay. This may be important for their well-being and could influence the recovery process.

Originality/value: The article presents two-track research conducted among the public and actual patients of a provincial public hospital. The methodology prepared in this way can be helpful for hospital managers because it provides insight into social expectations and the actual assessment of the examined infrastructure attributes.

Keywords: hospital infrastructure, management, patient satisfaction, Kano method.

Category of the paper: Research paper.

1. Introduction

The main goal of the activity of hospitals is providing medical care to the patients. Despite visible changes in hospitalization over recent years, driven by increasingly higher standards and requirements of medical care, entities such as hospitals must constantly ensure the quality of the services provided. This is confirmed by numerous studies in this field (Haller, Quenon, 2014; Marley et al., 2004). Hospitalization however, regardless of whether planned or emergency, is often associated with some mental discomfort for the patient. The hospitalisation itself, even if it is not related to surgery or procedure, but rather to regular health check-up, can be stressful. Obtaining patient satisfaction with the hospitalization process is therefore a difficult task and depends on many factors (Gavurova et al., 2020; Marcinów, Olejniczak, 2011), which can be binded into certain groups. The first is the quality of medical care and the general atmosphere. The important things are: accuracy of diagnosis, effectiveness of treatment, professionalism and politeness of medical staff, as well as assessment of non-medical staff, perception of technical medical skills and access to a medical centre (Salomon et al., 1999; Meesala, Paul, 2018). Another factor is communication between the patient and medical personnel, which should be effective, clear and maintained at a high level (Fortin, 2002; Moslehpour et al., 2022). Many researchers also refer to the availability of personnel and information (Keller et al., 2014; Lang, 2012; Gabryšová, Ciechomski, 2023) as one of the factors influencing patient satisfaction. Another group of factors is the patient's comfort (reflected primarily in cleanliness and appropriate accommodation conditions). Other researchers also mention factors such as waiting time for tests, consultations, and treatments, or even respect for patient rights (Xie, Or, 2017; Eilers, 2004; Kravitz, 2001). However, the group of factors that is least flexible due to the difficulties in implementing changes and high costs is infrastructure. It is also the least frequently described area in the literature, and at the same time it influences the level of patient satisfaction. As Islam and Habib (2023) note, the development of hospital infrastructure is a key element in achieving sustainable development in hospital supply chain management and ensures long-term financial stability and improved patient care.

Therefore, it becomes necessary to indicate the attributes of the hospital infrastructure that are important in the opinion of patients, and translate them into the level of satisfaction with the hospitalisation. A research problem was formulated regarding identifying public opinion on the importance of selected attributes related to hospital infrastructure. The goal of this study is to identify the infrastructure attributes that are crucial for achieving patient satisfaction during

hospitalization and to indicate those, improvement of which can increase the level of patient satisfaction. Therefore, the following research hypothesis was formulated: Elements of hospital infrastructure determine the level of patient satisfaction.

Verification of the hypothesis and achievement of the research goal allowed for indicating the directions of changes in the area of infrastructure.

Achieving the assumed goal required conducting survey research. Most studies in the field of patient satisfaction refer to the issue of the quality of medical services, including hospital services, usually on the base of selected method, e.g. SERVQUEL (Hekmatpou et al., 2012; Došen et al., 2020), or Kano (Materla et al., 2019; Christoglou et al., 2006; Priyono, Yulita, 2017). In this study, we decided to examine the impact of elements of hospital infrastructure identified on the basis of a literature review and focus meetings with representatives of a selected health care unit. The focus group study was carried out on 6 February 2023 at the Blessed Virgin Mary Regional Specialist Hospital in Czestochowa. The focus study involved 10 patients whose health condition allowed for this type of action. Patients were randomly selected but differed in gender, age, and education. The focus study was conducted by one of the authors of this study. The result of this meeting was a list of hospital infrastructure attributes, the importance of which was verified in a further stage of the main study.

The main research consisted of two parts and was conducted in several stages. Two different survey questionnaires were developed. One of them was made available to patients of the research entity - a general hospital located in the Silesian Voivodship. In this part of the study, patients assessed individual attributes on an ordinal scale. The second questionnaire - based on the KANO methodology - was posted on social media. In this case, anyone with a link to the survey could be a respondent. This part of the study aimed to determine the importance of individual infrastructure attributes. The results of both studies were compared and then analysed. On the base of the analyse, we identified the areas of greatest importance for public opinion and the areas requiring improvement.

2. Material infrastructure and quality of hospitalization - literature review

Undertaking research in the area of assessing patients' level of satisfaction determined by the infrastructure provided by the hospital was possible after a prior review of the literature on the quality of hospitalization. The researchers used the ScienceDirect database in order to identify key research works. It was found, that approximately over 21,000 English-language studies dating from 2010-2023 in the field of hospital patient satisfaction exist in open access, and the number of review articles alone is almost 3000. Published work shows that patient satisfaction is an important outcome that is considered a determinant of quality of care (Asamrew et al., 2020). Many factors influence patient satisfaction in hospitals. For example

Hekmatpou et al. (2012) showed that there are significant differences between patient expectations and perceptions of quality in teaching hospitals, with accessibility being the most serious issue. Another study (Sarwar, 2014) conducted a qualitative study in Malaysian private hospitals and identified cost and location, quality of patient care, and facility accessibility as important aspects of health care service quality. Other researchers (Sharmila, Krishnan, 2013) focused on private corporate hospitals and found that physicians generally cared for their patients, but noted some discomfort with the quality of patient services. The study presented by Došen et al. assessed the quality of healthcare services in a public university hospital in Croatia and highlighted the need for improvement in dimensions such as responsiveness and tangibility. The researchers showed that patients prioritize the quality of medical care, the polite attitude of personnel, and a comfortable hospital environment. Shareef et al. (2020) research identified areas such as front desk personnel, nursing care, housekeeping, doctor-patient interaction, and pharmaceutical services as important to patient satisfaction. In turn, Asamrew et al. (2020) emphasized the importance of doctors' services, availability of laboratory and pharmacy services, pain management, and facility amenities. Other researchers (García-Alfranca et. al., 2018) point to the importance of timely response and case resolution in pre-hospital emergency services. Overall, this work indicates that patient satisfaction is influenced by factors such as quality of care, personnel behavior, facility cleanliness, and efficient provision of the service.

In the next step, the search for studies was narrowed to those focusing on the connection between hospital infrastructure and patient satisfaction. After defining the key term "patient satisfaction", narrowing the research period to 2010-2023 and entering the term "hospital infrastructure" in the field containing title, abstract or author-specified keywords, the result was 215 studies (Table 1). About a quarter of these studies is published under open access and open archives rights, and these are the focus of this work. Among the studies identified at this stage, it was discovered that many of them concerned equipping hospitals with IT infrastructure systems used in the work of personnel, therefore they were excluded from the research. Studies that did not fit were also excluded from the review, including, for example, studies on job satisfaction of medical personnel or management of hospital pharmacy activities.

Table 1.

Number of included papers in the research

Patient satisfaction	number of papers
Hospital infrastructure (2010-2023)	215
Open access and open archive	59
Open access - excluded papers	39
Reasons: IT infrastructure, job satisfaction of staff, others	
Results	20
Open access - Included papers	

Source: Own study.

The works qualified for the study show that hospital infrastructure has a significant impact on patient satisfaction (Nyundo et al., 2023; Hamed, Salem, 2014). Mariano et al. (2022) indicate that in order to improve the perception of the overall quality of care, it is necessary to provide appropriate infrastructure and equipment in health centres. The Triyono 2020 study found that competencies and infrastructure have a significant impact on patient satisfaction in a health centre. Amankwah et al. study (2022) showed that the quality of health care infrastructure and equipment influences the connection between health care delivery and patient satisfaction. Rafik 2021 showed that the quality of hospital services and facilities significantly affects patient satisfaction. Yakin 2022 found a positive correlation between physical facility infrastructure and patient satisfaction in the context of Covid-19 patients. The researchers also pointed to elements related to hospital infrastructure such as: hygienic atmosphere (Liang et al. 2021; Shah et al., 2021; Liu et al., 2021), less noise, more natural light, guest-friendly amenities, room furnishings and hotel-like atmosphere (Hwang et al., 2020), condition of waiting rooms and consultation rooms (Nuri et al., 2019), physical comfort and privacy of the patients (Andres et al., 2019; Akthar et al., 2023). Overall, these studies highlight the importance of maintaining and improving hospital infrastructure to increase patient satisfaction. The literature on the subject also includes studies using the Kano model to classify and improve customer requirements in the context of hospitals and healthcare infrastructure (Shahin, Akhaskeh, 2017, Santhoshkumar et al., 2022). Materla 2019 conducted a systematic literature review and highlighted the potential of the Kano model to improve the quality of healthcare services and understand customer needs. Christoglou 2006 applied the Kano model to the study of the quality of patient service and identified the importance of personal knowledge, employee politeness and instilling trust. Priyono 2017 study integrated the Kano model with quality function implementation to identify service attributes and improvement strategies in the hospital front office. The cited studies confirm the possibility of using the Kano model in understanding and increasing customer requirements in hospitals and infrastructure.

3. Methodology of the research

The study aimed at checking how elements of hospital infrastructure affect the level of patient satisfaction was carried out in several stages. The study process is presented in Fig. 1.

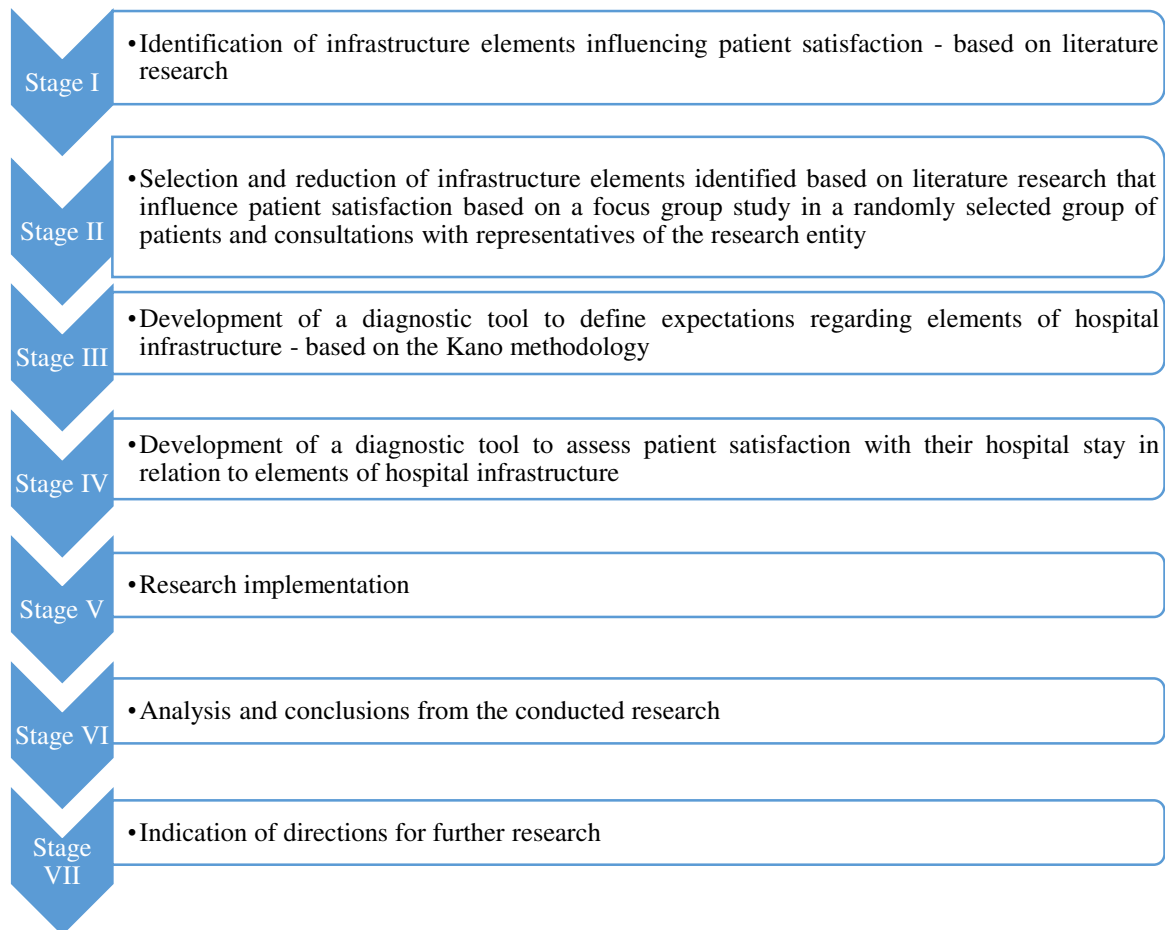


Figure 1. Stages of the research procedure.

Source: Own study.

During the focus group study being the next step in the research procedure, factors related to hospital infrastructure identified at the stage of literature research were limited to crucial factors, and were additionally supplemented in areas not indicated in the literature review. The focus group study was carried out in February 2023 at the Internal Medicine Unit of the Blessed Virgin Mary Regional Specialist Hospital in Czestochowa. The study involved 10 patients of different gender, age and education.

The effect of the focus group study was a list of factors determining the level of patient satisfaction, which was the basis for preparing two research tools for two separate parts of the study:

- a survey questionnaire identifying expectations regarding elements of hospital infrastructure (KANO),
- a survey questionnaire assessing satisfaction with the hospital stay in relation to elements of hospital infrastructure.

The study distinguished the following elements of hospital infrastructure (further referred to as attributes): hospital room equipment (I1), cleanliness of the hospital room (I2), availability and cleanliness of sanitary rooms (I3), marking of hospital units and communication routes (I4), facilities for people with disabilities (I5) and the availability of a rest and relaxation area (I6).

The first part of the study, including the first questionnaire, was based on the Kano methodology, which helps to understand and classify customer expectations regarding products or services, in this case respondents' expectations regarding the hospitalization process. The surveys were collected using the CAWI (Computer-Assisted Web Interview) method, and responses were obtained from 212 respondents who were provided with a link to the form via social media. In this case, the respondents did not have to be patients of the hospital selected for the study. The important part was their assessments of selected attributes influencing the perception of the quality of hospital services. An example of a question regarding the I1 attribute is presented in Table 2.

Table 2.
An example question related to attribute I1

I1. Hospital room equipped with ergonomic equipment, including furniture with the possibility of storing personal belongings and eating meals, a system for calling for personnel's assistance, and others									
1a. What if it is the case? (functional form of the question)					1b. What if it is not the case? (dysfunctional form of the question)				
like it	expect it	don't care	live with it	dislike it	like it	expect it	don't care	live with it	dislike it

Source: Own study based on Kano's Methods.

Then, in accordance with the Kano methodology guidelines, respondents' answers regarding the distinguished infrastructure attributes were assigned to a specific type, i.e.: Q – Questionable, A – Attractive, R – Reverse, I – Indifferent, O – One-dimensional and M –Must-be (table 3).

Table 3.
Kano evaluation table

Requirements		Dysfunctional				
		Like it	Expect it	Don't care	Live with it	Dislike it
Functional	Like it	Q	A	A	A	O
	Expect it	R	I	I	I	M
	Don't care	R	I	I	I	M
	Live with it	R	I	I	I	M
	Dislike it	R	R	R	R	Q

Source: Own study based on Kano's Methods.

The existence of correlation between a given infrastructure attribute and patient satisfaction was checked using the coefficients of satisfaction (CC) and patient dissatisfaction (DC) - in accordance with the formulas proposed by Berger et al. (1993):

$$CC = (A+O)/(A+O+M+I) \tag{1}$$

$$DC = (O+M)/(A+O+M+I) \tag{2}$$

The satisfaction coefficient (CC) can range from zero to one. The higher the CC value, the greater the impact of a given attribute on patient satisfaction. Value of the dissatisfaction coefficient (DC) close to one means that the patient is dissatisfied with a given attribute (Berger et al., 1993; Matzler, Hinterhuber, 1998).

The second part of the study was carried out in the general hospital operating in the Silesian Voivodship. The selected study entity consists of two main hospital units, including 32 departments enabling the hospitalization of over 800 patients at the same time. The hospital also performs the so-called one-day admissions or procedures not exceeding one day that do not require hospitalization. In this case, the infrastructure attributes were rated by patients on a five-point scale, where a score of 1 meant that the patient was very dissatisfied and a score of 5 meant that the patient was very satisfied. In this case, statistical analysis of the study results was performed using IBM SPSS Statistics 28, PS IMAGO PRO 8.0 software.

4. Results

In the first part of the study, based on the KANO methodology, in July and August 2023, responses were obtained from 212 respondents. In the second part of the study, 147 forms were collected from patients of the selected hospital. Responses from patients of the selected hospital were also collected from July to the end of August 2023. The characteristics of the respondents in both studies are presented in Figures 2a and 2b.

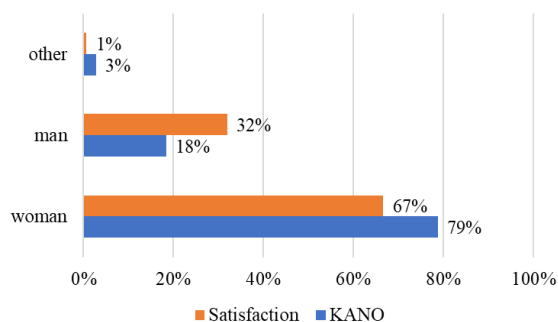


Figure 2a. Respondents gender.

Source: Own study based on empirical research.

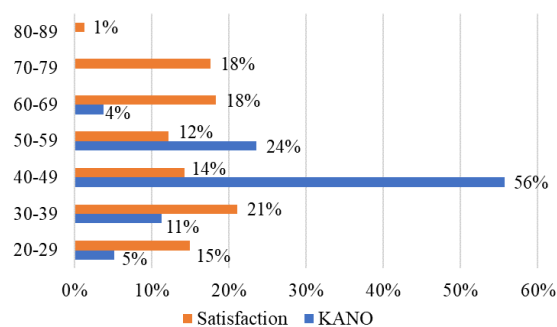


Figure 2b. Respondents age.

Source: Own study based on empirical research.

Analysing the distribution of answers in the context of gender, it can be noticed that in both studies the largest groups of respondents were women (67% of hospital patients and 79% of Kano survey respondents). In the case of an online survey, such high level of participation of women can be explained by the fact that women are more willing to take steps to complete the questionnaire and are more active social media users. Such high participation of women in the study conducted in the hospital was influenced by the specificity of the departments where the completed questionnaires were collected (Fig. 3a-b). Moreover, the average age of hospital patient respondents was much higher than that of online respondents and was over 50. The share of patients in the hospital study in the age group 60 and over was 37%.

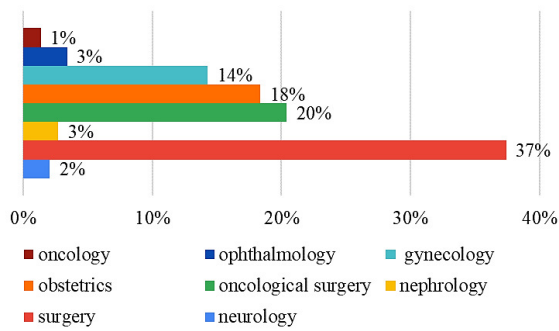


Figure 3a. Hospital's patients.

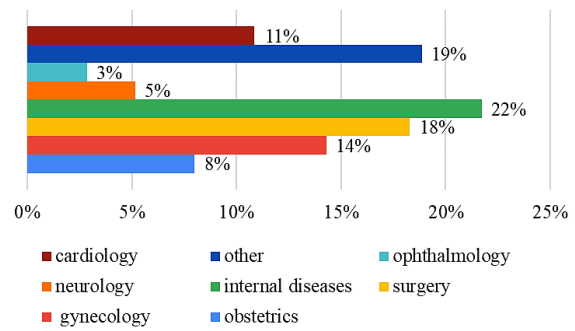


Figure 3b. Kano respondents.

Source: Own study based on empirical research.

Source: Own study based on empirical research.

Analyzing the distribution of answers given by hospital patients in the context of the ward where they were hospitalized, it can be noted that a total of 32% of respondents were obstetrics and gynaecology patients, i.e. wards typically dedicated to women. Other branches in the online survey included: rheumatology, otolaryngology, rheumatology, allergist, children's, covid and rehabilitation.

The next step of the study (stage VI) was the analysis of the results obtained in the survey. According to the Kano methodology, for each of the 6 attributes (I1 - hospital room equipment, I2 - cleanliness of the hospital room, I3 - availability and cleanliness of sanitary rooms, I4 - marking of hospital units and communication routes, I5 - facilities for people with disabilities and I6 - availability of a rest and relaxation area), the statistics of the answers provided by the respondents were analyzed (Table 4).

Table 4.

Response statistics from respondents according to Kano methodology for attributes I1-I6

Attribute	M	O	A	I	Class	CC	DC
I1	15%	17%	33%	34%	I	0.51	0.33
I2	19%	17%	30%	34%	I	0.47	0.36
I3	21%	29%	31%	19%	A	0.60	0.50
I4	23%	25%	32%	21%	A	0.56	0.47
I5	19%	22%	32%	27%	A	0.54	0.41
I6	8%	6%	36%	50%	I	0.42	0.14

Source: Own study based on empirical research.

Kano's analysis shows that 3 attributes: I3 (accessibility and cleanliness of sanitary rooms), I4 (marking of hospital units and communication routes) and I5 (facilities for people with disabilities) were classified as class A (Attractive). This means that these attributes are most important for achieving a state of satisfaction among respondents. This is confirmed by satisfaction coefficient (CC), the highest level of which - 0.6 - was recorded for the I3 attribute. In turn, the remaining attributes, i.e. I1 (hospital room equipment), I2 (cleanliness of the hospital room), and I6 (availability of the rest and relaxation area) were classified as class I (Indifferent), meaning a neutral state. Interpreting the results, it can be concluded that respondents perceive the advantages of these attributes to a moderate extent. Therefore, these attributes will not have a significant impact on patients' feeling of satisfaction or

dissatisfaction. This is confirmed by the satisfaction coefficients (CC), where the values for this set of attributes are in the range of 0.42-0.51.

The next step in this stage was the statistical analysis of the results of the survey conducted in the hospital selected for the study (table 5).

Table 5.
Basic statistics for attributes I1-I6 in patients' responses

Statistics		Attribute					
		I1	I2	I3	I4	I5	I6
Mean		4.42	4.70	4.59	4.49	4.38	3.72
Median		5.00	5.00	5.00	5.00	5.00	4.00
Mode		5	5	5	5	5	5
Standard deviation		.829	.645	.835	.912	.967	1.464
Sample variance		.687	.417	.696	.831	.934	2.145
Skewness		-1.671	-2.258	-2.245	-1.752	-1.634	-.851
Standard error of skewness		.201	.200	.200	.201	.208	.209
Kurtosis		3.215	4.643	4.612	2.161	2.226	-.708
Standard error of kurtosis		.399	.397	.397	.399	.413	.416
Minimum		1	2	1	1	1	1
Maximum		5	5	5	5	5	5
Meter		146	147	147	146	136	134
Percentiles	25	4.00	5.00	4.00	4.00	4.00	3.00
	50	5.00	5.00	5.00	5.00	5.00	4.00
	75	5.00	5.00	5.00	5.00	5.00	5.00

Source: Own study based on empirical research.

The average scores for most attributes (I1, I2, I3, I4, and I5) are quite high, suggesting that respondents are generally satisfied with these elements of the infrastructure of the hospital environment. The highest average rating is 4.70 for I2, which means that the cleanliness of the hospital room is rated the highest. The skewness is negative for all features, indicating that rating distributions are skewed towards higher values and most respondents rate these features at higher levels of satisfaction. The median values for most features are 5, which suggests that the middle value of the rating distributions is the highest, meaning that many people gave the maximum ratings. The standard deviation is relatively low for most characteristics, which means that the ratings are close to each other and have little variability. Kurtosis varies by attribute, but in most cases it is greater than 3, which suggests that the distributions of scores are more skewed than a normal distribution.

5. Conclusion and summary

The study identified six important attributes related to hospital infrastructure: hospital room equipment (Mariano et al., 2022; Hwang et al., 2020), hospital room cleanliness (Liang et al., 2021; Shah et al., 2021), availability and cleanliness of sanitary rooms (Liu et al., 2021), marking of hospital units and communication routes (Santhoshkumar et al., 2022), facilities for

people with disabilities (Akthar et al., 2023) and the availability of a rest and relaxation area (Andres et al., 2019). It was possible to identify these attributes on the basis of a literature review and a focus meeting with representatives of the general hospital selected for the study.

Two parallel main surveys were carried out to achieve the goal of the study (identification of attributes in the area of infrastructure that are most important for achieving patient satisfaction during hospitalization and identification of these improvement of which can increase the level of patient satisfaction). Overall, respondents appear to be satisfied with most attributes of hospital infrastructure. Based on the Kano methodology, it was shown that the availability and cleanliness of sanitary rooms, markings of hospital units and communication routes, and facilities for people with disabilities significantly influence the level of satisfaction with hospitalization. However, based on the analysis of the results of both studies, it is possible to indicate some areas in which the management of the studied hospital could make some improvements. For example, an attribute where changes could be recommended is attribute I5 - facilities for people with disabilities. In this case, the average patient satisfaction score was 4.38, and additionally, this attribute, according to the Kano methodology, belongs to class A (Attractive) with a quite high CC index of 0.54. In turn, in the area related to attribute I6 - availability of a rest and relaxation zone - the average rating of patients was the lowest (3.72) and even though this attribute was classified in the Kano study as I (Indifferent), i.e. neutral, with a recorded satisfaction index at a moderate level of 0.42, this type of facilities could to some extent influence the level of patient satisfaction during hospitalization.

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THE SOCIAL RESPONSIBILITY STRATEGIES IN TIME OF THE CLIMATE CRISIS IN SELECTED CAR MANUFACTURERS

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Purpose: The main purpose of the paper is to systematize and analyze social responsibility strategies the organizations operating in car industry perform with regard to climate crisis. The paper attempts to determine to what extent the non-financial reports reflect producers' concern for the environment and what impact it has on their CSR strategies.

Design/methodology/approach: The approach applied in the paper is of descriptive-empirical nature. The research methods involved in this paper are: induction, deduction, literature studies, as well as data analysis and case-study. The method of critical and comparative analysis was used in relation to the views presented in the literature.

Findings: The paper ends with a brief presentation of research findings which correspond to the formulated research questions on prevailing directions in shaping CSR strategies in car industry today.

Research implications: Future research directions should focus on further, expanded research exploration in the area, taking into account other producers worldwide. Additional work is needed to disseminate research findings among managers and to implement them in appropriate strategies.

Practical implications: The results of the research discussed in the paper have a theoretical but also some practical implications mainly for the managers but also for potential customers and cooperators of the automotive industry.

Social implications: Building awareness of trends in shaping social responsibility strategies in car manufacturing industry.

Originality/value The paper has a cognitive value for managers as well cooperators and customers of car manufacturers. The outcomes have theoretical as well as practical implications in search of solutions to improve CSR strategies in the light of ongoing climate crisis.

Keywords: social responsibility, climate crisis, car industry.

Category of the paper: research paper.

1. Introduction

The car manufacturers' industry holds a significant position in the global economy shaping transportation systems and exerting considerable influence on the environment and society (Lenort, Wicher, Zapletal, 2023). As concerns regarding environmental degradation and social impact continue to rise the concept of Corporate Social Responsibility (CSR) has gained prominence as a framework for businesses to go beyond profit-making and address their broader responsibilities (Lin, 2023). The key objective of the paper is to provide and explore the interplay between CSR and environmental aspects within the automotive industry.

The automotive sector's impact on the environment cannot be ignored. Vehicle emissions, manufacturing processes and resource consumption have profound consequences for air quality, climate change, and natural resource depletion. Recognizing these challenges the industry has undergone significant transformations, propelled by technological advancements and evolving regulatory frameworks aimed at reducing emissions and promoting sustainable practices (Sukitsch, Engert, Baumgartner, 2015).

Non-financial reports have become an essential tool for automotive manufacturers to communicate their CSR strategies, initiatives and performance to stakeholders. These reports go beyond traditional financial reporting and provide detailed insights into a company's environmental and social performance (Vieira, Li, Scotina, 2022). This paper aims to delve into the CSR strategies and non-financial reports of selected automotive manufacturers. Analyzing the reports can help to understand the comprehensiveness and preparedness of these companies in addressing environmental aspects and social responsibility.

The research's objective is to contribute to the growing body of knowledge on CSR in the automotive industry, highlighting the importance of integrating sustainability principles and responsible business practices. By exploring the CSR strategies and non-financial reports of prominent automotive manufacturers, the work aims to gain insights into their commitment to environmental stewardship, social well-being and the pursuit of a sustainable future. Ultimately this paper seeks to shed light on the role of the automotive industry in addressing pressing global challenges and the potential for positive change through CSR initiatives.

2. Some introductory remarks on non-financial reporting in car manufactures' industry

Dealing with sustainability reporting and communications requires to take a strategic and value-centric approach which is crucial to avoid unnecessary expenditure and inefficiencies (Rhoden, Ball, Vögele, Kuckshinrichs, 2023). The importance of focusing on the value created,

specifically highlighting the significance of community benefits when reporting on sustainability initiatives is commonly emphasized (Ogrea, Herciu, 2022).

It is recommended to incorporate the Sustainable Development Goals (SDGs) framework into communication strategies to enhance the relevance and impact of sustainability narratives (The Sustainable Development Goals, 2023). The Sustainable Development Goals (SDGs) are global targets aimed at addressing critical social, economic and environmental challenges to achieve a more sustainable future.

Additionally attention is paid to the Global Reporting Initiative (GRI) as a framework as it provides structure and credibility to sustainability reports. The Global Reporting Initiative (GRI) is a widely recognized framework that provides guidelines for transparent and credible sustainability reporting by organizations worldwide (The Global Reporting Initiative, 2023).

The value of sharing credit and maintaining honesty throughout the reporting process, as stakeholders appreciate transparency and authenticity is also emphasized (Kuo, Wu, Liu, 2022). Acknowledging challenges and showcasing how they were addressed is also encouraged, as it demonstrates resilience and progress (Lindow, Kaluza, Stark, 2018). Finally it is advised for organizations to prioritize engaging stories and issues that resonate with stakeholders, rather than excessive self-promotion. By adhering to these principles, businesses can optimize the effectiveness and value of their sustainability reporting and communications, garnering appreciation from both internal and external stakeholders (Leoński, Beyer, 2016).

Due to the environmental difficulties facing the sector CSR is significantly important in the context of the automotive industry. Vehicles significantly affect air quality, greenhouse gas emissions and the usage of natural resources (Tóth, Suta, Szauter, 2022).

Automakers have concentrated more and more on incorporating environmental sustainability into their business strategy as a result of this. Since the automobile sector already contributes significantly to the environment's negative consequences through emissions from its manufacturing, environmental responsibility is present and of special importance in this sector (Stefanoni, Voltes-Dorta, 2021). Unfortunately this is also true of the product which when used pollutes the air. These realities make it important for businesses in this industrial sector to modify their manufacturing methods and the creation of new goods so that they are sustainable and environmentally friendly (Ocampo, Clark, 2014).

Non-financial reporting which puts an emphasis on environmental issues is an important part of CSR in the automobile sector. Non-financial reports include in-depth analyses of a business' environmental activities, including its environmental objectives, strategy, and performance metrics (Beretta, Demartini, Lico, Trucco, 2021). Through these reports, stakeholders may assess a company's dedication to environmental responsibility and track its advancements in areas like waste management, emissions reduction, and emissions management. The demand for openness and responsibility regarding environmental performance is what has led to the rising significance of non-financial reporting (Lidvall, Rafstedt, 2023). Consumers, investors and regulators are among the stakeholders who are

growing more concerned about how automobile operations affect the environment. Non-financial reports are a way for automakers to share the actions they've made to lessen their environmental impact and encourage sustainable lifestyles (Sannö, Wallin, Fundin, 2014).

Automotive manufacturers can also find environmental opportunities and dangers thanks to non-financial reporting. Manufacturers may evaluate their performance, set goals and put plans into place to minimize harmful effects and enhance beneficial contributions to the environment by reporting on their environmental activities (Hąbek, Lavios, Krupah, 2022). Additionally automotive manufacturers may interact with stakeholders about environmental concerns through non-financial reporting. It enables businesses to share their environmental accomplishments, efforts and innovations, encouraging transparency and developing stakeholder confidence. This interaction may spark teamwork to advance environmental changes with suppliers, clients and communities (Hariyani, Mishra, Sharma, Hariyani, 2022).

In conclusion, the automobile sector places a high value on CSR's environmental components. The honest communication of a company's environmental objectives and performance relies heavily on non-financial reporting. Automakers may help create a greener, more sustainable future by incorporating environmental sustainability into their business plans and reporting procedures.

3. The overview of reports in leading car manufacturers

3.1. Introduction to the research

This part of paper examines the Corporate Social Responsibility reports from well-known automakers, highlighting their programs and objectives. These automakers have a significant influence on the global economy, transportation networks and environmental impact as key actors in the automobile industry. Automotive manufacturers have embraced CSR practices to match their business objectives with societal and environmental demands as they become more and more important. The described companies have become market leaders, garnering a sizable following and market share. Their pledges, achievements and upcoming goals in relation to CSR, environmental stewardship, community participation and ethical practices may all be learned through reviewing their non-financial reports.

The research focuses on the contents of reports published by automotive manufacturers, with a particular emphasis on the reports of Toyota Motor Corporation, BMW Group, Ford Motor Company, and Volkswagen Group. The selection of the mentioned brands for this research was based on their status as some of the largest car manufacturers in the industry. These companies have a significant global presence and their operations have a substantial impact on the automotive sector and the broader economy. The objective is to analyze and

evaluate if these reports cover various aspects of selected CSR objectives, including the social, environmental and future-related domains. The scope of this research includes analyzing the reports to determine the inclusion of key elements such as the social area, environmental sphere, recyclability, protection of the environment and future perspectives. By thoroughly examining the reports of each company a comprehensive assessment can be made regarding their CSR efforts and the transparency with which they report on these aspects. The selected automotive manufacturers represent significant players in the global market and their reports provide valuable insights into their sustainability practices and initiatives. The pre-run research of the reports will serve as a basis for their subsequent analysis in terms of each aspect. The area covered by reporting are presented in Table 1.

Table 1.

Selected areas covered by reporting from various manufacturers

guidelines/manufacturers	Toyota	BMW*	Ford*	VW AG
social area	Yes	Yes	Yes	Yes
environmental sphere	Yes	Yes	Yes	Yes
recyclability	Yes	Yes	Yes	Yes
protection of environment	Yes	Yes	Yes	Yes
future perspectives	Yes	Yes	Yes	Yes

Source: own elaboration.

BMW and Ford present one report integrating sustainability/CSR and financial aspects. The pre-run research revealed that all selected automotive manufacturers consistently covered the social area, environmental sphere, recyclability, protection of the environment and future perspectives in their reports. Their reporting indicates a strong commitment to corporate social responsibility and sustainable business practices. Having made sure that each of the selected companies has included the established criteria in its report it is feasible to lean into each of the reports and analyze them more deeply.

3.2. The case study of Toyota Motor Corporation

Toyota Motor Corporation, one of the leading automotive manufacturers globally, has gained recognition for its commitment to CSR and sustainability. This analysis focuses on Toyota's non-financial report, exploring its efforts in the social area, environmental sphere, recyclability, protection of the environment and future perspectives. By analyzing these key aspects we aim to gain insights into Toyota's CSR practices and assess the company's alignment with sustainable development goals (Toyota Motor Company, Sustainability Data Book, December 2022).

- **Social Area**

Toyota's non-financial report consistently emphasizes its dedication to social responsibility. The company's initiatives encompass employee welfare, community engagement, support for underprivileged groups, vehicle safety, privacy, intellectual property and health and safety. The main, salient risks that are taken care of by Toyota in 2022 were: migrant labor, child labor,

harassment, and discrimination (diversity and inclusion). Moreover the company focuses on promoting diversity (woman's activity, LGBTQ+ inclusion), equal opportunity, and human rights. The report highlights respect for internationally recognized Human Rights in line with the United Nations Guiding Principles on Business and Human Rights (UNGP) and the Universal Declaration of Human Rights and compliance with international Human Rights obligations together with the laws and regulations of the countries in which Toyota operates. Toyota also actively engages in philanthropic activities, partnering with organizations to address social challenges and contribute to sustainable community development.

- **Environmental Sphere**

Toyota recognizes the importance of environmental stewardship and demonstrates a strong commitment to mitigating climate change and reducing its ecological footprint. The company's non-financial report highlights various initiatives aimed at environmental sustainability. Toyota has set ambitious targets for reducing CO2 emissions, promoting energy-efficient manufacturing processes and increasing the use of renewable energy sources. The report also emphasizes Toyota's investments in research and development of eco-friendly technologies, such as hybrid and electric vehicles, as part of its broader commitment to sustainable mobility. Toyota formulated the 7th Toyota Environmental Action Plan (2025 Target), a five-year action plan to achieve the Toyota Environmental Challenge 2050. Their primary goal in that spheres Life Cycle Zero CO2 Emissions Challenge. As the report states Toyota is also committed to reducing CO2 emissions in each stage of the vehicle life cycle.

- **Recyclability**

In the non-financial report, Toyota showcases its commitment to recyclability and waste management throughout its value chain. The company emphasizes the importance of circular economy principles and aims to minimize waste generation and maximize resource utilization. Toyota's report detail efforts to design products for recyclability, increase recycling rates in manufacturing processes, and collaborate with suppliers to establish closed-loop systems. By prioritizing recyclability Toyota aims to minimize its environmental impact and contribute to a more sustainable automotive industry. The newest initiatives proposed by the company are "Toyota Global 100 Dismantlers Project Establishment of Social Systems for Appropriate Treatment and Recycling of End-of-life Vehicles" and "Toyota Global Car-to-Car Recycle Project".

- **Protection of the Environment**

Toyota's non-financial report emphasizes its dedication to the protection of the environment. The company implements comprehensive measures to conserve natural resources, preserve biodiversity and minimize the negative impacts of its operations. Toyota engages in initiatives such as reforestation, habitat restoration and water conservation programs. The report also highlights Toyota's commitment to adhering to environmental regulations, implementing stringent emission control measures, and promoting sustainable supply chain practices through initiatives with suppliers, dealers and distributors.

- **Future Perspectives**

Toyota's non-financial report provides valuable insights into the company's future perspectives and sustainability goals. The report outlines Toyota's long-term vision, which includes developing advanced technologies and mobility solutions that contribute to a low-carbon society. Toyota aims to expand its lineup of electrified vehicles, increase the use of hydrogen fuel cell technology, and promote innovative solutions for sustainable urban mobility. The report also highlights Toyota's commitment to continuous improvement and innovation, demonstrating the company's forward-looking approach to sustainability. The most important perspectives from the report are electrification leadership (Toyota aims to lead the electrification revolution by expanding its lineup of hybrid, plug-in hybrid, battery electric and fuel cell vehicles), carbon neutrality (Toyota has set a goal to achieve carbon neutrality across its entire vehicle lifecycle by 2050 through increased fuel efficiency, electrification, and renewable energy use) and sustainable mobility solutions (Toyota is investing in connected and autonomous driving technologies and promoting "Mobility as a Service" to create seamless and sustainable mobility experiences).

- **Conclusion**

In conclusion the analysis of Toyota's non-financial report showcases the company's strong commitment to CSR and sustainability. Toyota places a significant emphasis on social responsibility, addressing employee welfare, community engagement and supporting underprivileged groups. The company also actively promotes diversity, equal opportunity, and human rights. In terms of environmental sustainability Toyota is dedicated to mitigating climate change and reducing its ecological footprint. The company sets ambitious targets for reducing CO2 emissions, investing in eco-friendly technologies and promoting recyclability throughout its value chain. Toyota's non-financial report also provides insights into its future perspectives, including leadership in electrification, striving for carbon neutrality and investing in sustainable mobility solutions. Overall Toyota's non-financial report reflects its commitment to addressing social and environmental challenges while driving innovation in the automotive industry.

3.3. The case study of BMW Group

BMW Group, a renowned automotive manufacturer, has been actively engaged in corporate social responsibility and sustainability practices. This analysis focuses on BMW's non-financial report, examining the company's efforts in the social area, environmental sphere, recyclability, protection of the environment and future perspectives. By analyzing these key aspects this section aims to gain insights into BMW's CSR practices and assess the company's commitment to socially responsible and sustainable development.

- **Social Area**

BMW actively focuses on employee well-being, diversity and inclusion through programs that foster a supportive work environment. The report showcases BMW's initiatives to engage with local communities, promote education and skills development and support social causes. The company also places a strong emphasis on customer satisfaction and safety aiming to build trust and long-term relationships with its stakeholders. One of the most important documents for the company is the "BMW Group Supplier Code of Conduct – BMW Group Supplier Sustainability Policy" which covers the basic assumptions for suppliers (BMW Group Supplier Code of Conduct, 2023). In this document the BMW Group emphasizes social responsibility towards employees and expects its suppliers to adhere to guidelines on human rights, labor conditions and sustainability. The company prohibits child labor and forced labor, supports freedom of association and collective bargaining, advocates for non-discrimination and ensures health and safety in the workplace. The BMW Group also promotes fair remuneration, respects the rights of local communities and emphasizes animal welfare. Suppliers are expected to implement due diligence processes and comply with standards for critical raw materials. The BMW Group encourages continuous improvement and offers support to suppliers in meeting these requirements, noticing also that audits may be conducted on certain suppliers. (BMW Group Supplier Code of Conduct, 2023) Another important factor of social area responsibility is an increase in expenditures on employee training and development as well as taking part in young talent programs.

- **Environmental Sphere**

BMW recognizes the significance of environmental sustainability and has integrated it into its business strategy. The company's annual report emphasizes its commitment to reducing carbon emissions, energy consumption and water usage throughout its operations. BMW actively invests in research and development of sustainable mobility solutions such as electric and hybrid vehicles. The report also highlights BMW's efforts to increase the use of renewable energy sources in manufacturing processes, ensuring a more sustainable and environmentally friendly approach. In the previously mentioned document, the manufacturer presents also guidelines referring to environmental aspects, outlining the environmental responsibilities expected from BMW Group's suppliers. The BMW Group emphasizes the careful and efficient use of resources and expects suppliers to comply with national and international environmental standards and laws. Suppliers are required to minimize pollution and risks, reduce environmental impacts and introduce an environmental management system. The BMW Group is committed to reducing CO₂ emissions throughout the product life cycle and expects suppliers to implement measures for emission reduction. Transparency and reduction targets for emissions in the supply chain are also expected. Suppliers are encouraged to adopt resource conservation and circular economy practices and utilize recyclable materials. Protection of biodiversity, avoidance of deforestation and responsible land and forest use are emphasized. The BMW Group excludes the use of deep-sea raw materials until their

environmental impact is better understood. Handling hazardous materials and waste should adhere to regulations and conventions, with proper labeling, safe handling, and appropriate disposal (BMW Group Supplier Code of Conduct, 2023).

- **Recyclability**

BMW places a high priority on recyclability and waste management. The company's report showcases its commitment to incorporating sustainable materials and design principles into its products. As stated in the report, BMW Group uses secondary raw materials in their products, designs their products to facilitate their recycling, manages waste at their production sites in a way that prioritizes recycling over disposal as well as registers substances of concern systematically along the entire supply chain. BMW aims to maximize the recyclability of its vehicles and components, minimizing waste generation and promoting resource efficiency. The company emphasizes that in 2022 a total of 99.3 percent of waste generated by production was either recycled or recovered. The report highlights BMW's efforts to establish closed-loop supply chains and collaborate with suppliers to enhance recyclability throughout the product life cycle.

- **Protection of the Environment**

BMW's Group report underscores its commitment to protecting the environment. The company implements measures to reduce environmental impacts, including emissions control, responsible waste management and sustainable use of resources. For example, in the Leipzig plant, the company optimizes circulation systems by expanding the purification stages in wastewater treatment. BMW emphasizes compliance with environmental regulations and the integration of environmental considerations into its decision-making processes. The report also highlights BMW's engagement in projects focused on conservation, biodiversity and sustainable land use, demonstrating its dedication to preserving the natural environment.

- **Future Perspectives**

The report outlines BMW's commitment to innovation and the development of cutting-edge technologies that promote sustainable mobility. BMW's future perspectives include expanding its electric vehicle lineup, i.e. Neue Klasse (a technology platform with new standards for electromobility, digitalization, and sustainability), advancing autonomous driving capabilities and investing in smart mobility solutions. The report also emphasizes BMW's commitment to continuous improvement, transparency and stakeholder engagement in shaping its future sustainability strategies. The main goals of the manufacturer are by 2030 to have over 50 percent of all-electric vehicles in their deliveries, 80 percent reduction of carbon emissions per vehicle in their production, over 50 percent reduction in carbon emissions during a vehicle's use phase and over 20 percent reduction in carbon emissions in the supply chain.

- **Conclusion**

BMW Group is committed to corporate social responsibility and sustainability. The company focuses on employee well-being, diversity, and customer satisfaction. It expects suppliers to adhere to guidelines on human rights, labor conditions, and sustainability. BMW in their report prioritizes environmental sustainability, aiming to reduce carbon emissions, energy consumption and water usage. The noticeable practice is that of CSR-related policies with suppliers, who are expected to comply with environmental standards, reduce pollution, and implement environmental management systems. BMW emphasizes recyclability, waste management and the use of sustainable materials. The company is dedicated to protecting the environment and investing in future technologies for sustainable mobility. Its goals include increasing the use of electric vehicles and reducing carbon emissions throughout the supply chain.

3.4. The case study of Ford Motor Company

Ford Motor Company, another one of the prominent players in the automotive industry, has also been actively involved in CSR practices and sustainability initiatives. This analysis focuses on Ford's integrated sustainability and financial report, examining its efforts in the social area, environmental sphere, recyclability, protection of the environment and future perspectives (Ford Integrated Sustainability and Financial Report, 2023). By analyzing these key aspects we aim to gain insights into Ford's CSR practices and assess the company's commitment to sustainable development.

- **Social Area**

The part of Ford's non-financial report demonstrates a strong emphasis on social responsibility. The company prioritizes employee welfare and engagement, fostering a culture of inclusivity and diversity. Ford's report showcase initiatives that promote employee well-being, professional development, and work-life balance. For Ford, the emphasis is put on human and capital diversity, equity and inclusion, employee health, safety and wellbeing, human rights, supply chain management, product safety and quality, socioeconomic contributions and community engagement. The most salient issues for Ford are access to water and sanitation, air quality, child labor, climate change, equal and fair wages, ethical recruitment, harassment and discrimination, human trafficking, occupational health, safety and wellbeing and product safety and quality. The company also engages in community-based projects and partnerships, addressing social issues such as education, access to healthcare and economic empowerment. Ford's commitment to social initiatives reflects its dedication to creating positive social impacts beyond its core business operations.

- **Environmental Sphere**

Ford recognizes the importance of environmental sustainability and aims to minimize its environmental footprint. The company's report highlights its efforts to reduce greenhouse gas emissions, conserve energy and optimize resource utilization. Ford actively pursues sustainable

manufacturing practices, investing in technologies that promote energy efficiency and waste reduction. The most emphasis is put on the successes of Ford in actions to improve air quality, water use and waste management. The report also emphasizes Ford's commitment to developing and promoting electric and hybrid vehicles as part of its strategy to mitigate climate change and contribute to a greener future.

- **Recyclability**

Ford places a strong emphasis on recyclability and waste management throughout its value chain. The company's report outlines initiatives focused on designing products for recyclability, promoting recycling programs, and collaborating with suppliers to establish closed-loop systems. Ford's commitment to recyclability extends beyond its vehicles, encompassing packaging materials, manufacturing waste and end-of-life vehicle disposal. Ford states recycling can reduce the carbon footprint of some plastics by 70-90 percent. Through activities such as transforming recycled plastic bottles into vehicle parts, the company is helping to promote environmentally friendly auto parts. As they state in the report recycled plastic is ideal for the manufacture of underbody shields, engine under shields, and front and rear wheel arch liners. By prioritizing recyclability, Ford aims to reduce waste generation and promote resource conservation throughout its operations.

- **Protection of the Environment**

The environmental section of the report demonstrates the manufacturer's commitment to the protection of the environment. The company implements measures to minimize environmental impacts, such as water conservation, emissions control and the adoption of sustainable materials.

Ford's report highlights its efforts to comply with environmental regulations and promote responsible manufacturing practices. The company also engages in biodiversity conservation initiatives and supports projects focused on preserving natural habitats and ecosystems such as Ford's Wildlife Foundation which takes care of biodiversity and ecosystem health. Ford's commitment to environmental protection underscores its recognition of the importance of maintaining a healthy and sustainable planet. Finally the company highlights its portfolio that includes accessible lower carbon options like electric vehicles, hybrid vehicles, fuel cell vehicles, models with aerodynamic improvements and weight reductions, also vehicles that use carbon-neutral e-fuels, i.e. electricity, biofuels (CNG/LNG) and hydrogen.

- **Future Perspectives**

In the report one can find insights into the company's future perspectives and sustainability goals. The report outlines Ford's commitment to investing in research and development of advanced technologies, including electric vehicles, autonomous driving, and connected mobility solutions. Ford aims to contribute to a sustainable and efficient transportation ecosystem, reducing emissions and improving overall environmental performance. The report also highlights Ford's collaboration with industry partners, policymakers, and stakeholders to drive innovation and shape the future of mobility. The main aspirations include goals like

carbon neutrality no later than 2050 and 100 percent usage of carbon-free electricity in all manufacturing by 2035.

- **Conclusion**

The report exemplifies commitment to CSR and sustainability across various dimensions. The report highlights Ford's initiatives in the social area, its efforts to minimize environmental impact, promote recyclability, protect the environment and outline its future perspectives. Through a comprehensive analysis of the report, one gains valuable insights into the company's socially responsible practices.

3.5. The case study of Volkswagen Group

This analysis focuses on Volkswagen Group's non-financial report, providing an examination of the selected CSR practices and sustainability initiatives (The Volkswagen Group Sustainability Report 2022). The report offers valuable insights into the company's efforts in the social sphere, environmental conservation, recyclability, protection of the environment and future perspectives. By analyzing Volkswagen Group's non-financial report, this part aims to summarize the company's commitment to sustainable development and its overall CSR performance.

- **Social Area**

The report of Volkswagen Group shows its dedication to social responsibility by prioritizing employee well-being (according to the report, in 2022, the score on the employee satisfaction index in the Volkswagen Group was 82.4 out of 100), fostering diversity and inclusion (group diversity management is assigned to the VW Group Board of Management and reports to the individual responsible for Human Resources. More than 85 diversity managers meet at an annual convention to share best practices and discuss programs and actions) and engage with local communities. The report highlights initiatives that promote safe working conditions, employee development programs, and community outreach activities. VW Group's commitment to social responsibility extends to its customers through a focus on delivering high-quality products and services that meet their needs and preferences.

- **Environmental Sphere**

Volkswagen Group is committed to minimizing its environmental impact and promoting sustainable practices throughout its operations. The non-financial report provides insights into the company's efforts to reduce carbon emissions, energy consumption and water usage. As the report states, VW Group is committed to using water sparingly, focusing on production sites in risk zones. Closed-loop circulation or recirculation of cooling and process water can reduce the need for freshwater and the quantity of wastewater. Volkswagen supports the Water Disclosure Project (WDP) and has been given the top grade of A in the WDP ranking for its sustainable water management. The amount of wastewater produced is in line with the amount of fresh water used. It also highlights Volkswagen Group's investments in research and development of eco-friendly technologies such as electric vehicles and alternative fuels.

The report emphasizes the company's commitment to sustainable supply chain management and the adoption of renewable energy sources in its production facilities.

- **Recyclability**

Uncoupling economic growth from resource consumption and developing a circular economy are key sustainability topics for VW Group. The report showcases that the manufacturer recognizes the importance of recyclability and waste management in achieving sustainability goals. The VW Group actively collaborates with suppliers to improve recyclability and adopts innovative design principles to enhance the circularity of its products. The report also highlights the company's initiatives to reduce packaging waste and increase the utilization of recycled materials. Utilizing the largest percentage of recycled materials is crucial for VW as noted in the report. The ceiling headliners, textiles, carpets, seats, door trim and ornamental inlays are all comprised of sustainable materials in the ID. family (electric cars from the Volkswagen brand). All lines' seat fabrics are up to 100% recycled PET which was typically used to make PET bottles. In Golf 8, 6% of the thermoplastics and 28% of the fabrics come from recycled sources. Moreover the manufacturer reports that electric drives are an important step towards low-emission mobility and help to protect the climate, however, their production results in different materials entering circulation, such as high-voltage batteries. It is important for these materials to remain in circulation to reduce emissions and other environmental impacts. VW Group is working on a recycling concept for batteries and has entered into strategic partnerships with a company that specializes in battery recycling. Škoda (a brand of VW Group uses raw materials from renewable sources when manufacturing vehicles, such as flax, cotton, wood and cellulose. Škoda has developed sustainable materials such as sugar beet pulp and miscanthus reed and is investigating other ecologically sourced materials. Suppliers are also required to comply with sustainability standards. The Group's focus on high quality with low need for repair is to give vehicles long lives. If a part fails, they are replaced through the Exchange Parts Program. Reconditioning is a key component of the replacement program, reducing CO2 emissions and primary energy requirements by 54%.

- **Protection of the Environment**

Volkswagen Group is dedicated to protecting the environment and preserving natural resources. The report demonstrates the company's commitment to reducing environmental impacts through measures such as emissions control, sustainable land use and responsible waste management. It outlines VW Group's adherence to environmental regulations and standards, as well as its participation in environmental conservation projects. The report emphasizes the company's commitment to biodiversity preservation and the sustainable use of resources. Volkswagen has been involved in protecting and retaining biological diversity through conservation projects since 2007. As a founding member of the Biodiversity in Good Company initiative, they have defined corresponding action areas to make their contribution to achieving these goals within the framework of their business activities. Additionally they support the Agenda for Nature and People Initiative by publishing their commitment on the page of the

German Business for Biodiversity platform. Additionally, they have developed an internal assessment tool to assess both direct measures to increase biodiversity at their production sites and indirect measures, as well as introducing a biodiversity KPI.

- **Future Perspectives**

The report outlines VW Group's strategic plans for developing sustainable mobility solutions, expanding its electric vehicle portfolio, and advancing autonomous driving technologies. The report also highlights the company's commitment to research and development, innovation and continuous improvement in its pursuit of a sustainable and carbon-neutral future. Volkswagen Group aims to position itself as a leader in sustainable mobility and contribute to the global transition towards a greener automotive industry. The group has set a long-term goal of becoming net carbon neutral by 2050, with electric mobility being the biggest contributor. In 2022, 11 percent of sales will be electric vehicles, and by 2025 the group forecasts it to rise to 20 percent. The Group is also supporting the expansion of renewable energy on an industrial scale, and additional green electricity. Volkswagen is committed to the electric drive for decarbonization, with a goal of reducing production-related CO₂ emissions by 50 percent by 2030. They have laid the foundation for their first battery cell factory in 2022 and five more factories in Europe by the end of the decade. The focus on e-mobility and software development is going to change work in an employee-friendly and socially acceptable way.

- **Conclusion**

Volkswagen Group's non-financial report demonstrates its commitment to CSR and sustainability across various areas. In the social sphere, the company prioritizes employee well-being, diversity and inclusion, and community engagement. Environmental conservation is a key focus, with efforts to reduce carbon emissions, energy consumption, and water usage. The company also emphasizes recyclability and waste management, collaborating with suppliers and adopting circular design principles. Volkswagen Group is dedicated to protecting the environment through emissions control, sustainable land use and biodiversity preservation. Future perspectives highlight the company's plans for sustainable mobility solutions, expanding electric vehicle portfolios, and advancing autonomous driving technologies. This analysis of Volkswagen Group's non-financial report provides valuable insights into the company's CSR practices and its commitment to a sustainable and carbon-neutral future.

4. Conclusions

The analysis of the CSR strategies and non-financial reports of Toyota Motor Corporation, Ford Motor Company, BMW Group and Volkswagen Group reveals the comprehensive commitment of these automotive manufacturers to corporate social responsibility. It is worth

noting that due to the limited scope of the study, the examination focused solely on the selected automotive manufacturers, also concerning the extensive length of the reports (which span up to 343 pages in the case of the BMW Group's report) the analysis was limited to selected categories.

The reports of these companies are meticulously organized, demonstrating a well-structured approach to conveying their CSR efforts. The reports often include links to specific sections or references, enhancing the accessibility and navigation for readers and are presented in a reader-friendly manner. They are designed with clarity and visual appeal, comprehensive, well-structured and transparent, incorporating graphical elements that effectively convey information and data, and showcasing their adherence to the highest standards in reporting. This visual representation not only enhances the readability of the reports but also reflects the unique "spirit" and commitment to CSR of each brand. The reports showcase the companies' dedication to transparency and accountability, providing stakeholders with a comprehensive overview of their CSR strategies, performance and future goals.

All four companies demonstrate a strong dedication to achieving carbon neutrality by 2050, aligning their goals with global efforts to mitigate climate change. These manufacturers utilize internationally recognized frameworks such as the Sustainable Development Goals (SDGs) and Global Reporting Initiative (GRI) indicators to structure their reports and provide a clear understanding of their CSR initiatives.

While there are similarities in certain areas across the reports, each company distinguishes itself in different spheres. Toyota Motor Corporation's report emphasizes its commitment to environmental sustainability through its Toyota Environmental Challenge 2050 which outlines ambitious goals for reducing CO₂ emissions and promoting sustainable manufacturing processes. Ford Motor Company's report highlights its sustainability strategy focused on electrification, mobility solutions and community engagement. BMW Group's report showcases its efforts to promote sustainable mobility, including the expansion of its electric vehicle portfolio and the implementation of circular economy principles. Volkswagen Group's report emphasizes its dedication to sustainable mobility and resource efficiency with a strong focus on reducing emissions and advancing electric vehicle technologies.

In conclusion Toyota Motor Corporation, Ford Motor Company, BMW Group and Volkswagen Group might be described as prominent in CSR practices and reporting within the automotive industry. Their reports demonstrate their commitment to achieving carbon neutrality, their comprehensive and well-prepared approach to CSR reporting and their adherence to high standards. Each company presents a distinct focus in different spheres, reflecting its priorities and strategies. Collectively, these automotive manufacturers play a significant role in driving the industry toward a more sustainable and socially responsible future.

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INTELLECTUAL PROPERTY LEASING AS AN INSTRUMENT OF TAX ADVANTAGE

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Purpose: The purpose of the article is to indicate Polish legislation regarding the possibility of using intellectual property leasing as a business management tool. In addition to the use of this instrument, as well as the possibility of obtaining financial benefits, special attention is paid to tax issues.

Design/methodology/approach: Empirical research and comparative analysis using Polish and European act were used.

Findings: This article examines the practical aspects of the use of operational and financial leasing in the case of intellectual property on the basis of current Polish and European legislation. The advantages and disadvantages of various types of leasing of intangible property are revealed.

Practical implications: The topic is worthy of discussion, since for companies leasing is still the first choice among the methods of financing fixed assets used for the development of enterprises; the possibilities of this instrument are much wider.

Originality/value: The article is mainly dedicated to entrepreneurs. The advantages and disadvantages of leasing and the difference from a bank loan for fixed assets and intangible assets are presented, which can serve as a guide for entrepreneurs.

Keywords: Operational and financial leasing, Leasing-related taxes, Financial instrument, Economic activity.

1. Introduction

Leasing cars or industrial machines does not surprise anyone today. This type of agreement became widespread in business transactions long before its essential features were specified in the provisions of the Civil Code (hereinafter referred to as the Civil Code), as a result of which it was included in the group of named agreements of the Code. It would seem that civil law regulation has exhausted this topic. However, it turns out that among the provisions of the Income Tax Law there are also complementary rules of the Code. According to the rules of the Civil Code, only movable and immovable things become the subject of a leasing agreement. However, the Tax Law extends this catalog to include trademark protection rights. It is obvious that a person who wants to use leasing of a valuable brand as a tax optimization instrument must remember that such tax extension is limited by the need to meet certain conditions. The range of criteria that must be met in this case is presented both in tax legislation and in judicial practice, as well as in individual interpretations of tax authorities.

According to the Polish Leasing Association, leasing companies provided financing worth PLN 47.8 billion in the first half of 2023. This is 14.9% more than in the previous year. Although the driving force of the industry were light vehicles, mainly passenger cars. Thus, it confirms the definitive fact of the growing interest of entrepreneurs in this form of financing their activities. Data from the macroeconomic environment indicate that this trend may continue, and the total amount of financing provided to entrepreneurs by the Polish leasing industry will exceed PLN 100 billion by the end of 2023.

The vast majority of contracts concluded relate to fixed assets subject to depreciation, such as cars, tractors, semi-trailers, machinery and other industrial equipment. However, the provisions of the current tax legislation also provide for the possibility of concluding leasing agreements for intangible assets. The lease of copyright in the form of a software license or trademark lease is in principle uncontroversial (provided that formal and legal requirements regarding the correct definition of the subject matter and the legal transferability of these rights are met). Therefore, leasing companies are ready to provide financing in this area. However, poor awareness of the potential of this instrument means that there is little interest in leasing intellectual property.

Leases of copyrights (such as software) or trademarks are not the only categories of leasing agreements that cover intangible assets. As an interesting fact, it is worth referring to one of the latest interpretations of the Director of National Tax Information (hereinafter: KIS) regarding the possibility of concluding a financial leasing agreement, the subject of which is an intangible asset in the form of an enterprise of an individual.

2. Concept and classification of leasing

The leasing agreement under the provisions of the Civil Code (Articles 7091-70918) is a nominal, consensual and causal agreement, is bilateral, compensated and reciprocal in nature and can only be concluded for a certain period. The provisions governing the leasing agreement were introduced into the Polish Civil Code by the Act of 26 July 2000 amending the Act - Civil Code, Journal of Laws. 2000, No. 74, paragraph 857. In the justification of the presented act, it was stated that traditionally the term “leasing” refers to contracts involving the provision of goods for use for a fee. According to "Article 2A § 103(1)(j) of the U.S. Uniform Commercial Code, leasing is the grant for a consideration of the right to possess and use goods for a specified period of time”.

A lease agreement in the Polish Civil Code is formalized as a special type of agreement for the use of a thing, which is similar in structure to a lease or rental contract. For this reason, the provisions on the leasing contract have been placed after the provisions on rental and tenancy. Pursuant to Art. 7091 of the Civil Code: *By means of a leasing agreement, the financing party undertakes, within the scope of the activities of its enterprise, to purchase an item from a specific seller on the terms provided for in this agreement and to hand over the item to the lessee for use or for use and benefit for a specified period of time, and the lessee undertakes to pay the financing party in fixed installments, monetary consideration equal to at least the price or remuneration for the purchase of the item by the financing entity.*

According to K. Kopaczynska-Peczniak: “In the context of Article 7091 of the Civil Code on significant negotiations, leasing agreements should be considered as:

- 1) the financing party's obligation to purchase items from the designated seller and on the terms provided for in the leasing agreement;
- 2) the obligation of the financing party to transfer the thing to the beneficiary for use or to use and receive benefits for a specified period of time;
- 3) the beneficiary's obligation is to pay in agreed installments a monetary consideration equal to at least the price or remuneration for the purchase of the item by the financier.

Therefore, the structure of the leasing contract in the Civil Code is such that the obligations of the financing party include acquiring the ownership right (or the right of perpetual usufruct) of the thing from the seller within the enterprise managed by him and transferring it to ownership. user for use for a specified period of time. In turn, the beneficiary is obliged to pay the financing party in installments the price or the price and remuneration for the purchase of the item by the financing party. In a leasing agreement, the position of the user of the item should be defined as the position of the dependent owner of the item (Article 336 of the Civil Code). The requirement to “purchase” the leased asset expressed in Art. 7091 CC excludes the possibility of such a legal structure of a leasing agreement in which the financing party only provides the lessee with the leased asset for use, without becoming its owner. The regulations state that the leasing agreement must be concluded in writing under pain of nullity.

The issue of determining the criterion for leasing division is as complex as the issue of determining its essence. The doctrine rightly notes that the formulation of a unified assessment of the legal and economic aspects of leasing is not confirmed by the fact that this institution has different legal forms in individual countries. This procedure is not made easier by the fact that significant differences in the understanding of this legal method also characterize economic practice. Evaluative statements most often take a generalized form. They do not take into account the fact that a more complete assessment of leasing will be obtained only if individual types (forms) of leasing are subjected to appropriate analysis.

The basic classification includes financial and operational options. The UNIDROIT Convention on Financial Leasing contains the following provisions:

Chapter I. Scope and general provisions

1. This Convention governs the financial leasing transaction described in paragraph 2, in which one party (the lessor):
 - a) at the request of the other party (lessee), concludes an agreement (supply agreement) with a third party (supplier), under which the lessor purchases equipment, capital goods or other equipment on terms accepted by the lessee; and
 - b) concludes an agreement (leasing agreement) with the lessee, granting the lessee the right to use the equipment in exchange for payment of rent.
2. The financial leasing transaction referred to in the previous paragraph is a transaction consisting of the following features:
 - a) the lessee specifies the equipment and selects the supplier without relying on the skill or judgment of the lessor;
 - b) the equipment is purchased by the lessor in connection with a leasing agreement which, according to the supplier's knowledge, has already been concluded or will be concluded between the lessor and the lessee, and
 - c) the rent payable under the leasing contract is calculated in such a way as to take into account in particular the write-off of all or a significant part of the cost of the equipment.
3. This Convention applies regardless of whether the lessee has or subsequently acquires the right to purchase the equipment or retain it under lease for a further period and whether he pays a nominal price or rent for it.

The above quote shows:

1. The difference between a contract and a leasing transaction: the economic structure of a leasing transaction and the resulting priority of the supply contract in relation to the leasing agreement: - the decision of the future lessee to use the goods, - the lessor orders the goods for leasing, - provision of the delivered goods to the lessor,
2. exclusion of the issue of purchasing an item after the end of the leasing period as a criterion determining the nature of the concluded agreement,

3. economic purpose of the concluded agreement: providing the lessee with the opportunity to use the item in exchange for paying rent,
4. the ratio of rent to property value. Leaving aside the question of the consequences of distinguishing between a transaction and a leasing agreement, the primary question in the scope of the Convention is the question of what distinguishes financial and operating leasing as two types of leasing, if the criterion is not the acquisition of the object?

An indication of the criterion for distinguishing types of leasing under the UNIDROIT Convention is the statement that: [...] the rent paid under a leasing agreement is calculated taking into account the particular write-off of all or a significant part of the cost of the equipment.

However, from an economic point of view, this recommendation this recommendation is highly imprecise and cannot be compared in this form with the economic consequences of ownership. After eliminating the enigmatic nature of the directive containing the terms: “take into account in particular the write-off ...”, replacing it with an unambiguous term “calculate at a level not lower than ...”, there remains freedom arising from the formulation “all or a significant part of the cost of the equipment”. Changing this wording to “the entire value of the equipment” would make the Convention a clear criterion for distinguishing between financial and operating leasing. For the purposes of the discussion, it was assumed that: the difference between operational and financial leasing, which arises as a result of applying the criterion of the amount of remuneration, is that the rent for financial leasing requires taking into account all costs associated with the purchase of goods.

Despite this inaccuracy, the UNIDROIT Convention rightly focuses the search for the constitutive features of the financial and operational option on economic aspects, in contrast to the formalistic approach that links the criterion for qualifying the type of leasing not to functions and rights, but to the institution of ownership as such. The calculation of expenses and benefits resulting from the provisions of the leasing contract becomes fundamental. This approach does not eliminate the issue of ownership, which is important for a leasing institution. However, it places it in a different context: not formal and primary, but as a possible (but not exclusive) form of guaranteeing specific rights in the broadly understood use of things.

According to the economic process, ownership of the means of production is not a goal, but a method of ensuring its use. If the legal order allows the use of a means of production to the extent necessary to achieve production goals without acquiring ownership title (lack of ownership does not create risks that are excluded only through purchase), then for the entrepreneur the criterion for making the decision on how to ensure the right to use the good is only the result of statements of expenses and costs. Purchasing is only an attractive alternative if it is a cheaper way of using things than other forms available.

As a rule, the following types of leasing agreements can be specified:

- financial leasing, characterized by the fact that the financier receives compensation for the cost of the leased object,
- operational leasing, which allows more than one person to use the same thing,
- indirect leasing, in which the financier acquires the leased asset from a third party,
- direct leasing, in which the financier is also the manufacturer of the product,
- sale-leaseback, characterized by the fact that the user transfers ownership of the thing to the financier, and then acquires only the right to use it under a leasing agreement.

Entrepreneurs deal with two types of leasing every day: operational and financial. These definitions also arise from tax legislation. The choice of form depends solely on the taxpayer using the leasing agreement, which may depend on the need to settle tax expenses and the length of the period during which the leased asset is planned to be used.

3. Types of leasing

Operational leasing. In this form of contract, the leased item is included in the assets of the lessor (for example, a leasing company). However, the cost of generating income for the user using the subject of the agreement is monthly rental payments. Since VAT is added to each leasing installment, with this form of leasing, unlike financial leasing, there is no obligation to pay VAT in full at the beginning of the leasing agreement. Additionally, it should be mentioned that the cost of obtaining income may also include a down payment.

This fee can be included as a one-time fee, which is confirmed by the individual interpretation issued by the Director of the Tax Chamber in Bydgoszcz on March 8, 2016, ref. ITPB1/4511–1158/15/AK, which reads:

(...) the conclusion of the contract is determined by the initial leasing fee, i.e. it should be related not so much to the entire contract understood in time, but to the moment of its conclusion. This applies not so much to the duration of leasing services, but to the right to use them in general. Therefore, no fee is charged for the entire duration of the leasing contract. Accordingly, this fee is a one-time expense associated with concluding a leasing agreement. Consequently, there is no obligation to settle it in proportion to the duration of the contract; the down payment must be included as a tax-deductible expense only once on the date it is incurred.

It is also worth remembering that the amount of remuneration agreed in the contract, less the VAT due, must correspond at least to the initial value of the fixed assets. After the end of the contract period, the lessee has the right to purchase the used item. In the case of operational leasing, the subject of the contract remains the property of the lessor, and depreciation is written off by the lessor.

Financial leasing. When choosing this type of leasing agreement, the taxpayer must know that the leased asset will be included in the assets of the lessee. Thus, unlike operating leasing, there is an obligation to write off depreciation. In this respect, operating leasing and financial leasing differ significantly. Additionally, the user may only include the interest part of the leasing installment as tax deductible costs. In the first installment, VAT must be paid in full in advance immediately upon receipt of the item. It is worth adding that the customer becomes the owner of the leased item automatically after paying the last installment. The situation is different in the case of the down payment; with financial leasing, the lessee does not bear the costs associated with this contribution. In the case of financial leasing, the item will be included in the register of fixed assets of the lessee, which makes depreciation write-offs.

The last decade has become a period of intense digitalization of economic processes. The source of market information has enabled the analysis of wider investment potential and an increasing understanding of the proper allocation of financial resources, as well as the speed and flexibility of trading available funds while maximizing profitability. In such conditions, one can confidently put forward the thesis about the revival of the leasing institution. Today, few entrepreneurs think about acquiring fixed assets - this is a relic of the past. Modern investments are based on the potential financial benefits that can be obtained, and this is achieved, including through: leasing, rental (short-term, long-term).

Entrepreneurs use leasing not only of cars, but also of all types of machines, devices, electronic equipment and real estate. However, nothing prevents this form of financing from also covering intangible assets. The form of leasing is, of course, decided by the entrepreneur, especially since operational leasing and financial leasing are two completely different types of leasing that impose different obligations on the lessee.

The decisive factor when choosing the type of leasing is the initial costs, which in the case of operational leasing are significantly lower due to less attraction of equity capital. The majority of contracts concluded on the Polish market are operating leases.

An entrepreneur entering into a financial leasing agreement is required to pay VAT in full in advance, and in case of operational leasing, VAT is added to each leasing payment.

In addition, it is recommended to select an operating lease if the expected useful life of the asset is relatively short. As a result, there may be an increase in ongoing operating expenses and a reduction in the tax base. The final choice of the form of the leasing agreement remains with the taxpayer. In this case, only the entrepreneur is able to determine which form will be most beneficial for him, taking into account the type of activity being carried out, the expected period of use of the object and financial issues, including taxation issues.

4. Conclusion

Intellectual property (IP) in the form of trademarks, patents, copyrights, know-how or designs is one of the main driving forces of the modern economy, representing a central (business) resource that is used in business processes. Although a license is undoubtedly one of the most common, when it comes to a significant range of benefits, it is worth mentioning that leasing intellectual property, especially a trademark, carries the potential for financial benefits, including tax ones. Multinational corporations use intellectual property (IP) to avoid taxes on a massive scale. Economists estimate that intellectual property abuse costs the U.S. budget \$90 billion annually, and curbing this practice is a real challenge for lawmakers and economics to develop desirable and effective solutions in this area. Tax Law.

Leasing is a "financial instrument" intended mainly for entrepreneurs. Regardless of what leasing formula an entrepreneur chooses, it should be perceived primarily as a method of external financing. Business practice shows that it is usually easier to obtain than a bank loan. This is due to the fact that leasing is not subject to restrictions arising from the provisions of banking legislation or the recommendations of the Polish Financial Supervisory Authority regarding bank loans. This article discusses the practical aspects of the use of operational and financial leasing in the case of intellectual property on the basis of current Polish and European legislation. The advantages and disadvantages of various types of lease of intangible property are revealed.

A significant part of a company's value is its equipment, buildings, furnishings and materials. However, intangible assets are becoming an increasingly important part of a company's overall asset portfolio, especially in the commercial realities of the digital age. These items typically maintain their value and sometimes even increase in value depending on current market conditions as well as the company's potential, unlike other types of assets that can lose value.

From patents to trade secrets, many intellectual property (IP) functions as intangible assets. The IRS describes assets in this category as valuable property that cannot be touched or seen. These items have always been an important part of daily activities in various fields, but the growing emphasis on "knowledge industries" in recent years has further emphasized the importance of intangible assets.

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LOGISTICS IN THE PROCESS OF ENTERPRISE MANAGEMENT IN CONDITIONS OF THE COVID-19 PANDEMIC ON THE EXAMPLE OF SELECTED ENTERPRISES

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Purpose: The aim of the article is to analyze and assess the role of logistics in the process of enterprise management during the COVID-19 pandemic on the example of selected manufacturing, trade and service enterprises.

Design/methodology/approach: The article is based on the study of literature and own empirical research. The results of own empirical research presented in the study constitute the effects of more extensive research on an in-depth analysis of the logistics process management in Polish manufacturing, trade and service enterprises in 2019-2021 in the context of shaping enterprise results. The research was conducted in 2022 among 335 randomly selected small, medium and large Polish manufacturing, trade and service enterprises.

Findings: The results of the research show that the strategic and operational management of logistics processes within the enterprise and between entities which are the links in the supply chain increasingly determined the economic and market results of the best surveyed enterprises and the supply chains they created during the COVID-19 pandemic. Thanks to adequately applied logistics to the occurred conditions, the best surveyed enterprises responded quickly and appropriately to the effects of the pandemic and created and maintained the competitive advantage. The analyzed enterprises did not use the full potential of logistics processes to reduce the negative influence of the COVID-19 pandemic on their results. The research confirmed that logistics played an extremely important role in the process of enterprise management during the COVID-19 pandemic.

Research limitations/implications: The article presents only selected aspects of logistics in the process of enterprise management of the surveyed enterprises during the COVID-19 pandemic.

Practical implications: The article offers logistics managers practical suggestions on how to use logistics to achieve above-average economic and market results in conditions of a pandemic.

Originality/value: The article fills the cognitive and empirical gap regarding logistics in the process of enterprise management during the COVID-19 pandemic.

Keywords: Logistics, enterprise, supply chain management, competitive advantage, COVID-19 pandemic.

Category of the paper: Research paper.

1. Introduction

Contemporary enterprises are increasingly exposed to unpredictable occurrences that have a significant influence on their functioning. In recent years, the COVID-19 pandemic have quickly caused economic shocks in most countries around the world and unprecedented, enormous and global changes in the conditions of functioning of economic entities. As a result of the COVID-19 pandemic, enterprises had to face challenges related to rapid changes in demand and supply, health and safety, supply chain, slowing down the globalization process, reorganization of global value chains, disruption of foreign direct investment flows, workforce, cash flows, sales and marketing, acceleration of digital transformation, robotization and automation of production (Donthu, Gustafsson, 2020; Acioli, Scavarda, Reis, 2021; Gorynia, Kuczevska, 2022; Zhaon, Chen, 2022; Choi et al., 2023; Klöckner et al., 2023). During the pandemic, the most effective managers took quick actions to reduce the likelihood of disruption and severity of the effects of the occurred events, and create and maintain competitive advantages of their enterprises.

The activity of every enterprise is related to logistics processes that concern physical flows, services and associated with them information within the enterprise and between economic entities participating in the delivery of a product or service to a customer. Logistics processes implemented within logistics system determine the results of enterprises and are very susceptible to disruptions during the pandemic. Logistics is responsible for managing logistics processes in order to provide the service desired by customers at the lowest possible costs. Logistics managers increasingly deal with logistics processes across the enterprise and the entire supply chain. The COVID-19 pandemic has caused unprecedented disruptions to logistics procurement processes, logistics production processes, and logistics distribution processes in enterprises and supply chains around the world (Chowdhury et al., 2021; Butt, 2022; Ardekani et al., 2023; Montoya-Torres, Muñoz-Villamizar, Mejia-Argueta, 2023; Rinaldi, Bottani, 2023). During the pandemic, logistics managers should very quickly identify rapidly emerging threats related to logistics processes, opportunities to reduce logistics costs, emerging opportunities and implement appropriate adaptation processes to rapidly changing market conditions.

The aim of the article is to analyze and assess the role of logistics in the process of enterprise management during the COVID-19 pandemic on the example of selected manufacturing, trade and service enterprises.

2. Theoretical aspects of logistics in business process management during the COVID-19 pandemic

The COVID-19 pandemic has induced unprecedented, enormous changes in the conditions of enterprise functioning, which overlapped with the determinants of activities of contemporary organizations before the pandemic. Fast, adequate and effective response of enterprises to the unprecedented dynamics of changes in the global market, complexity, uncertainty, high risk, growing and changing customer requirements and expectations, rapid technological progress, consequences of the COVID-19 pandemic, hypercompetition, growing political tensions and increased importance of national interests depend on the adequate management of physical flows, services and associated with them information at the scale of the enterprise and the entire market system (Remko, 2020; Roscoe et al., 2020; Chung, 2021; Herold et al., 2021; Park, 2021; Zahra, 2021; Wolniak, 2023).

Modern logistics managers should apply a strategic approach for creating logistics activities and solutions which is implemented at the strategic and operational level in the enterprise (Gąsowska, 2022a). Strategic decisions concern a long time horizon and come down to selecting some action options from an incomplete set of possibilities in an imperfectly perceived environment and the accompanying ambiguity and uncertainty (Czakon, 2020). At the strategic level, decisions are made regarding solving basic logistics problems and tasks. When there are serious disruptions in the environment, such as a pandemic, logistics managers should make strategic decisions adequate to the logistics conditions, regarding the reallocation of resources, reconfiguration of structures, processes and strategies. At the operational level, logistics managers make short-term decisions resulting from implementation of the strategic decisions and responding to current disruptions and problems.

The COVID-19 pandemic has induced many new challenges in the operational management of logistics processes in enterprises and supply chains (Paul, Chowdhury, 2020; Farooq et al., 2021; Schleper et al., 2021; Singh et al., 2021; Kayikci, Usar, Aylak, 2022; Mishra, Singh, Subramanian, 2022). Adequate operational management of logistics processes in the enterprise and between economic entities participating in the process of delivering a product or service to a customer enables the implementation of strategic goals, quick and appropriate response to changing wishes and expectations of customers, threats, disruptions, opportunities, risk reduction, and in the case of the occurrence of risk factors, the reduction effects of losses, ensuring business continuity, maintaining good reputation, better use of assets, generating sales revenues, reducing logistics costs, improving financial liquidity and protecting health and safety. Logistics affects the basic factors determining enterprise's existence in the conditions of a pandemic.

During the pandemic, the ability to adapt is very important. It means the ability to adapt to the changing environment and involves the necessity to make changes (Chingwena, Scheepers, 2022). Creating company value, competitive advantage and above-average results during the pandemic conditions is conditioned by building and improving dynamic capabilities (Dyduch et al., 2021; Ali et al., 2022; Ahmad, Naseem, Rehman, 2023; Dejardini et al., 2023; Kähkönen et al., 2023). The basic component of enterprise's dynamic capabilities is the ability to change. Logistics processes of enterprises during the pandemic must be adequate to rapidly changing conditions, which involves the necessity to make changes (Handfield et al., 2020; Yang et al., 2022; Gąsowska, 2022b; Gąsowska, 2022c; Zwolińska, 2022).

The most effective managers treat innovations as a response to difficult market conditions (Markovic et al., 2021). Open innovations played a key role in adapting the enterprise's activities to the conditions related to the COVID-19 pandemic (Greco et al., 2022; Sharma et al., 2022; Jabeen et al., 2023). In order to prevent unpredictable disruptions, enterprises should respond quickly and adequately to the effects of the pandemic, create and maintain a competitive advantage and implement logistics innovations (Dovbischuk, 2022; Gligor, Russo, Maloni, 2022; Orlando et al., 2022). The innovativeness of an enterprise in the area of logistics is conditioned by engaging appropriate financial resources, appropriate staff, knowledge, skills, appropriate culture supporting creativity and openness to new ideas, and cooperation with customers and entities involved in the process of delivering products or services to a customer.

The COVID-19 pandemic has caused enormous uncertainty and a sharp increase in risk in logistics systems. In such conditions, the key task of logistics managers is to strive to reduce the probability of disruption of logistics processes in the entire logistics system and to quickly take actions to reduce the severity of the effects of the occurred event (Handfield, Graham, Burns 2020; Kovács, Sigala, 2021). Digital technologies play an important role in the risk analysis of logistics systems, enable the acceleration of decision-making processes with the appropriate use of information, and facilitate quick responses to disruptions in logistics systems (Choi, 2021).

Logistics managers should build an information system enabling the integration and coordination of logistics processes, constituting the basis for effective solving logistics problems, enabling a very quick response to threats, identifying and exploiting opportunities faster than competitors, and reducing uncertainty and risk associated with logistics activities and solutions on the scale of the enterprise and the entire market system. The use of modern technologies in the area of logistics enables the enterprise to increase the speed and reliability of deliveries, provide and accelerate the information sharing, supports the traceability of physical flows along the supply chain, monitors and replenishes inventories, allows for the satisfaction of customer wishes and expectations, reduces operating costs, implements the principles of sustainable development, helps identify, analyze, reduce and monitor risks related

to logistics processes in the enterprises and supply chains (Fischer-Preßler et al., 2020; Acioli, Scavarda, Reis, 2021). The mentioned benefits are particularly important during the pandemic.

Cooperation with other entities, including competitors, may be a source of benefits, such as improving the level of customer service, greater flexibility, reducing costs, increasing operational efficiency, unique access to resources and competences, implementing innovations, reducing operational risk, increasing resistance to disruptions, quicker use of opportunities and, consequently, achieving above-average results in the conditions of the pandemic. Enterprises increasingly compete with supply chains. Logistics is a key area in supply chain management. Fast, efficient and effective logistics activities and solutions determine the survival and building the competitiveness of the supply chain in the conditions of the COVID-19 pandemic (Choi, 2020; Singh et al., 2021; Gąsowska, 2022b; Gąsowska, 2022c; Song et al., 2022).

Supply chains, especially the global ones, are particularly vulnerable to the disruptions and had to face enormous supply, demand and logistics challenges during the pandemic. According to many researchers, in conditions of extreme uncertainty, enterprises should create resilient supply chains (Pettit et al., 2019; Aslam et al., 2020; Świerczek, 2020; Madhavi, Wickramarachchi, 2022). The resilient supply chains are ready to respond quickly and effectively to emerging threats, maintaining continuity of operations at the desired level and control over the structure and functions (Ponomarov, Holcomb, 2009). The attributes of disruption-resistant supply chains are flexibility and adaptability. Research shows that during the pandemic, enterprises undertook proactive and reactive actions to build resilience to disruptions, but these were not enough to mitigate all the negative effects of the COVID-19 pandemic. The most effective factor in building supply chain resilience during the pandemic was innovation (Ozdemir et al., 2022). Building resilience to supply chain disruptions was also possible by systemic risk management in the supply chain, strengthening the position, building strong relationships with suppliers, customers and employees, adequate forecasting and designing products (Ozdemir et al., 2022; Browning et al., 2023; Gurbuz et al., 2023).

Agile, resilient, innovative and sustainable supply chains can respond quickly and effectively to emerging opportunities, short-term supply chain disruptions and long-term global crises such as the COVID-19 pandemic (Ivanov, 2022). The COVID-19 pandemic has contributed to the acceleration of digital transformations in enterprises and supply chains. Digital technologies help organizations develop global value chains, visibility, agility, flexibility and dynamic capabilities necessary for sustainable enterprise development, which enables enterprises creating the supply chain to achieve greater efficiency during the pandemic (Lee, Trimi, 2021; Ye et al., 2022).

3. Research methodology

The results of author's own empirical research presented in the study are the effects of more extensive research on an in-depth analysis of the logistics process management in Polish manufacturing, trade and service enterprises in the years 2019-2021 in the context of shaping enterprise's results. The research was conducted in 2022 using the method of direct interview with managers responsible for logistics in the surveyed companies and the method of computer-assisted interview conducted via the Internet with logistics managers. During the interviews, a detailed survey questionnaire was used, consisting of 39 questions.

335 randomly selected small, medium and large manufacturing, trade and service enterprises (based in Poland) from the following provinces were examined: Masovian, Lesser Poland, Kuyavian-Pomeranian, Greater Poland, Lodz, Lublin, Subcarpathian, Podlasie, Pomeranian, Silesian, Swietokrzyskie, Warmian-Masurian and Greater Poland. The majority of the surveyed population constituted enterprises from the Masovian Province. The surveyed enterprises were characterized by diverse competitive positions on the market.

The largest group among the surveyed companies constituted small enterprises (44.4%). The share of medium enterprises in the surveyed population was 30.1%. The smallest percentage of the surveyed enterprises represented large companies (25.5%). Manufacturing enterprises constituted 37.0% of the surveyed sample of the enterprises (14.3% small manufacturing enterprises, 11.9% medium manufacturing enterprises, 10.8% large manufacturing enterprises). Trade and service enterprises had a similar share in the surveyed population. Trade enterprises accounted for 32.2% of the surveyed companies (13.7% small trade enterprises, 10.4% medium trade enterprises, 8.1% large trade enterprises), whereas service enterprises constituted 30.8% of the surveyed population (16.4% small service enterprises, 7.8% medium service enterprises, 6.6% large service enterprises).

In the structure of the surveyed enterprises, from the point of view of the sales revenue criterion, the largest group constituted companies generating sales revenues up to PLN 10 million (41.1%). The second largest surveyed group were enterprises generating sales revenues from PLN 10 to 50 million (18.2%). There was also a large group of enterprises with sales revenues ranging from PLN 100 to 500 million (17.3%). Enterprises with sales revenues exceeding PLN 1 billion constituted 9.6% of the surveyed population. 8.7% of the surveyed companies were companies generating sales revenues from PLN 50 to 100 million. The smallest share in the surveyed population had enterprises generating revenues from PLN 500 million to PLN 1 billion (5.1%).

The majority of the surveyed enterprises (56.1%) conducted international operations. The vast majority of the surveyed national enterprises constituted small companies. Only 31 of the 149 small surveyed companies operated internationally. Among international enterprises, the largest group constituted companies with the share of exports in the sales value

up to 10% (18.5% of the surveyed sample of the enterprises). The second largest group among international enterprises were companies with the share of exports in the sales value above 50% (15.8% of the surveyed sample of the enterprises). Companies with the share of exports in the sales value in the range of 10-30% constituted 13.7% of the surveyed population. The analysis covered 28 enterprises with the share of exports in the sales value in the range of 30-50% (8.1% of the surveyed sample of the enterprises). The surveyed companies with international operations exported their products or services primarily to the European Union.

The research results presented in the article concern selected aspects of logistics in the surveyed enterprises in the years 2019-2021.

4. Logistics in management of the surveyed enterprises in the conditions of the COVID-19 pandemic – selected aspects

The logistics goals of the surveyed enterprises in 2019-2021 constituted the subject of the research. The analysis of the research results led to the conclusion that 331 out of 335 surveyed companies had clearly defined logistics goals in 2019-2021. The largest number of the survey participants declared that in 2019 the logistics goals of the enterprise were: improving customer service (76.1%), building customer trust (65.7%), shaping the enterprise's competitive advantage (54.6%), maximizing sales revenues (52.2%), reducing logistics costs (45.9%), reliability of deliveries (44.1%), increasing enterprise flexibility (43.3%), increasing enterprise adaptability (42.1%), increasing sensitivity to customer requirements (40.8%).

In the years 2020-2021, the surveyed enterprises operated during the COVID-19 pandemic. The analysis of the research results allowed for the conclusion that in 2020, in most of the surveyed enterprises, the logistics goals were: improving customer service (78.2%), building customer trust (69.9%), maximizing sales revenues (56.4%), shaping the enterprise's competitive advantage (55.2%), shortening the order fulfilment time (53.7%), increasing the enterprise's flexibility (51.6%), increasing the speed of response to changing conditions – agility (50.7%).

In 2021, respondents most often indicated that the logistics goals of the company were: improving customer service (86.6%), building customer trust (74.0%), shaping the enterprise's competitive advantage (69.2%), maximizing sales revenues (62.6%), shortening the order fulfilment time (61.8%), reducing uncertainty and risk of business activity (61.8%). The majority of the study participants declared that the logistics goals of the enterprise were: building an effective information system (59.4%), increasing the speed of response to changing conditions – agility (58.8%), reducing logistics costs (58.2%), increasing the enterprise's flexibility (57.3%), increasing the enterprise's adaptability (54.6%), building resistance to

disruptions (53.7%), increasing sensitivity to customer requirements (52.2%) and increasing reliability of supplies (50.7%).

In order to check whether there are significant differences in frequency of distributions between subsequent periods in the case of the answers regarding logistics goals in the surveyed enterprises, chi-square tests were performed. $P < 0.05$ was adopted as the limit of the statistical significance. In the following years, a statistically significant increase was observed in the frequency of choosing the following answer options regarding the logistics goals of the surveyed enterprises: shaping the enterprise's competitive advantage ($p < 0.001$), shortening the order fulfilment time ($p < 0.001$), building resistance to disruptions ($p < 0.001$), reducing uncertainty and risk of business activity ($p < 0.001$), increasing the speed of response to changing conditions – agility ($p < 0.001$), building an effective information system ($p < 0.001$), inventory protection ($p < 0.001$), making logistics sustainable ($p < 0.001$), improving customer service ($p = 0.001$), increasing the enterprise's flexibility ($p = 0.001$), reducing logistics costs ($p = 0.002$), increasing the innovativeness of logistics ($p = 0.002$), maintaining safety stocks ($p = 0.004$), increasing adaptability of the enterprise ($p = 0.005$), increasing sensitivity to customer requirements ($p = 0.013$), optimization of logistics personnel management ($p = 0.015$), maximization of sales revenues ($p = 0.02$), increasing resource productivity ($p = 0.046$), optimization of inventory levels ($p = 0.048$). The response to increasing the financial liquidity was $p = 0.05$.

The results of the research show that in the analyzed period 15.2% of the surveyed enterprises did not create plans to achieve logistics goals. The vast majority of the surveyed companies had specified logistics goals in their operational plans (80.3% in 2019, 82.4% in 2020, 83.6% in 2021). During the examined period, the percentage of companies that included logistics problems in the process of strategic planning increased the most (34.9% in 2019, 36.7% in 2020, 46.3% in 2021), which ensured the systemic and consistent pursuit to achieve the set goals. In the years 2019-2021, most medium and large enterprises created logistics goals defined in their strategic plans.

The enterprise's logistics goals should be supported by an appropriate logistics strategy. The research shows that not all surveyed enterprises had logistics goals supported by an appropriate strategy. In the years 2019-2021, less than half of the surveyed enterprises had a formalized global logistics strategy, i.e. they had developed a coherent concept of the systemic operation in the area of logistics, implementation of which was to achieve the competitive advantage (39.2% in 2019, 45.4% in 2020, 47.2% in 2021). In 2019, 24.5% of the surveyed companies had a formalized supply chain management strategy (38 manufacturing enterprises, 27 trade enterprises and 17 service enterprises). In 2020, the number of the surveyed manufacturing enterprises possessing a formal supply chain management strategy increased to 39, and in the case of trade enterprises to 31. In 2021, 29.9% of the surveyed companies implemented a supply chain management strategy (47 manufacturing enterprises, 33 trade enterprises and 19 service enterprises).

The analysis of the respondents' declarations allows for the conclusion that in the years 2019-2021, almost every fifth surveyed enterprise did not have a formalized logistics strategy (21.2% in 2019, 19.4% in 2020, 17.9% in 2021). The percentage of surveyed enterprises that did not have a formalized logistics strategy was much higher in small enterprises than in medium and large enterprises. In the years 2019-2021, over 30% of the surveyed enterprises did not have a formalized global logistics strategy, but had developed partial strategies for supply and distribution (14.3% in 2019, 11.3% in 2020, 11.0% in 2021), partial strategies for procurement, production and distribution (12.5% in 2019-2021) or partial strategies for production and distribution (8.4% in 2019, 9.3% in 2020 and 2021).

In the years 2019-2021, most of the surveyed medium and large companies, in which logistics created the competitive advantage, implemented a supply chain management strategy that was in a constant stage of creation and development and was characterized by an immediate response to changing customer requirements, environmental conditions and competitors activities. More than half of the surveyed enterprises with the best economic and market results during the pandemic implemented a supply chain management strategy, respecting, at the same time, the principles of sustainable development.

The research results provided the basis for formulating the conclusion that almost every second surveyed enterprise cooperated with enterprises in the supply chain to reduce the negative impact of the COVID-19 pandemic on their results (49.0% in 2020, 51.6% in 2021). In the years 2019-2021, the vast majority of the surveyed enterprises did not integrate logistics processes with all entities in the supply chain and did not build relationships in the supply chain based on the principles of trust, sharing risks and benefits which translates into not using all possibilities of logistics activities and solutions to adequately respond to the effects of the pandemic.

The importance of logistics in enterprise management in the years 2019-2021 was the subject of the research. Most respondents indicated that in 2019, logistics had a significant influence on the quality of customer service (79.7%) and creating and maintaining the competitive advantage (76.4%). Subsequently, the participants of the study indicated the following importance of logistics in enterprise management: logistics has a significant influence on the reduction of operating costs (66.3%), logistics has a significant influence on the increase in sales revenues (66.0%), logistics enables reliable deliveries (65.4%), logistics has a significant influence on the increase in market share (64.8%), logistics increases the enterprise's flexibility (55.2%), logistics has a significant influence on the reduction of transport costs (54.3%), the information system has a large influence on the economic and market results of the enterprise and achieving the advantage over its competitors (53.7%), there is still a very large potential for improvements in operational logistics (50.7%), logistics has a significant influence on the enterprise value (50.1%).

In 2020, over 80% of the respondents indicated that logistics had a significant influence on the quality of customer service (86.3%) and logistics had a significant influence on creating and maintaining the competitive advantage (83.2%). According to 75.8% of the respondents, logistics had a significant influence on adapting the enterprise's activities to the conditions related to the COVID-19 pandemic. In more than half of the surveyed enterprises: logistics had a significant influence on the increase in sales revenues (69.9%), logistics had a significant influence on the reduction of operating costs (68.1%), logistics enabled reliable deliveries (66.9%), logistics had a significant influence on the increase in market share (66.2%), logistics increased the enterprise's flexibility (64.5%), operational logistics still had a very large potential for improvements (61.8%), the information system had a significant influence on the economic and market results of the enterprise and achieving the advantage over its competitors (59.1%), logistics had a significant influence on the increase in the innovativeness of the enterprise (56.7%), logistics had a significant influence on the adaptability of the enterprise (55.8%), logistics had a significant influence on the reduction of transport costs (55.2%), logistics increased the enterprise's resistance to disruptions (54.9%), logistics became more and more professional and organized (51.6%), logistics had a significant influence on the reduction of storage costs (51.0%) and logistics had a significant influence on increasing the financial liquidity (50.4%).

Nearly 90% of the survey participants indicated that in 2021 logistics had a significant influence on creating and maintaining the competitive advantage (90.7%), and the quality of customer service (89.6%). 82.4% of the respondents indicated that logistics had a significant influence on adapting the enterprise's activities to the conditions related to the COVID-19 pandemic. Subsequently, the participants of the study indicated the following importance of logistics in enterprise management: logistics has a significant influence on the reduction of operating costs (77.9%), logistics has a significant influence on the increase in sales revenues (75.2%), logistics has a significant influence on the increase in market share (72.8%), logistics enables reliability of deliveries (71.6%), logistics increases the enterprise's flexibility (70.7%), operational logistics still has a great potential for improvements (68.4%), logistics has a significant influence on the increase in the enterprise adaptability (68.1%), the information system has a significant influence on the economic and market results of the enterprise and achieving the advantage over its competitors (65.7%), logistics increases the enterprise's resistance to disruptions (65.7%), logistics is becoming more and more professional and organized (64.5%), logistics has a significant influence on the increase in the enterprise innovativeness (60.1%), logistics has a significant influence on the enterprise value (55.8%), logistics has a significant influence on the reduction of storage costs (55.2%), logistics has a significant influence on the reduction of transport costs (58.2%), logistics has a significant influence on increasing the financial liquidity (51.3%).

In the following years, the frequency of selecting the following answer options regarding the importance of logistics in the management of the surveyed enterprises increased significantly: logistics has a significant influence on creating and maintaining competitive advantage ($p < 0.001$), logistics increases the enterprise's flexibility ($p < 0.001$), logistics has a significant influence on the increase in the enterprise adaptability ($p < 0.001$), logistics increases the enterprise's resistance to disruptions ($p < 0.001$), operational logistics still has a great potential for improvements ($p < 0.001$), logistics is becoming more and more professional and organized ($p < 0.001$), logistics is a tool for sustainable development ($p < 0.001$), logistics has a significant influence on the quality of customer service ($p = 0.001$), logistics has a significant influence on the reduction of operating costs ($p = 0.002$), the information system has a significant influence on the economic and market results of the enterprise and achieving the advantage over its competitors ($p = 0.007$), logistics is included in the overall strategy of the enterprise ($p = 0.007$), logistics has a significant influence on the increase in the enterprise innovativeness ($p = 0.008$), logistics has a significant influence on adapting the enterprise's activities to the conditions related to the pandemic COVID-19 ($p = 0.03$), logistics has a significant influence on the increase in sales revenues ($p = 0.03$).

The research also covered the changes actually made in the logistics processes of the surveyed enterprises in the years 2019-2021. In 2019, the respondents most often indicated the following changes in logistics processes: improving the quality of customer service (50.4%), increasing sales revenues (49.6%), strengthening cooperation with customers (45.7%), strengthening cooperation with suppliers (45.1%), increasing the ability to achieve the competitive advantage (43.2%), increasing flexibility (44.2%), cost reduction (43.2%), increasing the efficiency and effectiveness of logistic distribution processes (41.2%).

The analysis of the research results provided the basis for formulating the conclusion that in 2020 most of the surveyed enterprises made the following changes in logistics processes: improving the quality of customer service (55.2%), tightening cooperation with customers (52.2%), increasing flexibility (52.2%), tightening cooperation with suppliers (51.3%). The next most frequently mentioned changes in the logistics processes of the surveyed enterprises were: shortening the order fulfilment time (47.8%), increasing the efficiency and effectiveness of logistics supply processes (46.6%), possessing diversified supply sources (45.1%), cost reduction (44.2%), increase in the efficiency and effectiveness of logistics distribution processes (44.2%), increase in sales revenues (43.6%), health protection and safety assurance (43.3%), increase in innovativeness (41.9%), development of distribution channels (41.5%), reliability of deliveries (40.3%).

In 2021, the majority of the survey participants indicated that in the analyzed enterprise the following changes were made in the logistics processes: improvement of the quality of customer service (61.2%), shortening the order fulfilment time (55.5%), increase in sales revenues (54.0%), strengthening cooperation with customers (53.4%), strengthening cooperation with suppliers (51.6%), cost reduction (50.7%). In almost every second surveyed enterprise changes

in the logistics processes included: development of distribution channels (49.6%), increasing the ability to achieve the competitive advantage (49.0%), increasing flexibility (48.7%), increasing the efficiency and effectiveness of logistics procurement processes (47.2%), possessing diversified supply sources (47.1%). Subsequently, the respondents mentioned the following changes in the logistics processes of the surveyed enterprises: usage of new distribution channels (46.0%), increase in the efficiency and effectiveness of logistics distribution processes (44.8%), reliability of deliveries (44.5%), increase in innovativeness (43.3%), health protection and safety assurance (42.7%), increase in sensitivity to customer requirements (42.7%), implementation of new information and communication technologies (41.8%), increase in the effectiveness of the information system (41.5%), implementation of new digital technologies (40.3%), reducing uncertainty and risk (40.1%).

In the following years, a statistically significant increase was observed in the frequency of selecting the following answer options regarding the changes actually made in the logistics processes of the surveyed enterprises in the years 2019-2021: shortening the order fulfilment time ($p < 0.001$), usage of new distribution channels ($p < 0.001$), health protection and safety assurance ($p < 0.001$), increase in innovativeness ($p < 0.001$), development of distribution channels ($p < 0.001$), possessing diversified supply sources ($p < 0.001$), increase in sensitivity to customer requirements ($p < 0.001$), making logistics processes sustainable ($p < 0.001$), implementation of new information and communication technologies ($p = 0.001$), implementation of new digital technologies ($p = 0.001$), increase in the effectiveness of the information system ($p = 0.002$), changes in logistics staff management ($p = 0.002$), increase in the efficiency and effectiveness of logistics procurement processes ($p = 0.004$), improvement of the quality of customer service ($p = 0.02$), increase in sales revenues ($p = 0.025$), increase in the ability to achieve the competitive advantage ($p = 0.03$), reduction of uncertainty and risk ($p = 0.03$), increase in the efficiency and effectiveness of processes in the area of reverse logistics ($p = 0.04$).

It should be emphasized that in 2020 and 2021, the surveyed enterprises made changes in logistics more often than in 2019. Changes made in logistics during the pandemic allowed the surveyed companies to adapt better to rapidly changing operating conditions. The research results provided the basis for formulating the conclusion that in the years 2020–2021, the most frequently mentioned main cause of changes in the management of logistics processes of the surveyed enterprises was the COVID-19 pandemic (73.3% in 2020, 72.8% in 2021). In the analyzed period, some enterprises did not achieve all logistics goals, which adversely affected the economic and market results of these companies. It is worth noting that in 2020 and 2021, the surveyed enterprises failed to achieve all logistics goals more often than in 2019. This is confirmed by a very large potential for improvements in operational logistics indicated by the respondents (50.7% in 2019, 61.8% in 2020, 68.4% in 2021).

Logistics innovations implemented in the surveyed enterprises in the years 2019-2021 constituted the subject of the study. During the analyzed period, 93.7% of the surveyed enterprises implemented logistics innovations. The most frequently implemented logistics innovations in the surveyed enterprises in 2019 were the improvement and development of logistics processes to improve customer service (47.5%) and the improvement of work organization (45.1%). In the years 2020-2021, the majority of the survey participants indicated that logistics innovations consisted in improving the work organization (63.5% in 2020, 65.1% in 2021) and improving and developing logistics processes to achieve improvement in customer service (53.4% in 2020, 59.1% in 2021).

In the following years, a statistically significant increase was observed in the frequency of selecting the following answer options regarding logistics innovations implemented in the surveyed enterprises in 2019-2021: improvement of work organization ($p < 0.001$), usage of new distribution channels ($p < 0.001$), improvement and development of logistics processes to achieve improvement in customer service ($p = 0.001$), usage of information and communication technologies ($p = 0.001$), usage of digital technologies ($p = 0.001$), improvement and development of logistics processes to achieve time advantage ($p = 0.04$).

The research results provided the basis for formulating the conclusion that in 2019 the sources of logistics innovations most frequently indicated by the respondents were employees' ideas and enterprise's own resources (51.3%), monitoring competitive enterprises and products on the market (48.1%) and customers (43.3%). In 2020 and 2021, the vast majority of the surveyed enterprises implemented logistics innovations in response to the COVID-19 pandemic (68.7% in 2020, 66.3% in 2021). Subsequently, the respondents indicated that the sources of innovation during the pandemic were: employees' ideas and enterprise's own resources (56.4% in 2020, 55.8% in 2021), monitoring competitive enterprises and products on the market (51.9% in 2020, 50.4% in 2021), customers (47.2% in 2020, 47.8% in 2021) and suppliers (43.3% in 2020, 43.0% in 2021). The economic considerations and the ability to better adapt the enterprise to the conditions related to the pandemic played a key role in decisions to implement logistics innovations during the pandemic.

5. Conclusion

The research shows that the pandemic has resulted in a significant increase in the importance of logistics in shaping the results of the analyzed enterprises. Most enterprises achieving the best results during the pandemic quickly and adequately adjusted logistics goals to dynamically changing conditions, included them in strategic and operational planning and implemented a supply chain management strategy that was in a constant state of creation and development, characterized by an immediate response to changing customer requirements,

environmental conditions and competitors' activities. During the pandemic, the best enterprises made numerous changes in the logistics process management within the company and between entities in the supply chain, appropriate to the conditions; they shortened the order fulfilment time, tightened contacts with suppliers and customers, used new distribution channels, developed existing distribution channels, increased operational flexibility, sensitivity to customer requirements, adaptability and resistance to disruptions, built customer trust and sense of security, increased the efficiency and effectiveness of all logistics processes, used digital technologies to analyze, create, implement and transform logistics processes, possessed diverse sources of deliveries, took systemic actions to reduce uncertainty and risk and balanced economic, ecological and social goals. Thanks to the implemented logistics innovations, the best companies responded quickly and adequately to the effects of the pandemic and created and maintained their competitive advantages. The best-performing enterprises used partnership relationships with suppliers based on the exchange of strategic and operational information to jointly implement logistics innovations contributing to the improvement of the efficiency and effectiveness of logistics processes, which translated into achieving above-average economic and market results.

Strategic and operational management of logistics processes within the enterprise and between entities which are the links in the supply chain, increasingly determined the economic and market results of the best surveyed enterprises and the supply chains they created during the COVID-19 pandemic. All enterprises did not use the full potential of logistics processes to reduce the negative impact of the COVID-19 pandemic on their results. The research confirmed that logistics plays an extremely important role in the process of enterprise management during the COVID-19 pandemic.

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INTELLECTUAL CAPITAL AND COMPANY VALUE: THE EXAMPLE OF THE WARSAW STOCK EXCHANGE

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Purpose: The main purpose of the study is to ascertain whether intellectual capital will affect company growth expressed by the earnings per share (EPS) indicator.

Design/methodology/approach: The relationship between the company's growth expressed by EPS and intellectual capital was checked using the vector autoregression (VAR) model.

Findings: This study analyzed the relationship between measures of intellectual capital and the future development of companies listed on the main market of the Warsaw Stock Exchange. It demonstrated that measures of intellectual capital are reflected in the future growth of enterprises, especially earnings per share, and that the development phase can change the results related to the opportunity for company growth and future development.

Research limitations/implications: The sample size is small for any generalization. A mixed method approach in the future could contribute to a holistic finding

Practical implications: The results of empirical analyzes reflect the growth of enterprises and should be based on various economic measures, because it is impossible to clearly determine which indicators influence or do not influence this growth and to what extent they determine it.

Originality/value: The added value of the presented research results concerns the demonstration that investments in human capital influence the increase in the value of the enterprise on the capital market. Although the Polish market, with companies listed on the WIG, is considered an example of a developing economy, the Polish capital market has not yet been covered by this type of research.

Keywords: company growth, EPS, intellectual capital, Warsaw Stock Exchange.

Category of the paper: research paper.

1. Introduction

The main goal of a modern enterprise is to maximize its value in the long term. It results from the productivity not only of the enterprise's tangible resources, but also its intangible assets. For a long time, what determined a company's position and value was predominantly its material resources (Jordão et al., 2022). However, an enterprise's value depends less and less on tangible assets; the factor that is increasingly important for the growth of the company's

value is the ability to use intangible resources, i.e., its intellectual capital. Each company has these assets, but not all of them appreciate their importance or manage them effectively, and it is the effective management of this capital that is vital for the development of the company and shaping its value (Munir, Djaelani, 2022).

The dynamically changing political and economic conditions after 1989 and the transition from a centrally planned economy to a capitalist economy, resulted in a thriving development of the labor market in Poland. Taking advantage of the achievements of the global economy, access to knowledge and technological thought at the highest level, and observing global standards in the approach to organizations and employees forced changes in the functioning of numerous modern enterprises emerging in Poland. Outwork was less and less important; thought and specialist knowledge became more important, and such knowledge could only be provided by well-educated, satisfied, and loyal employees. Its important role in the functioning and development of enterprises began to be noticed. A man, with his knowledge, experience and competence, became one of the most important factors in the organization. Success in a competitive market often depended on the human resources available (Snyder, Pierce, 2002). The implementation of modern information technologies and the increase in the share of specialized service companies in the Polish market meant that companies increasingly sought employees whose knowledge and skills would allow them to be successful.

The main purpose of the study is to ascertain whether intellectual capital will affect company growth expressed by the earnings per share (EPS) indicator (Salvi et al., 2020). It results from the productivity not only of the enterprise's tangible resources, but also its intangible assets. The relationship between the company's growth expressed by EPS and intellectual capital was checked using the vector autoregression (VAR) model.

The added value of the presented research results concerns the demonstration that investments in human capital influence the increase in the value of the enterprise on the capital market. Although the Polish market, with companies listed on the WIG, is considered an example of a developing economy, the Polish capital market has not yet been covered by this type of research.

The paper comprises the following sections: a literature review, a presentation of the data and methods, a discussion of the research results and conclusions.

2. Literature review

Value is one of the most important elements of a company, and the maximization of value is the goal of modern enterprises. The conscious influence on the company's value formation is manifested through institutionalized and formal actions. By utilizing a comprehensive understanding of the essence, features, and determinants of the company's value, coupled with

proper analysis, these actions can maximize value to benefit owners while shaping the desired pace of development and image of the company (Dmitriev et al., 2020; Berzkalne, Zelgalve, 2014; Tseng, Goo, 2005). Thus, a precise definition and understanding of the sources of company value are essential to the development of any company management strategy aimed at maximizing its value.

In the 21st century, a company's success in the market must be associated with its ability to acquire and use intangible resources. A modern employer must efficiently and dynamically transform employees' skills, competencies, and knowledge into lucrative solutions and services. Developing new technologies, implementing advanced software, creating a positive brand image, or creating an extensive network of contacts and customer base will provide the organization with the greatest value a growing company can have – its intellectual capital (Postula, Chmielewski, 2019; Kasych, 2020; Ali, Anwar, 2021).

The intellectual capital of a company is a difficult concept to define clearly. The most common definition is perceiving it as a source of creating company value thanks to intangible resources, such as the skills and knowledge of company employees, patents, trademarks, information systems (Marcinkowska, 2013; Widiartanto et al., 2020). Intellectual capital is an asset that is created on the basis of knowledge from the above. intangible assets. These elements also shape the market value of the organization. It can therefore be concluded that intellectual capital, which is intangible, contributes to the process of creating tangible assets. It is the hidden potential of the enterprise (Edvinsson, 2000; Agomor et al., 2022).

Initially, intellectual capital consisted of two components, which were information together with knowledge capital and structural capital. The first element was both formal and informal. The second functioned as a process of collecting, storing and re-receiving information in order to communicate it in a processed form, i.e. knowledge. The consequence of this was the emergence of an idea whose aim was to improve the flow of information in various organizations through the use of network technologies. As a result, a new capital component has also emerged, which is customer capital (Crupi et al., 2021; Dumay et al., 2020; Alvino et al., 2021).

Currently, we can come across many different concepts related to the presentation of individual components of intellectual capital. In the literature, many authors present different, in their opinion, views. So far, it is difficult to specify this capital (Nirino et al., 2022).

Table 1.

Classification of elements of intellectual capital according to individual authors

Bratnicki (2000)	Human capital Social capital Organizational capital	Saint-Onge (1996)	Human capital Organizational capital Customer Capital
Edvinsson and Malone (1997)	Human capital Structural capital	Sullivan (1998)	Human capital Intellectual assets Intellectual property

Cont. table 1.

Pietruszka-Ortyl et al. (2021)	Social capital Organizational capital	Ritvanen, Sveiby (2018)	Employee competencies The internal structure of the organization The external structure of the organization
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Source: own study.

According to one of the authors, intellectual capital consists of human, structural or organizational capital. Others classify its elements as human assets, or intellectual property. In turn, others divide it through the prism of intangible resources. Undoubtedly, it can be seen that the most frequently mentioned component is human capital. In many concepts of intellectual capital, it is presented as the most important component from which other components may arise. The other elements have different names in given ideas, but they have a common property: one of the groups of components is external and the other is internal (Ujwary-Gil, 2009; Cremers et al., 2019).

Human capital is an element that consists of all skills, abilities, knowledge, experience and individual competences of employees and managers of the enterprise. In other words, it is also the employee's ability to perform the work entrusted to him and to solve the difficulties arising in the company. Human capital is based on the possibility of creating interpersonal relationships. This capital is responsible for the formation of knowledge in many organizations. Human capital does not constitute the property of the company, as it is only used during the employment of the employee. The poor quality of this capital significantly reduces the internal potential in the company (Sodirjonov, 2020; Batish et al., 2021).

Another element may be organizational capital, the components of which support the work of all employees. It can be grouped into structural capital (organizational structure of the company), process capital (methods, rules, techniques that improve work efficiency) and innovative capital (innovative awareness of the company). Compared to human capital, it can be owned by the company and is also the result of people's work (Bassi, Laurie, 1997; Tseng, Lee, 2014; Hsu, Fang, 2009; Alhasani et al., 2023).

Intellectual capital can also include market capital. It is the result of the involvement of human capital and organizational capital. It consists of the relationship between the external environment (customers, competitors, suppliers, partners) and the company. This capital also includes customer loyalty to the company. Just like organizational capital, it is owned by the company, but it can be sold. He is difficult in management because it is outside the enterprise (Bellucci et al., 2020; Quintero-Quintero et al., 2021; Rossi et al., 2021; Olarewaju et al., 2021).

This classification should also be supplemented by the region's capital. It is understood as intangible resources of the region, thanks to which it is possible to develop innovations and its absorption. It can be created by the degree of regional industrialization, labor mobility, location and technological development (Faggian et al., 2019).

Obtaining a competitive advantage by enterprises is a huge challenge in today's economic reality. This is because the contemporary determinant of competitiveness, apart from the proposed products and services, is the unique and unconventional knowledge that creates intellectual capital. Enterprises compete with each other in areas such as: innovation, flexibility, ability to adapt to changing consumer needs mainly through specific and hard-to-forge intangible deposits (i.e. intellectual capital) (Luthy, 1998; Poorani, Sullivan, 2019; Zahid, 2021). Intellectual capital is an important factor in the permanent success of the company and has a significant impact on its competitive advantage. It plays an increasingly important role in all organizations, both business, public and public benefit organizations. The need for identification, including measurement, and sustainable use and development of these hidden intellectual resources occurs in every organization. The value of knowledge-based companies, which make maximum use of the intellectual potential of people and possessed structural capital, increases the fastest in creating unique products and services. The companies that dominate the market in this area are: telecommunications companies, IT companies, trade and service companies, insurance companies and pharmaceutical concerns (Bassi, Laurie, 1997; Tseng, Lee, 2014; Hsu, Fang, 2009; Alhasani et al., 2023). Knowledge, competences, as well as rare, even unique skills of employees are perceived by some economists as very important and actually the only source of competitive advantage of a given company. It is worth noting that in the era of knowledge-based economy, the process of educating and developing employees is treated as a priority investment that is a tool for improving the current efficiency and shaping the strategic potential of the company (Bukh et al., 2001; Nirino et al., 2022).

The emergence of a new factor determining the market value of an enterprise, which is intellectual capital, forces the need to measure it. So far, a uniform measure of the value of a company's intellectual capital, recognized by all, has not been created. Experts in the subject try to create synthetic indicators based on the measurement of individual forms of intellectual capital. Due to the immeasurability of some elements, this task is very difficult (Kubicka, Dubanevich, 2017).

3. Research methods and statistical data

The main purpose of this study is to verify whether intellectual capital affects company growth, as expressed by the EPS indicator (Salvi et al., 2020; Subaida et al., 2018). In this paper, company growth is represented by the growth in earnings per share.

The growth rates of earnings per share are determined in the following way:

$$\Delta EPS_{+n} = \frac{EPS_n - EPS_0}{TA_0}, \quad (1)$$

where: EPS_n is earnings per share in n years ahead from year 0. Earnings growth is calculated in relation to asset size (Total Asset), as earnings can be negative. A change in the ratio from the negative and positive value of earnings is not symmetric and could affect the results.

Two indicators, Human Capital Value Added (HCVA) and Human Capital Return On Investment (HCROI), were adopted as the measures of intellectual capital for further analysis (Priyandana, 2022; Word Bank, 2021)

HCROI is an indicator of the return on investment in human capital. It is a metric that represents the dollar value that employees contributed compared to the resources employers spent on them, including compensations, benefits, and training. It can be treated as the basic measure of the profitability of human resources on the scale of the entire company (Zahid, 2021). It is the amount of profit made by a company against every dollar invested in their human capital compensation. The HCROI shows the ratio of income derived against total employment costs (Poorani, Sullivan, 2019). HCROI shows the financial value individually or collectively contributed by employees, providing a true measure of the productivity of human resources.

The indicator is calculated as follows:

$$HCROI = \frac{R - (OC - TLC)}{TLC} \quad (2)$$

where:

R = Revenue.

OC = Operating Costs.

TLC = Total Labor Costs.

A positive HCROI means that the costs of employee salaries translate into company revenues, leading to increased investment opportunities. By contrast, a negative HCROI means that the employees use more resources to perform their work than they generate income (Vodák, 2010). HCROI helps to analyze which factors help or hinder an organization's profitability and productivity, and they can be either organizational or personal factors.

HCVA shows the company's profit that is attributable to the person employed. This profit includes taxation, and the cost of invested capital is deducted. It is an indicator, or measurement, of the financial value (profit) an average employee brings to an organization. In other words, it shows the average profit per employee or to what extent the average employee contributes to the bottom line. HCVA is commonly calculated on a quarterly basis, which means it is calculated four times each year. This measure is considered an important criterion for evaluating an enterprise's management staff. It shows what added value employees create for the organization in terms of full-time equivalents (Fariana, 2014; Ahmed et al., 2019).

The indicator is calculated as follows:

$$HCVA = \frac{R-(OC-TLC)}{E} \quad (3)$$

where:

R = Revenue.

OC = Operating Costs.

TLC = Total Labor Costs.

E = Number of employees (full-time equivalent).

The HCVA metric measures employees' profit contribution once costs have been removed. This metric can be embedded in the profit and loss statement and monitored, managed, and reported by month, by division, and compared to previous years. The HCVA looks at the human impact on revenue by numbers and by visuals. If HCVA is dropping, then it might be worth analyzing further employee data and determining if people are taking their allocated annual leave; if not, perhaps they are burnt out or stressed. Alternatively, the company may need to employ more people or change working practices.

The relationship between the company's growth expressed by Δ EPS and intellectual capital was checked using the vector autoregression (VAR) model.

The choice of lag order is a very important issue in the vector autoregressive model. There are several criteria that will indicate the best lag order. The most popular are:

- Akaike information criterion (AIC).
- Schwarz information criterion (BIC).
- Hannan-Quinn information criterion (HQ).

All of the above criteria point to the order of delay with the lowest value, which therefore gives the least information loss. When creating a VAR model, make sure that it does not have autocorrelation of residuals, not only in the case of the first order, but also higher. To answer the question of whether there is an autocorrelation, the Ljung-Box test can be used, and so it was done in this case. The Ljung-Box test did not show the existence of autocorrelation of residuals, not only in the case of the first order, but also higher.

As with AR models, in VAR model, it does not have a division into exogenous and endogenous variables, as each variable in the model affects the other variables, and the modeling process applies to each variable. Thanks to this dependence, it is possible to better model the studied phenomenon. In every process in the economy, there are conjugate dependencies, and their existence makes it possible to take VAR models into account. Another feature that distinguishes VAR models from ordinary structural models is that there are no zero restrictions imposed on the model's parameters. This process can be represented by the equations below:

$$y_t = \alpha_0 + \sum_{j=1}^k \alpha_{1j} y_{t-j} + \sum_{j=1}^k \beta_{1j} x_{t-j} + \varepsilon_{1t} \quad (4)$$

$$x_t = \alpha_0 + \sum_{j=1}^k \alpha_j x_{t-j} + \sum_{j=1}^k \beta_j y_{t-j} + \varepsilon_t \quad (5)$$

In that case, the null hypothesis is as follows:

$$H_0: \beta_1 = \beta_2 = \dots =: \beta_k = 0 \quad (6)$$

This means that there is no causality from the explanatory variable to the response variable.

The VAR model examined the impact of the measure of intellectual capital (HCROI or HCVA) on selected variables that explain the company's growth potential; the basic formula (4-6) is presented above. The VAR models were made to indicate the value of the impact factor in the case of a statistically significant relationship between the variables. The following financial data were analyzed:

- Δ EPS – earnings to the number of issued shares,
- IC_t – measure of intellectual capital (HCROI or HCVA) in period t.

The study was conducted on a group of non-financial companies listed on the Warsaw Stock Exchange included in the WIG index from 01/01/2013-31/12/2020. In addition, large companies included in the WIG 30 index and medium-sized companies included in the WIG 40 index were extracted from the WIG index to better verify whether the examined relationships also apply to the group of large and medium-sized companies. All companies that are also included in the WIG30 index, as well as banks and other financial institutions, were excluded from the mWIG40 index. The study was conducted on annual data. All data used in the study came from the NOTORIA and Bloomberg databases. Prices have been adjusted for equity changes such as pre-emptive rights, dividends, and splits. The table below presents data statistics for the analyzed indices.

Table 2.
Data descriptive statistics

	Mean	Median	Std. Dev.
WIG			
HCROI	335043.323	5930.680	699604.5
HCVA	1410.782	12.7753	3298.159
EPS	10.818	2.584	35.651
WIG 30			
HCROI	4138.229	1304.085	8415.002
HCVA	4.203239	2.277347	6.749219
EPS	13.39585	1.22	48.38089
WIG 40			
HCROI	6806.368	1186.446	12772.44
HCVA	10.69386	2.988823	16.16282
EPS	7.937046	4.925	8.251012

Source: own study.

As the table above shows, the HCROI and HCVA ratios in the WIG30 companies are lower than in the WIG40 companies. With EPS, the situation is reversed; higher values are recorded for large companies from the WIG30 index and lower for medium-sized companies included in the WIG40 index.

4. Empirical research

The main purpose of this study is to verify whether intellectual capital will affect the company's growth expressed by the Δ EPS indicator. The study was conducted using the VAR model, and the results from the individual groups of companies are presented in the table below. The Granger test (Bessler and Kling, 1984) of the analyzed variables was conducted first.

Table 3.
Granger test

	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
	WIG30		WIG 40		WIG	
HCROI \Rightarrow Δ EPS	-0.0004	0.3985	0.00015	0.0240	0.000005	0.0484
Δ EPS \Rightarrow HCROI	-11.9962	0.3985	243.438	0.0240	2420.1	0.0484
HCVA \Rightarrow Δ EPS	1.4518	0.0042	-0.0574	0.1922	0.0005	0.3472
Δ EPS \Rightarrow HCVA	0.03646	0.0042	-0.2203	0.1922	5.3441	0.3472

Source: own study.

As can be seen from Table 3 above, in the case of the WIG 40 indices and the entire WIG index, only the HCROI index has an impact on enterprise growth expressed as Δ EPS. On the other hand, in the case of the WIG30 index, i.e., an index that represents large companies, the HCVA index has an impact on Δ EPS. We created VAR models with one explanatory variable, namely HCROI and HCVA, and a dependent variable, Δ EPS. Our analysis demonstrated that Granger influence runs from HCROI and HCVA to Δ EPS. We selected one lag period for the dependent variable in each model. The results for the VAR models are presented in Table 4.

Table 4.
VAR models for selected variables

Specification:	Δ EPS WIG 30	Δ EPS WIG 40	Δ EPS WIG
Δ EPS(-1)	0.7949 ***	0.7798 ***	0.789101 ***
Const	1.4686	2.0730 ***	2.51033
HCROI	0.0002	0.000005 **	-0.0002 *
HCVA	0.7736 **	0.01414	0.000028
R-squared	0.6359	0.6208	0.6245
Adj. R-squared	0.6285	0.6121	0.6205
F-statistic	85.6112	71.5074	156.9153

Note: */**/** Ratios are significant at 10% / 5% / 1%, respectively.

Source: own study.

The VAR model confirmed the previously reported results using the Granger test. There is a weak statistical relationship between the variable representing intellectual capital (HCROI) and the variable representing enterprise growth (Δ EPS) both for the entire WIG index and the WIG 40 index, which represents medium-sized companies. For the WIG30 index, there is no statistically significant relationship between the HCROI variable and Δ EPS, although there is one between the HCVA index and Δ EPS. This relationship could not be confirmed for the WIG and WIG 40 indexes, however, which also confirms the previous results in the Granger test.

5. Discussion

The Granger causality test showed a causal relationship between HCROI and Δ EPS in the group of companies included in the WIG and WIG40 indexes. These results were confirmed in a study using the estimation of VAR for Δ EPS, in which the exact value of the impact factor was determined. For companies included in the WIG30 index, the impact of HCVA on Δ EPS was found (an increase in HCVA causes an increase in Δ EPS).

The company's value is most influenced by factors such as the increase in operating profit, the cash tax rate, the dynamics of revenue growth, working capital, the weighted average cost of capital, capital expenditure, and the period of competitive advantage. If managers correctly apply these factors in their decisions, it leads to a situation where the present value of cash flows is maximized at the same level as EPS (Wu et al., 2020; Samans et al., 2020). The results indicate that in the group of companies included in the WIG and WIG 40 indexes, there is a relationship between the increase in EPS and intellectual capital, expressed by the HCROI index. In the group of companies included in the WIG30 index, no such relationship was observed, either using the Granger method or the VAR model. This may be due to the fact that companies listed on WIG30 are characterized by traditional growth patterns (Sabourin et al., 2022; Goh, 2020). In the case of the WIG30 index, a relationship was observed between the increase in EPS and intellectual capital, expressed by the HCVA index. In the group of companies included in the WIG and WIG40 Index, no such relationship was observed, either using the Granger method or the VAR model. Many companies listed in the WIG and WIG 40 indexes are known for their nontraditional growth patterns. These companies often operate in innovative and disruptive industries, where their growth trajectory may differ significantly from that of more traditional and mature companies (Morales et al., 2022). Due to their growth-orientated nature, shares of companies listed on WIG and WIG 40 may show a higher level of price volatility compared to more mature companies, such as the blue chips included in WIG30. The valuations of these companies may be influenced by market sentiment, investor expectations, and future growth prospects (Hsu et al., 2019), but they are based on fundamental valuations related to growth.

6. Conclusion

Intellectual capital is an important factor that significantly helps companies develop and affects their effectiveness. Additionally, as the effective use of intellectual capital translates into the creation of added value, it is becoming increasingly popular among enterprises. They are beginning to see that value depends not only on material resources, but also increasingly on

intangible resources related to the ability to use knowledge and the ability to create the potential of intellectual capital. Intellectual capital management is a complicated, multi-stage process and requires a comprehensive approach. It involves identifying and managing individual components of intellectual capital while also focusing on the mutual relations between them. The greater the cooperation and mutual integration of the elements of intellectual capital, the greater the value created.

This study analyzed the relationship between measures of intellectual capital and the future development of companies listed on the main market of the Warsaw Stock Exchange. It demonstrated that measures of intellectual capital are reflected in the future growth of enterprises, especially earnings per share, and that the development phase can change the results related to the opportunity for company growth and future development. Based on the results, it can be concluded that for companies included in the WIG and WIG30 indexes, as well as medium-sized companies in the mWIG40 index, intellectual capital measured either by the HCROI or HCVA index significantly affects company growth expressed by the Δ EPS index. Different regression models characterize the increase in the EPS of companies listed on different markets. Certain factors contribute to the increase in Δ EPS – and thus value – based on different patterns that reflect internal strategies and external investor assessments of companies.

Intellectual capital is considered to be the hidden wealth of an organization that is not accounted for in financial statements and accounting systems. Intangible assets are recognized by investors, and they have a strong influence on the strategic decisions of companies and their shareholders. Nevertheless, which means that, in practice, there are many approaches to the concept. Effective intellectual capital management has become a new challenge for business managers. Thus, intellectual capital management has become a response to the emerging profound socio-economic changes. Managing intellectual capital effectively is a challenging task that requires two distinct approaches. Firstly, it involves identifying and managing the various components of intellectual capital. Secondly, there is a need to understand and manage the relationships between these components.

Future research should expand this topic, taking into account the level of development, asset structure and innovation of the studied companies. If high-tech enterprises develop in a less predictable way, it is necessary to analyze whether they effectively manage their value, and whether mature enterprises focus on growth and their condition, which, as expected, are positively related to each other and whether they effectively manage their value. Moreover, analyzes should focus on the impact of market crises on the relationship between investments in intellectual capital and the development of enterprises.

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THE EFFECTS OF LEADERSHIP TALENT MANAGEMENT ON THE COMPANY PERFORMANCE RESULTS

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Purpose: Leadership talent management (LTM) is one of the crucial aspects of HRM nowadays, which can decide of an organization success. This effect is considered in four types of contexts, i.e. in the headquarters (HQs) of multinational companies (MNCs) in the pre-pandemic and pandemic period of COVID-19, and in the foreign subsidiaries of these MNCs also in the pre-pandemic and pandemic period of COVID-19. The main goal of the article, identified with the main research problem, is to determine the mediating role of HRM outcomes in the relationships between LTM and company performance results and to establish whether there are any identifiable regularities in this scope in the pre-pandemic and pandemic period of COVID-19 in the HQs and foreign subsidiaries of MNCs.

Design/methodology/approach: The research sample covered 200 nonfinancial business entities headquartered in a Central European country with their subsidiaries located around the World. The research was conducted using Computer Aided Telephone Interview method. The Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to verify the research hypotheses and assess the mediating effects.

Findings: What was found in the course of the work? This will refer to analysis, discussion, or results. The mediating role of HRM outcomes in the relationships between LTM and the company performance results has been determined and some regularities in this scope in the pre-pandemic and pandemic period of COVID-19 in the HQs and foreign subsidiaries of MNCs have been identified. The mediating role of HRM outcomes is important in each of analyzed contexts, but during a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results stronger than in the pre-pandemic time.

Practical implications: The research outcomes lead to the conclusion that in difficult conditions the specific focus on HRM can be an important factor improving the company's performance results.

Originality/value: What is new in the paper? State the value of the paper and to whom it is addressed. The research is of an innovative character, identifies some general scientific laws and describes the aspects that haven't been studied yet. The originality of own research focused on LTM, mediating role of HRM outcomes in HQs and foreign entities of MNCs are difficult to compare with similar studies. In addition, the article presents an innovative approach to taking into account employee KPIs as an indicator of performance.

Keywords: leadership talents management, multinational company, company performance results, pandemic COVID-19.

Category of the paper: Research paper.

1. Introduction

One of the key issues in management science and business practice is the relationship between HRM practices and company performance, which has been a subject of research interest for several decades (Arthur, 1994; Pattnaik, Sahoo, 2020). During this time, much empirical evidence was provided for the existence of statistically significant relationships between these variables (Huselid et al., 1997; Ferguson, Reio, 2010; Bučiūnienė, Kazlauskaitė, 2012; Furusawa, Brewster, 2016; Stor, 2021; Zhao et al., 2022; Chawla et al., 2023), with some considering HRM as a set of specific subfunctions (Budhwar et al., 2009) and others focusing on individual HRM subfunctions (Sheehan, 2014; Wood, 2021). A review of the literature, however, leads to the conclusion that the issue of context is too rarely addressed in this type of research, hence many authors suggest increasing research interest in this problem (Meyer et al., 2011; Cook et al., 2016; Boon et al., 2019; Farndale, Paauwe, 2018).

In this article, the subject of interest is the effect of leadership talent management (LTM), as one of HRM subfunctions, on the company's performance results. This effect is considered in four types of contexts, i.e. in the headquarters (HQs) of multinational companies (MNCs) in the pre-pandemic and pandemic period of COVID-19, and in the foreign subsidiaries of these MNCs also in the pre-pandemic and pandemic period of COVID-19.

Hence, **the main goal of the article**, identified with the main research problem, is to determine the mediating role of HRM outcomes in the relationships between LTM and company performance results and to establish whether there are any identifiable regularities in this scope in the pre-pandemic and pandemic period of COVID-19 in the HQs and foreign subsidiaries of MNCs. To solve this problem, an empirical research was conducted and its main goal was to identify, analyze, and diagnose the relationships between these selected variables.

2. The theoretical background

Treating LTM as a subfunction of HRM requires defining the concepts of leadership, talent management and leadership talent management. The definitions of talent management and its relation to leadership can be found in numerous publications (Vaiman, Collings, 2023; Poczowski et al., 2020; Scullion et al., 2019; Collings et al., 2017; Ingram, 2011; Miś, 2020; Björkman et al., 2017; Tarique, 2022; Haromszeki, 2022) and well-known reports i.a. Talent Management: Employers' Views, Kaplan, 2018; Global Talent Trends 2022; Mercer, Global Talent 2021, Oxford Economics; Talent Management, Human capital Institute, Hewitt, 2021; New talent strategy, Society for HRM, 2020. So far, most research conducted in MNCs has taken place in organizations, whose headquarters were located outside Poland, but there are

also studies in MNCs with HQ in Central Europe presenting different aspects of organizational success like strategy of internalization (Głodowska et al., 2019) or talent management (Stor, 2023a, Haromszeki, 2022). They present different definitions of leadership and talent management. However, the purpose of this article is not to review and analyze them. Therefore, the definitions that most clearly constitutes the theoretical basis of the conducted empirical research were chosen.

There are many different definitions of leadership (Schedlitzki, Edwards, 2014), but the approach presented in this article is based on the assumption that: The organizational leadership is defined as the relationship between a superior (e.g., manager) and his/her subordinates (or coworkers, depending on the particular type of organizational leadership) (Haromszeki, 2010, p. 40). According to this definition, a leader is a person who not only feels appointed to fulfil this role, but above all is considered a leader by their followers. This approach results in a situation where leadership occurs only in real situations of impact on people and can be examined only from a pragmatic perspective, as an explanation of effective action that has ended and has measurable effects (Haromszeki, 2010). Only real situations and relations at work are an example of organizational leadership possible to measure and analyze in existing contexts (Iszatt-White et al., 2021).

Talent management is the process to attract, retain, motivate and develop talented employees in accordance with the needs of the organization (Armstrong, 2007, p. 354), which can be organize in a different way due to the definition of talents and the character of TM program (Bonneton et al., 2020). From the overall discussion of talent management it is important separating to present the leadership talents, who are experienced and prospective managers or people in non-managerial positions with above-average abilities, skills and potential to lead others manifested in a positive impact on their work results and leadership talent management (Haromszeki, 2023).

The basic theoretical assumptions adopted in this article are as follows. On the one hand, it is assumed that LTM can directly affect the company's performance (Haromszeki, 2022), and on the other hand, it is assumed that its impact can also take place through interactions with other HRM subfunctions (MacDuffie, 1995; Liu et al., 2019; Salas-Vallina et al., 2021). Such a synergistic effect together with other subfunctions is important, it may involve training managers in terms of influencing subordinate employees and their work performance, which in turn may affect the performance of the organization (van der Hoek, Kuipers, 2022; Haromszeki, 2016; Hazy, Uhl-Bien, 2015; Sadeli, 2012). Certain assumptions are also made regarding context. Namely, referring to previous research, it is assumed that from the perspective of both people holding managerial or leader roles (Mabey, 2013; Megheirkouni, 2016) as well as from the perspective of HRM in MNCs (Farndale et al., 2018; Stor, 2023a), it matters whether the LTM is considered at the HQs of MNC or in its foreign subsidiaries. In addition, it is also assumed that LTM practices may have a different impact on company performance before and during the pandemic (Amankwah-Amoah et al., 2021). The specific time and place conditions

are very important factors of leadership (Sutherland et al., 2022). As the research results so far show, crisis management requires the development of firm-specific capabilities (Gancarczyk, Ujwary-Gil, 2021) based on specific human resources, like leadership talents, as well as on performance interventions that enable the employees to identify, respond, and recover from crisis events. This can result in employee productivity well above expectations (Minbaeva, Navrbjerg, 2023). Organizational leadership is central to the implementation of crisis management initiatives (Fernandes et al., 2023). LTM can be used to promote learning within and across networks, aligning crisis management efforts with the core values of the organization, and continually learning from experience (Wang et al., 2009), especially important during pandemic (Wilson, 2020), which can be treated as the best example of crisis situation (Kerr, Robinson, 2011). However, during the pandemic, training and development programs had to be specially adapted to the extraordinary circumstances, often preventing direct contact (Mikołajczyk, 2022; Belte, 2022).

Based on the above assumptions and the conviction that unusual situations need specific approach (Czakon, 2020; Ujwary-Gil, Godlewska-Dzioboń, 2021; Sułkowski, Lenart-Gansiniec, 2023), the following three main hypotheses and related auxiliary hypotheses were formulated, describing the relationships under study as follows:

H1: LTM may impact directly and positively on the company's performance results.

- **H_{1A}** – LTM may impact directly and positively on the company's performance results in HRM (HRM outcomes).
- **H_{1B}** – LTM may impact directly and positively on the company's performance results in finance.
- **H_{1C}** – LTM may impact directly and positively on the company's performance results in innovativeness.
- **H_{1D}** – LTM may impact directly and positively on the company's performance results in quality.

H2: The company's performance results in HRM may mediate positively the relationships between LTM and the company's performance results.

- **H_{2A}** – The company's performance results in HRM (HRM outcomes) may mediate positively the relationships between LTM and the company's performance results in finance.
- **H_{2B}** – The company's performance results in HRM (HRM outcomes) may mediate positively the relationships between LTM and the company's performance results in innovativeness.
- **H_{2C}** – The company's performance results in HRM (HRM outcomes) may mediate positively the relationships between LTM and the company's performance results in quality.

H3: During a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results stronger than in the pre-pandemic time.

- **H_{3A}** – During a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results in finance stronger than in the pre-pandemic time.
- **H_{3B}** – During a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results in innovativeness stronger than in the pre-pandemic time.
- **H_{3C}** – During a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results in quality stronger than in the pre-pandemic time.

3. The methodics of the conducted empirical research

The research sample covered 200 nonfinancial business entities headquartered in a Central European country and which. These MNCs employed a total of 76 740 employees worldwide (the smallest employed 35 and the largest 4000 people), and had 416 foreign subsidiaries in 26 countries. They accounted for about 11% of the general population. The empirical research was performed in March 2022 using the CATI method (computer aided telephone interview based on a structured questionnaire). The respondents were people with the best knowledge both in the area of HRM and company performance. The structure of the respondents was as follows: HR business partner – 1%; HR manager – 47%; HR director – 51%; managing director/CEO – 2%; business owner – 1%. The respondents were asked to provide information on two time periods: 1) pre-pandemic of 2018-2019 and 2) pandemic from the beginning of 2020 to 03.2022 when the interview was conducted.

The Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to verify the research hypotheses and assess the mediating effects. To capture the actual relations between the variables under study the raw data in the variables were adjusted with the efficiency index (EI) (Stor, 2023b). Correlation and path analysis were therefore conducted on the adjusted values of the variables.

The adjusted values of the LTM variable were calculated using the following formula (1) expressing the ratio of the advancement level of LTM to the efficiency of employees measured by employee key performance indicator used in companies (Stor, 2023b):

$$EI_LTM = \frac{AL_LTM}{EKPIs} \quad (1)$$

where:

EI_LTM – Efficiency index of leadership talent management,

AL_LTM – Advancement level of leadership talent management,

EKPI – Employee key performance indicators.

The adjusted values of the company performance results were calculated according to the below formula (2) which includes the ratio of the company performance results to the efficiency of employees measured by employee key performance indicator used in companies (Stor, 2023b):

$$EISCPR \text{ in } (x) = \frac{CPR \text{ in } (x)}{EKPIs} \quad (2)$$

where:

EISCPR – Efficiency index of company performance results.

(x) – one of the four categories of the company performance results, respectively in: human resources management (HRM), finance (F), innovativeness (I), and quality (Q).

CPR – Company performance results.

EKPI – Employee key performance indicators.

The formulas for adjusting the value of individual categories of the company performance results were developed accordingly.

4. The empirical research findings

4.1. The descriptive and correlational statistics

The numbering As shown in Table 1, both before and during the pandemic, the performance results of the HQs of MNCs in the four categories under study, were similar to the results of other companies operating on the market. Interestingly, that the results in innovativeness were slightly higher during the pandemic, both at the HQs ($\bar{x} = 3.82$) and in local subsidiaries ($\bar{x} = 3.90$) than in the pre-pandemic time ($\bar{x} = 3.77$; $\bar{x} = 3.93$; $\bar{x} = 3.81$ respectively). Employee performance was compliant with the established organizational expectations when measured in standard company's KPIs. However, it is worth emphasizing that it was slightly

better in the pandemic than in the pre-pandemic period. This applies to both HQs and foreign subsidiaries of MNCs. As for the advancement level of LTM, both at the HQs and in the local subsidiaries it was slightly higher before the pandemic compared to the pandemic time. Regarding the significance of LTM to company performance results, at the HQs it was slightly higher before the pandemic, and in the case of foreign subsidiaries, it was slightly higher during the pandemic.

The correlation analysis shows that all variables are positively correlated with each other in each of the studied contexts (see Table 2). The range of values for their correlation coefficients is in the interval between $r = .43$ ($p < .001$) and $r = .91$ ($p < .001$). So, they span from moderate to strong.

The correlation analysis also reveals some regularities. Namely, at the HQs of MNCs, the company performance results in HRM have slightly stronger correlations with the results in finance ($r = .91$; $p < .001$) and quality ($r = .69$; $p < .001$) before the pandemic than during the pandemic ($r = .89$; $p < .001$ and $r = .65$; $p < .001$ respectively). In the pandemic period, the results in HRM reveal slightly stronger correlation with results in innovativeness ($r = .80$; $p < .001$) than before the pandemic ($r = .76$; $p < .001$). When it comes to the advancement level of LTM before the pandemic, its correlations with the results in finance ($r = .71$; $p < .001$), quality ($r = .56$; $p < .001$), innovativeness ($r = .61$; $p < .001$), and HRM ($r = .71$; $p < .001$) are slightly stronger compared to the pandemic period ($r = .65$; $p < .001$; $r = .52$; $p < .001$; $r = .56$; $p < .001$; $r = .68$; $p < .001$ respectively).

The situation looks differently in the case of local subsidiaries of MNCs. Excluding the correlation between the results in HRM and the results in finance, which is slightly stronger in the pre-pandemic ($r = .90$; $p < .001$) than pandemic time ($r = .87$; $p < .001$), the results in HRM are slightly stronger correlated with the results in quality ($r = .64$; $p < .001$) and innovativeness ($r = .84$; $p < .001$) in the pandemic time compared to the pre-pandemic ($r = .61$; $p < .001$; $r = .68$; $p < .001$ respectively). A similar regularity is observable regarding the advancement level of LTM. Again, excluding the correlation between the advancement level of LTM and the results in finance, which is slightly stronger in the pre-pandemic ($r = .64$; $p < .001$) than pandemic time ($r = .49$; $p < .001$), the advancement level of LTM is slightly stronger correlated with the results in quality ($r = .49$; $p < .001$), innovativeness ($r = .59$; $p < .001$), and HRM ($r = .66$; $p < .001$) in the pandemic time compared to the pre-pandemic ($r = .43$; $p < .001$; $r = .43$; $p < .001$; $r = .63$; $p < .001$ respectively).

Table 1.
Descriptive statistics for the major variables

Variables	HQs IN THE PRE-PANDEMIC TIME					Variables	HQs IN THE PANDEMIC TIME				
	Valid N	Mean	Min.	Max.	Std.Dev.		Valid N	Mean	Min.	Max.	Std.Dev.
Results in HRM	200	3,98	3,0	5,0	0,38	Results in HRM	200	3,92	3,0	5,0	0,37
Results in finance	200	4,03	3,0	5,0	0,32	Results in finance	200	3,92	3,0	5,0	0,36
Results in innovativeness	200	3,77	2,0	5,0	0,57	Results in innovativeness	200	3,82	2,0	5,0	0,54
Results in quality	200	3,85	3,0	5,0	0,60	Results in quality	200	3,7	2,0	5,0	0,58
Employee performance in KPIs	200	3,00	2,0	4,0	0,49	Employee performance in KPIs	200	3,24	2,0	4,0	0,53
Advancement level of LTM	200	3,40	2,0	4,0	0,54	Advancement level of LTM	200	3,23	2,0	4,0	0,53
Significance level of LTM	200	3,53	2,0	5,0	0,57	Significance level of LTM	200	3,36	2,0	5,0	0,60
Variables	FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME					Variables	FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME				
	Valid N	Mean	Min.	Max.	Std.Dev.		Valid N	Mean	Min.	Max.	Std.Dev.
Results in HRM	200	3,98	3,0	5,0	0,31	Results in HRM	200	3,92	3,0	5,0	0,34
Results in finance	200	3,99	3,0	5,0	0,24	Results in finance	200	3,93	3,0	5,0	0,37
Results in innovativeness	200	3,81	2,0	5,0	0,56	Results in innovativeness	200	3,90	3,0	5,0	0,50
Results in quality	200	3,81	2,0	5,0	0,57	Results in quality	200	3,77	3,0	5,0	0,54
Employee performance in KPIs	200	3,05	2,0	4,0	0,39	Employee performance in KPIs	200	3,19	2,0	4,0	0,51
Advancement level of LTM	200	3,44	2,0	4,0	0,53	Advancement level of LTM	200	3,24	2,0	5,0	0,56
Significance level of LTM	200	3,27	2,0	5,0	0,64	Significance level of LTM	200	3,28	2,0	5,0	0,63

Scales:

- Company performance results in HRM, finance, innovativeness, quality → benchmarked to the companies of similar business profile: 1 – poor, 2 – below average, 3 – similar to others, 4 – above average, 5 – very good;
- Employee performance in KPIs: 1 – significantly below standards, 2 – rather below standards, 3 – exactly with the standards, 4 – rather higher than standards, 5 – significantly higher than standards;
- advancement level of LTM → benchmarked to the best market practices: 1 – significantly lower, 2 – lower, 3 – similar to others, 4 – higher, 5 – significantly higher;
- significance level of LTM to the company's performance results: 1 – not important, 2 – slightly important, 3 – important, 4 – very important, 5 – of critical significance.

Source: Own empirical research.

Table 2.
Correlation matrix for the major variables modified by the efficiency ratio (employee KPIs)

Variables	HQs IN THE PRE-PANDEMIC TIME					Variables	HQs IN THE PANDEMIC TIME				
	1. $\left(\frac{F}{EKPIs}\right)$	2. $\left(\frac{Q}{EKPIs}\right)$	3. $\left(\frac{I}{EKPIs}\right)$	4. $\left(\frac{HRM}{EKPIs}\right)$	5. $\left(\frac{AL_LTM}{EKPIs}\right)$		1. $\left(\frac{F}{EKPIs}\right)$	2. $\left(\frac{Q}{EKPIs}\right)$	3. $\left(\frac{I}{EKPIs}\right)$	4. $\left(\frac{HRM}{EKPIs}\right)$	5. $\left(\frac{AL_LTM}{EKPIs}\right)$
Results in finance $\left(\frac{F}{EKPIs}\right)$	1,00	0,70* **	0,77* **	0,91* **	0,71* **	Results in finance $\left(\frac{F}{EKPIs}\right)$	1,00	0,67* **	0,75* **	0,89* **	0,65* **
Results in quality $\left(\frac{Q}{EKPIs}\right)$	0,70* **	1,00	0,57* **	0,69* **	0,56* **	Results in quality $\left(\frac{Q}{EKPIs}\right)$	0,67* **	1,00	0,63* **	0,65* **	0,52* **
Results in innovativeness $\left(\frac{I}{EKPIs}\right)$	0,77* **	0,57* **	1,00	0,76* **	0,61* **	Results in innovativeness $\left(\frac{I}{EKPIs}\right)$	0,75* **	0,63* **	1,00	0,80* **	0,56* **
Results in HRM $\left(\frac{HRM}{EKPIs}\right)$	0,91* **	0,69* **	0,76* **	1,00	0,71* **	Results in HRM $\left(\frac{HRM}{EKPIs}\right)$	0,89* **	0,65* **	0,80* **	1,00	0,68* **
Advancement level of LTM $\left(\frac{AL_LTM}{EKPIs}\right)$	0,71* **	0,56* **	0,61* **	0,71* **	1,00	Advancement level of LTM $\left(\frac{AL_LTM}{EKPIs}\right)$	0,65* **	0,52* **	0,56* **	0,68* **	1,00

Cont. table 2.

Variables	FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME					Variables	FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME				
	1. $\left(\frac{F}{EKPIs}\right)$	2. $\left(\frac{Q}{EKPIs}\right)$	3. $\left(\frac{I}{EKPIs}\right)$	4. $\left(\frac{HRM}{EKPIs}\right)$	5. $\left(\frac{AL_LTM}{EKPIs}\right)$		1. $\left(\frac{F}{EKPIs}\right)$	2. $\left(\frac{Q}{EKPIs}\right)$	3. $\left(\frac{I}{EKPIs}\right)$	4. $\left(\frac{HRM}{EKPIs}\right)$	5. $\left(\frac{AL_LTM}{EKPIs}\right)$
Results in finance $\left(\frac{F}{EKPIs}\right)$	1,00	0,62* **	0,65* **	0,90* **	0,64* **	Results in finance $\left(\frac{F}{EKPIs}\right)$	1,00	0,69* **	0,79* **	0,87* **	0,62* **
Results in quality $\left(\frac{Q}{EKPIs}\right)$	0,62* **	1,00	0,47* **	0,61* **	0,43* **	Results in quality $\left(\frac{Q}{EKPIs}\right)$	0,69* **	1,00	0,61* **	0,64* **	0,49* **
Results in innovativeness $\left(\frac{I}{EKPIs}\right)$	0,65* **	0,47* **	1,00	0,68* **	0,43* **	Results in innovativeness $\left(\frac{I}{EKPIs}\right)$	0,79* **	0,61* **	1,00	0,84* **	0,59* **
Results in HRM $\left(\frac{HRM}{EKPIs}\right)$	0,90* **	0,61* **	0,68* **	1,00	0,63* **	Results in HRM $\left(\frac{HRM}{EKPIs}\right)$	0,87* **	0,64* **	0,84* **	1,00	0,66* **
Advancement level of LTM $\left(\frac{AL_LTM}{EKPIs}\right)$	0,64* **	0,43* **	0,43* **	0,63* **	1,00	Advancement level of LTM $\left(\frac{AL_LTM}{EKPIs}\right)$	0,62* **	0,49* **	0,59* **	0,66* **	1,00

Notes:
* Correlations significant at $p < ,05$; ** Correlations significant at $p < ,01$; *** Correlations significant at $p < ,001$.

Source: Own empirical research.

4.2. Mediation statistics based on PLS-SEM

The results of the path analysis are presented in Tables 3-5. In Table 3 are the relations between LTM and company performance results in finance. In Table 4 are the relations between LTM and company performance results in innovativeness. In Table 5 are the relations between LTM and company performance results in quality. Based on them it can be said that the main hypothesis **H1** is only partially confirmed. This is because none of the auxiliary hypotheses can be accepted in full. Although LTM impacts directly and positively on the company's performance results in HRM in four considered contexts, its effect is statistically significant only in the pre-pandemic period (**H1A**). In the case of results in innovativeness its impact is also direct and positive in the four contexts, but statistically significant only for the HQs in the pre-pandemic time (**H1B**) (see Table 4). Regarding the results in quality, LTM impacts directly and positively on all types of company's performance results but in each context it is statistically insignificant (**H1C**) (see Table 5).

The main hypothesis **H2** can be accepted in its entirety because company's performance results in HRM mediate positively the relationships between MSD and the other three categories of company performance results, regardless of the context considered. This hypothesis confirmation is supported by the confirmation of three auxiliary hypotheses, i.e. **H2A**, **H2B**, and **H2C**.

Table 3.
Path analysis summary in PLS-SEM for LTM and company performance results in finance

HQs IN THE PRE-PANDEMIC TIME					HQs IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Finance	0,14	2,93	< 0,01	[0,05;0,24]	LTM → Finance	0,07	1,49	> 0,05	-
LTM → HRM (α)	0,71	12,70	< 0,001	[0,60;0,82]	LTM → HRM (α)	0,68	13,33	< 0,001	[0,58;0,78]
HRM → Finance	0,80	12,61	< 0,001	[0,68;0,93]	HRM → Finance	0,84	15,00	< 0,001	[0,73;0,95]
Mediation effect of HRM ($\alpha\beta$)	0,57	7,86	< 0,001	[0,43;0,71]	Mediation effect of HRM ($\alpha\beta$)	0,58	11,45	< 0,001	[0,48;0,68]

Cont. table 3.

FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME					FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Finance	0,11	2,42	< 0,05	[0,02;0,20]	LTM → Finance	0,09	1,48	> 0,05	-
LTM → HRM (α)	0,63	9,04	< 0,001	[0,49;0,77]	LTM → HRM (α)	0,66	9,58	< 0,001	[0,52;0,79]
HRM → Finance	0,83	11,80	< 0,001	[0,69;0,97]	HRM → Finance	0,81	13,48	< 0,001	[0,69;0,93]
Mediation effect of HRM ($\alpha\beta$)	0,52	7,24	< 0,001	[0,38;0,67]	Mediation effect of HRM ($\alpha\beta$)	0,53	8,10	< 0,001	[0,40;0,66]

Note: All variables modified by the efficiency ratio (employee KPIs).

Source: Own empirical research.

Table 4.

Path analysis summary in PLS-SEM for LTM and company performance results in innovativeness

HQs IN THE PRE-PANDEMIC TIME					HQs IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Innovativeness	0,15	2,24	< 0,05	[0,02;0,27]	LTM → Innovativeness	0,03	0,57	> 0,05	-
LTM → HRM (α)	0,71	12,70	< 0,001	[0,60;0,82]	LTM → HRM (α)	0,68	13,33	< 0,001	[0,58;0,78]
HRM → Innovativeness	0,66	8,52	< 0,001	[0,51;0,81]	HRM → Innovativeness	0,78	12,18	< 0,001	[0,65;0,90]
Mediation effect of HRM ($\alpha\beta$)	0,47	6,62	< 0,001	[0,33;0,60]	Mediation effect of HRM ($\alpha\beta$)	0,53	9,62	< 0,001	[0,42;0,64]
FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME					FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Innovativeness	0,00	0,03	> 0,05	-	LTM → Innovativeness	0,07	1,15	> 0,05	-
LTM → HRM (α)	0,63	9,04	< 0,001	[0,49;0,77]	LTM → HRM (α)	0,66	9,58	< 0,001	[0,52;0,79]
HRM → Innovativeness	0,67	8,17	< 0,001	[0,51;0,84]	HRM → Innovativeness	0,79	11,96	< 0,001	[0,66;0,92]
Mediation effect of HRM ($\alpha\beta$)	0,43	5,87	< 0,001	[0,28;0,57]	Mediation effect of HRM ($\alpha\beta$)	0,52	6,42	< 0,001	[0,36;0,68]

Note: All variables modified by the efficiency ratio (employee KPIs).

Source: Own empirical research.

Table 5.

Path analysis summary in PLS-SEM for LTM and company performance results in quality

HQs IN THE PRE-PANDEMIC TIME					HQs IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Quality	0,14	1,69	p > 0,05	-	LTM → Quality	0,14	1,74	> 0,05	-
LTM → HRM (α)	0,71	12,70	< 0,001	[0,60;0,82]	LTM → HRM (α)	0,68	13,33	< 0,001	[0,58;0,78]
HRM → Quality	0,59	6,34	< 0,001	[0,41;0,77]	HRM → Quality	0,55	6,49	< 0,001	[0,39;0,72]
Mediation effect of HRM ($\alpha\beta$)	0,42	5,24	< 0,001	[0,26;0,57]	Mediation effect of HRM ($\alpha\beta$)	0,38	6,05	< 0,001	[0,26;0,50]
FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME					FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME				
Variables in paths	β	Z	p	95%CI	Variables in paths	β	Z	p	95%CI
LTM → Quality	0,08	0,99	> 0,05	-	LTM → Quality	0,13	1,55	> 0,05	-
LTM → HRM (α)	0,63	9,04	< 0,001	[0,49;0,77]	LTM → HRM (α)	0,66	9,58	< 0,001	[0,52;0,79]
HRM → Quality	0,56	5,31	< 0,001	[0,35;0,77]	HRM → Quality	0,55	6,03	< 0,001	[0,37;0,73]
Mediation effect of HRM ($\alpha\beta$)	0,35	5,32	< 0,001	[0,22;0,48]	Mediation effect of HRM ($\alpha\beta$)	0,36	5,75	< 0,001	[0,24;0,49]

Note: All variables modified by the efficiency ratio (employee KPIs).

Source: Own empirical research.

The main hypothesis **H3** can be considered largely confirmed. This is due to the fact that while the auxiliary hypotheses **H3A** and **H3B** can positively verified in terms of the studied phenomena both for the HQs and foreign subsidiaries, hypothesis **H3c** is true only for the foreign subsidiaries. The details are as follows. With regard to the results in finance (**H3A**), in the pandemic time both at the HQs ($\alpha\beta=0,58$; $p < 0,001$) and in the local subsidiaries ($\alpha\beta=0,53$; $p < 0,001$) the indirect mediation effect is stronger than in the pre-pandemic period ($\alpha\beta=0,57$; $p < 0,001$; $\alpha\beta=0,52$; $p < 0,001$ respectively) (**H3A**) (see Fig. 1).

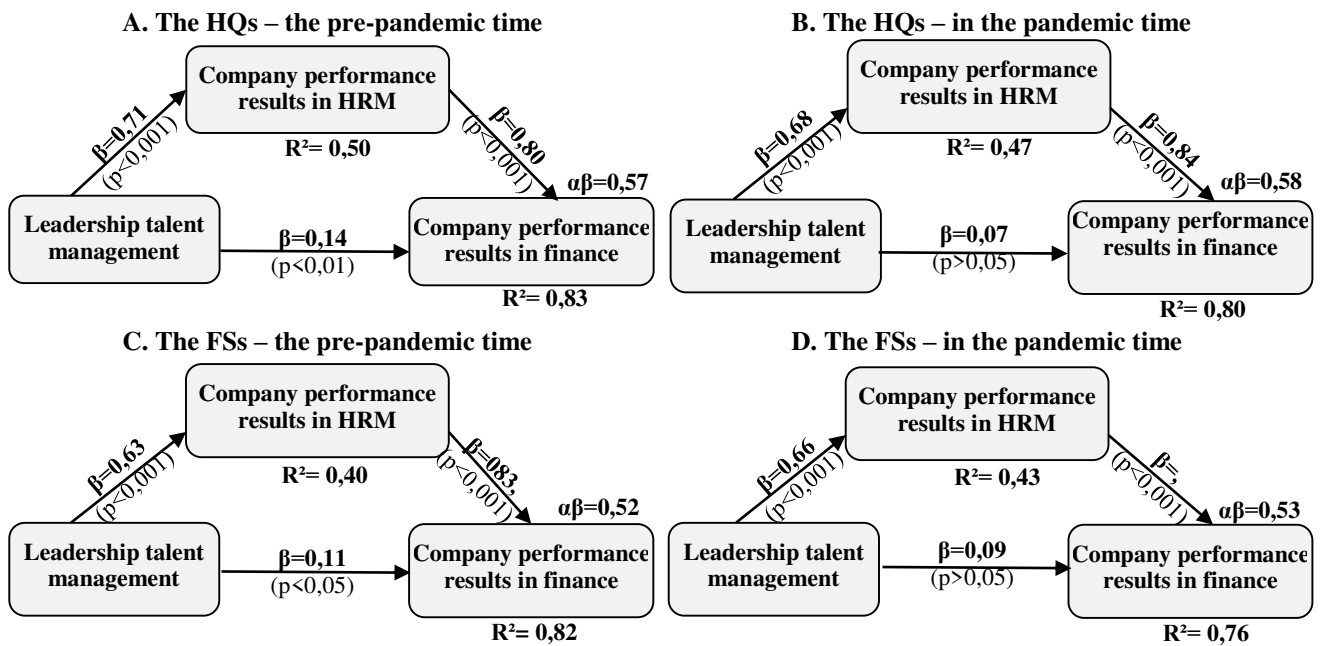


Figure 1. The HRM mediation model of the relationships between LTM and company performance results in finance.

Source: Own empirical research.

The same phenomenon is identified with reference to the results in innovativeness. It means that in the pandemic time both at the HQs ($\alpha\beta=0,53$; $p < 0,001$) and in the local subsidiaries ($\alpha\beta=0,52$; $p < 0,001$) the indirect mediation effect is stronger than in the pre-pandemic period ($\alpha\beta=0,47$; $p < 0,001$; $\alpha\beta=0,43$; $p < 0,001$ respectively) (**H3B**) (see Fig. 2).

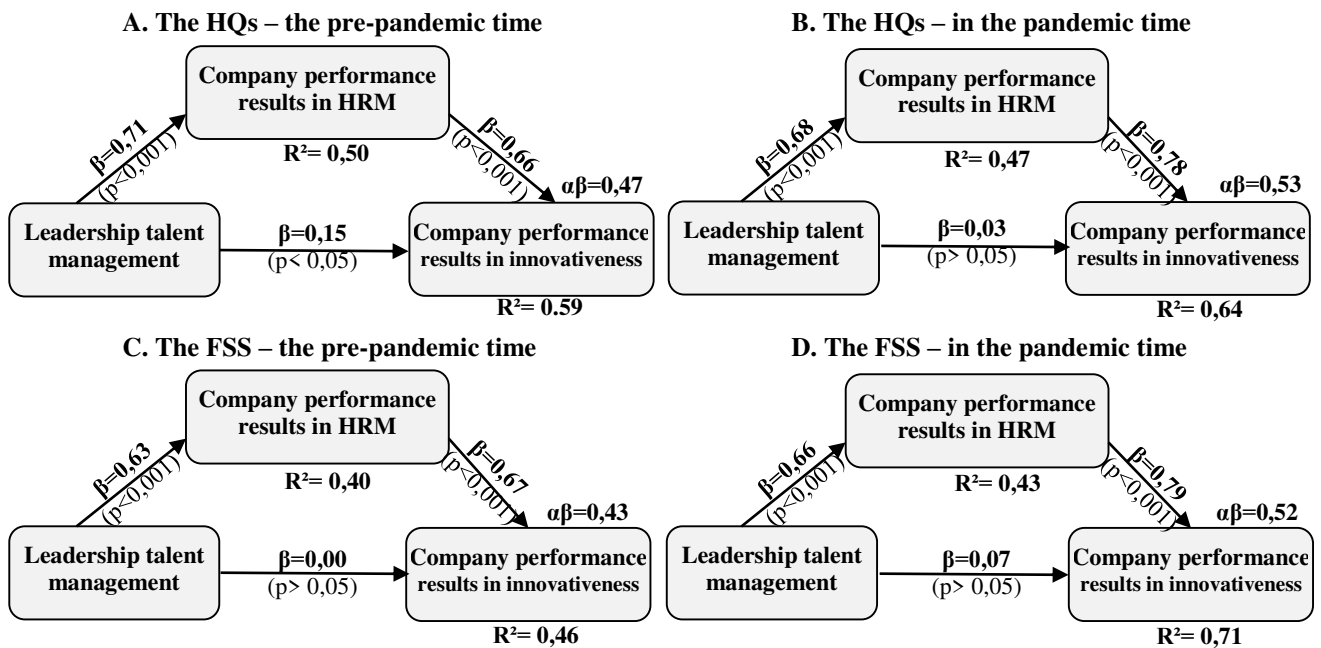


Figure 2. The HRM mediation model of the relationships between LTM and company performance results in innovativeness.

Source: Own empirical research.

As for the results in quality, at the HQs the indirect mediation effect is stronger in the pre-pandemic ($\alpha\beta = 0,42$; $p < 0,001$) than in pandemic time ($\alpha\beta = 0,38$; $p < 0,001$), whereas in the foreign subsidiaries it is slightly stronger in the pandemic ($\alpha\beta = 0,36$; $p < 0,001$) than in pre-pandemic time ($\alpha\beta = 0,35$; $p < 0,001$) (**H_{3c}**) (see Fig. 3).

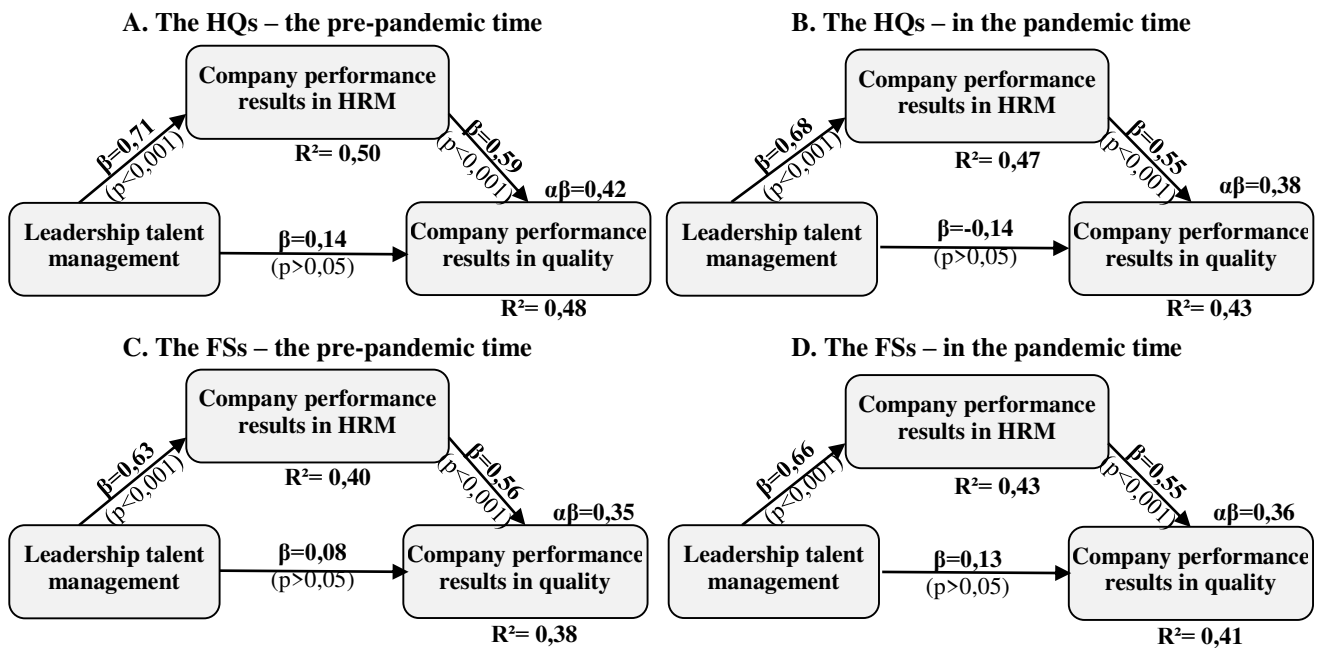


Figure 3. The HRM mediation model of the relationships between LTM and company performance results in quality.

Source: Own empirical research.

And when it comes to the explanatory capability of all the models, the amount of variance explained in the company performance results ranges from moderate to strong (Ringle et al., 2020; Hair et al., 2022). This data is presented in Table 6.

Table 6.

The explanatory capabilities of the HRM mediation models of the relationships between LTM and company performance results

HQs IN THE PRE-PANDEMIC TIME		HQs IN THE PANDEMIC TIME	
Variables in models	R ²	Variable in models	R ²
Results in HRM	0,50	Results in HRM	0,47
Results in finance	0,83	Results in finance	0,80
Results in innovativeness	0,59	Results in innovativeness	0,64
Results in quality	0,48	Results in quality	0,43
FOREIGN SUBSIDIARIES IN THE PRE-PANDEMIC TIME		FOREIGN SUBSIDIARIES IN THE PANDEMIC TIME	
Variable in models	R ²	Variable in models	R ²
Results in HRM	0,40	Results in HRM	0,43
Results in finance	0,82	Results in finance	0,76
Results in Innovativeness	0,46	Results in Innovativeness	0,71
Results in quality	0,38	Results in quality	0,41
Interpretation: R ² - the amount of variance explained in the construct (very weak $\geq 0,1$, weak $\geq 0,19$; moderate $\geq 0,33$, substantial $\geq 0,67$, strong $\geq 0,75$)			

Source: Own empirical research.

5. Discussion

In the light of the research findings, a basic conclusion can be formulated that the aim of the article has been successfully achieved. That is to say that the mediating role of HRM outcomes in the relationships between LTM and the company performance results has been determined and some regularities in this scope in the pre-pandemic and pandemic period of COVID-19 in the HQs and foreign subsidiaries of MNCs have been identified. The mediating role of HRM outcomes is important in each of analyzed contexts (H₂), but during a pandemic, the company's performance results in HRM mediate the relationships between LTM and the company's performance results stronger than in the pre-pandemic time (H₃).

The originality of own research focused on LTM, mediating role of HRM outcomes in HQs and foreign entities of MNCs are difficult to compare with similar studies, but there are some research works describing the relationship between transformational leadership and organizational and individual innovative behavior, with mediating role of HRM (Awan, Jehanzeb, 2022), talent management and companies' performance with mediating role of human capital (AlQershshi et al., 2022), job satisfaction (Putri et al., 2023) or employee engagement (Abdullahi et al., 2022). In other studies can be seen the mediating role of talent management between leadership and business performance (Kafetzopoulos et al., 2022) and

between HRM practices and innovative behavior (Datta et al., 2023). There are also studies emphasizes the importance of proper use of HRM in process of shaping skills of potential leaders (i.a. Mai et al., 2022). The role of LTM as a foundation of successful leadership and its impact on companies' sustainable performance is conformed in research conducted by Kafetzopoulos & Gotzamani (2022). Other studies highlighting the role of transformational leadership in organization's success (Kurniawanti et al., 2023). However, there are also studies which show the role of different constraints limiting the effectiveness of leadership (Korzyński et al., 2021). Hence, taking into account contexts, the role of HRM outcomes is visible in the pre-pandemic and pandemic period of COVID-19 in the HQs and foreign subsidiaries of MNCs, but the increasing importance of them during pandemic can be effects of deteriorating conditions (Böhmer, Schinnenburg, 2023) What matters is how this experience will affect the Human Resource Management Policies of Multinational Corporations (Brewster et al., 2008).

6. Conclusion

The conducted study has some limitations. The research sample which, albeit deliberately, but covered only those MNCs that were headquartered in Poland with a dominant share of Polish capital. This means that the research conclusions cannot be extended to all MNCs operating in Europe. The sample was diverse in terms of the type of business activity performed by the organizations, but not all sectors of economy were represented. The survey was conducted only among the HQ. The validity of this study may be also weakened by the fact that the measures used for the evaluation of the company's financial performance were based on subjective benchmarking instead of hard indicators, i.e. the respondents compared the financial results of their companies with those of their local competitors

Despite the above problems, the value of research results is evident. Firstly, the issue of leadership talent management was addressed, which is rarely a separate area from talent management and at the same time connected with leadership. Secondly, the research findings confirm the results of other widely understood studies, in particular those concerning the relationships between selected HRM subfunctions and different types of company performance results. Thirdly, they also bring new added value because they determine the mediating role of HRM outcomes in the relationships between LTM and company performance results in finance, innovativeness, and quality. And, fourthly, as said above, they made it possible to identify certain regularities in this scope in four specific contexts which make a novelty in management science. In addition, the article presents an innovative approach to taking into account employee KPIs as an indicator of performance in the analysis of relationships between variables of interest in the research.

A possible contribution that this study makes to the literature is that it provides the evidence for on-going debate that the contextual perspective with its configurational implications in the HRM research field is not only useful in identifying some scientific phenomena that are difficult to identify or even unidentifiable otherwise, but it is also utilitarian in its practical sense. The research findings may have also an impact on managerial practices in the scope of how LTM can affect company performance results in finance, innovativeness, and quality. The mediating role of HRM outcomes observed in my study can also be inspirational for companies and can affect the increasing role of their HRM departments in the organizational structure and culture. Additionally, the research methods and empirical findings can foster closer cooperation between the academic staff and business practitioners in research projects which aim at discovering some new scientific laws and developing practices that best fit the business needs.

As it was highlighted in the paper, the increasing global shortage of leadership talent is now recognized as a key source of risk to business success. MNCs are interested in improving their HRM subfunctions and focus on their outcomes, because they can play a mediating role between leadership talent management and company performance results, especially in difficult conditions of business in crisis. The last international crisis caused by the COVID-19 pandemic has an impact on MNCs headquarters and their local subsidiaries worldwide. I hope that my research provides at least a partial answer to the question on how to develop global leaders and their roles as a source of competitive advantage for organizations. What I would recommend for the practical solutions within the leadership talent management of both HQ and local entity is to consider how focus on HRM can improve their results in finance, innovativeness and quality.

Acknowledgements

Funding: The project was financed by the Ministry of Education and Science in Poland under the program Regional Initiative of Excellence 2019-2023. Project number: 015/RID/2018/19.

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IMPACT OF THE COVID-19 PANDEMIC ON THE CHOICE OF INVESTMENT STRATEGIES AND INVESTORS' BEHAVIOR ON THE WARSAW STOCK EXCHANGE – 2017-2020 RESEARCH FINDINGS

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Purpose: This paper attempts to reveal the potential differences between the portfolios of dividend-paying companies with growth or value potential and the same portfolios fortified with the financial instruments replicating precious metals or real estate price behavior in a turbulent global economy.

Design/methodology/approach: The research objective of this paper is accomplished by means of a thorough literature analysis. Moreover, the authors employ comparative analysis methods to explore the features of stock portfolios held by dividend-paying companies with value or growth potential and portfolios of the companies that are fortified with financial instruments replicating the price behavior of precious metals or real estate and uncover the similarities and differences. Research of the characteristics of financial instrument portfolio variants and comparison between them is conducted by means of standard deviation of the rate of return, coefficient of variation, the Pearson correlation coefficient and the Spearman's rank correlation coefficient. It was also assessed whether the estimated correlation coefficients were statistically significant through the use of a non-parametric correlation coefficient significance test.

Findings: The results of the empirical analyses conducted here reveal that the average annual return of portfolios held by dividend-paying companies with value and growth potential is lower than ETFs replicating precious metals. Furthermore, during the turbulent economy of 2020, the inclusion of precious metal assets boosted the rates of return of the Polish dividend-paying companies portfolios.

Research limitations/implications: The research was carried out on a limited number of the analyzed companies. Therefore, it could be biased, due to the deterministic stock sampling method.

Practical implications: Knowledge of the similarities and differences between dividend-paying companies with value or growth potential and the risk diversification of such companies' stock portfolios by means of instruments replicating the price behavior of precious metals or real estate is of great importance to both the investors and investment funds' boards. Consequently, one can make better investment decisions.

Social implications: Among the paper's social implications, the most important appears to be a possible change in the investors' attitude towards dividend-paying companies with value potential and financial instruments replicating the price behavior of precious metals or real estate. Ultimately, investors' needs could be better addressed.

Originality/value: What is new in the paper is the stock comparison of dividend-paying companies' with value and growth potential with precious metals and real estate-based instruments. The paper also attempts to compare efficiency of investing in the portfolio variants, capturing the effect of the SARS-CoV-2 pandemic, thereby filling our knowledge gap.

Keywords: COVID-19 pandemic, precious metals, ETFs, Spearman rank correlation coefficient.

Category of the paper: Research paper.

1. Introduction

The stock portfolios' rates of return are determined by the possible profit from the sale of stocks and a possible income from dividends distributed over the stock ownership period. In the long term, it is becoming particularly important to invest in the stocks of issuers that maintain a dividend policy and distribute dividends on a regular basis, generating steady income for the investor. However, ever since the publication of a paper by F. Modigliani and M. Miller (Miller, Modigliani, 1961) proving that there is no impact of dividend policy on the stock prices, this matter has proved to be the topic of extensive research and consideration in many scientific publications (Al-Malkawi, Rafferty, Pillai, 2010). In particular, it was considered a key issue to determine whether investing in dividend companies makes it possible to achieve above-average income (McQueen, Shields, Thorley, 1997). M. Lichtenfeld (Lichtenfeld, 2015, p. 63) states that for the 2001–2011 period, the average annual rate of return of the S&P Dividend Aristocrats Index was 7.1% compared to 2.9% average annual rate of return of the S&P 500 Index. A. Williams and M. Miller (Williams, Miller, 2013, pp. 58-69), however, based on the research conducted, found that during the financial crisis in the USA (especially 2008), the rates of return of companies that paid dividends on a regular basis (dividend aristocrats) were characterized by higher rate of return than the S&P 500 index. Together with the issue of dividend policy and dividend payments, the issue of the market ratios of these companies (P/E and P/BV) and how the level of these ratios actually determines the choice of dividend-paying companies' stocks is often cited. R.A. Haugen has conducted a research using both ratios, showing that companies with high P/BV ratio are characterized by the highest risk and the lowest rate of return (Haugen, 1999, pp. 2-10). However, R. Banz (1981) proved that this rate is even higher for companies with lower market capitalization. J. Czekaj, M. Woś and J. Żarnowski (2001) came to the analogous conclusions but pertaining to the Polish stock market and P/BV ratio. They proved that companies featuring low P/BV ratios have brought statistically significant above-average rates of return, as opposed to the companies with high P/BV ratio values.

This paper attempts to reveal the potential differences between the portfolios of dividend-paying companies with growth or value potential and the same portfolios fortified with the financial instruments replicating precious metals or real estate price behavior in a turbulent global economy.

The scope of the research covers investment strategies that include dividend-paying companies with value and growth potential and financial instruments replicating precious metals and real estate price behavior. According to the literature of the subject (Haugen, 1999, pp. 2-10), based on the P/BV parameter indications, dividend-paying companies are assigned to two groups – companies with growth potential and companies with value potential. Companies with a high P/BV indicator, i.e. above 1, were assigned to the first group, and those with a low P/BV indicator, i.e. below 1, were assigned to the second group.

It should be noted that there are studies on the attitudes and behavior of investors in the capital market, also including their investment strategies (among others, G.C. Selden, O.K. Burrell, W.S. Bauman, S. Benartzi, R.H. Thaler, J.R. Nofsinger, S.E.G. Lea, R.M. Tarpay, P. Webley, R.A. Haugen, H. DeAngelo, L. DeAngelo and R.M. Stulz). These studies, however, do not address the division into dividend-paying companies with growth and value potential. Similarly, they fail to address the development and implementation of investment strategies in a turbulent global economy and incorporation of instruments regarded as “safe harbors” like precious metals (namely monetary metals such as gold and silver) and real estate.

2. Literature review and research hypotheses development

The perception of a group as a psychological, rather than physical phenomenon has been confirmed by researchers like G. Le Bon, S. Freud, C. Jung or A. Koestler (Le Bon 1986 after Plummer 1995, p. 11). Le Bon's observations suggest that the group displays specific characteristics such as a collective mind and an influence on the behavior of an individual, provided that such an individual becomes a member of the group. The group's influence on an individual is powerful enough to change one's existing beliefs (Koestler, 1978; Talbot, 1981 after Plummer, 1995, pp. 16-19). Group affiliation alters the individual's perception of personal responsibility and the population implements its objectives in an emotional and often irrational manner. This could explain financial instruments price change mechanism in the financial markets, as the co-existence of two groups with different perception of the future market trends and future valuation of an instrument results in different investment decisions. Notwithstanding the correctness of decisions made, an individual will seek validation and acceptance of their views within the group. Therefore, an individual identifies himself with other investors that belong to a group with similar investment philosophy. A rational investor always acts to maximize the profits, is not driven by emotions or pressure from the group of other gamblers,

and only follows information based on the reliable financial analyses (known as fundamental data) (Zaleśkiewicz, 2003, pp. 9-10). G.C. Selden, O.K. Burrell and W.S. Bauman are among the first to outline the application of the field of psychology to the capital market (Razek, 2011, p. 8). The authors indicate a new field of benefits that can arise from combining quantitative investment models with behavioral finance (Olsen, 1998, p. 10). *EMH – Efficient Market Hypothesis* was published in 1965 by E.F. Fama (Fama, 1995, pp. 75-80). According to the theory, the capital market is operated by the rational investors who are able to utilize public information to anticipate stock price changes. Meanwhile, an efficient market is a place with a huge number of rational and return-maximizing investors and information flow is free and unlimited for any investor. In 1970, P.A. Samuelson proved that information flowing into the capital market is quickly and appropriately interpreted by the investors (Samuelson et al., 1995, p. 445). However, the paradox of market efficiency is that if a hypothetical situation occurs, and all investors believe it exists and accept the required conditions, the market will instantly cease to be efficient. The reality, however, is that markets are neither efficient nor inefficient, so efficiency can only take different shades (Dembny, 2005, pp. 79-80). According to A Timmermann and C.W.J. Granger, the efficient markets hypothesis is, however simple, hard to empirically verify. Identifying at least one accurate forecast constitutes an evidence against the efficient markets hypothesis, if uncertainty as to the choice of the best forecasting model is ignored. Otherwise, such proof can only be accepted if the optimal model selection methodology allows investors to identify the correct ex ante model (Timmermann et al., 2004, pp. 15-27). Also, the research by R.H. Thaler, J.R. Nofsinger and S.E.G. Lea, R.M. Tarp, P. Webley (Thaler, 1999; Nofsinger, 2001; Lea et al., 1987) reveals that most investors tend to make financial choices hot-headed because they hope for fast profit. Investors are too hot-headed, lack self-control and struggle to defer financial gratification. Research by S. Benartzi, R.H. Thaler, however, indicates that investors revise their portfolios far too often. They no longer consider investing as a long-term process in favor of swift decisions of short-term importance. The authors believe that mental accounting and loss aversion play a significant role here (Benartzi et al., 1995, pp. 73-92). Investment principles indicate that all the revenue obtained should be considered collectively – for an economically reasonable investor it is not important whether they profit from the payment of dividends or the sale and acquisition of stocks¹. According to the research, investors distribute their income as if dividends and profit on sale constituted two separate incomes, and their purpose is also different. This is because collecting dividends is mainly related to a short-term consumption goal, while the profit on the disposal of stocks is associated with a long-term goal. H.M. Shefrin and M. Statman also conclude that those investors, who need cash for their current expenses, will look for stocks that provide them with regular dividend payments (Shefrin et al., 1984, pp. 253-282;

¹ It is also based on the estimation of the stock's income value, which recognizes stock price fluctuations (profit or loss) and dividends collected.

Zaleśkiewicz, 2003, pp. 134-136). Considering the prospect of investment, according to R.A. Haugen, the relationship between stock rate of return and P/E and dividend values becomes relevant when the period over which the relationship is considered extends (Haugen, 1999, pp. 69-94). This indicates that short-term market behavior does not correspond to what happens in the long term. It is particularly important when investors are creating their portfolios in the long term (see more: Zaleśkiewicz, 2003, p. 88). Therefore, investing in stocks of companies, whose issuer pays regular dividends becomes particularly important for the investor. Research conducted by K.P. Fuller and M.A. Goldstein (Fuller, Goldstein, 2011, pp. 457-473), H. Rubin and C. Spaht II (Rubin, Spaht II, 2011, pp. 11-19) and P. Asquith and D.W. Mullins Jr. (Asquit, Mullins, 1983, pp. 77-96) confirm that stock price behavior variations in favor of dividend-paying companies can be observed, especially during a bull market. E. Fama and K. French (Fama, French, 1992) carried out research of all stocks listed on the New York Stock Exchange, the American Stock Exchange and the over-the-counter market (Nasdaq) for the 1963-1990 period, taking into account the relationship between the book value of equity and the stock's market value. The correspondence of these values was analyzed by the authors of research by investigating behavior of the companies' P/BV parameter. The authors attributed a low P/BV parameter to companies being entities with value potential, while stocks of companies characterized by a high level of this parameter were considered to have growth potential. The research results indicate that an average annual rate of return for the companies with value potential was 24.4%, and for the companies with growth potential it was only 8%. R.A. Haugen has reached similar conclusions, by using the P/BV indicator to describe companies with growth and value potential (Haugen, 1999, pp. 2-10). By contrast, H. DeAngelo, L. DeAngelo and R.M. Stulz (DeAngelo, H., DeAngelo, L., Stulz, 2006) connected P/BV values to the dividend payments by companies. The authors believe that the higher the P/BV value of a company in the preceding year, the higher the possible dividend in the reference year. Meanwhile, research conducted by M. Baker and J. Wurgler (Baker, Wurgler, 2004, pp. 271-288) indicates that companies with higher P/BV values are paying dividends more often than those with low values of this parameter. During the periods of elevated inflation, stocks of the dividend-paying companies could be seen as attractive to the investors because dividend income is a real variable and investors collect dividends that are generally inflation-adjusted (Lee, 2000, p. 192).

The research and analysis presented, despite the broad time span and inclusion of various stock exchanges, does not cover the research on how the inclusion of assets regarded as “safe harbors”, i.e. precious metals (monetary metals such as gold and silver) and real estate, affects rates of return and investment risk in dividend-paying companies portfolios. They also do not cover as to whether the division of dividend-paying companies into value and growth potential companies is important to the investor and how the characteristics of these portfolios evolve in a turbulent global economy.

Based on the literature review and the identified research gaps, the following research hypotheses were defined:

- H₁: The average annual rate of return of dividend-paying companies portfolios with value and growth potential is higher than ETFs replicating precious metals.
- H₂: During the turbulent 2020 economy, the inclusion of precious metals assets or REITs has improved the Polish dividend portfolios' rates of return.
- H₃: The portfolios of dividend-paying companies with growth and value potential behave much like a portfolio made of companies replicating the real estate market.

3. Sample selection and methodology

In order to fulfill this paper's objectives, companies listed on the Warsaw Stock Exchange in Poland, which have been regularly paying dividends in the 2017-2020 period and their dividend payment policy dates back to at least 2006 (10 years of uninterrupted dividend payments), were covered by the research. 52 WSE listed companies were analyzed, namely: Asseco Business Solutions (ABS), ACAutogaz (ACG), Asseco Poland (ACP), Ambra (AMB), Aplisens (APN), Apator (APT), Aqua (AQU), Asseco South Eastern Europe (ASE), Atende (ATD), ATM Grupa (ATG), Budimex (BDX), Bank Handlowy w Warszawie (BHW), CCC (CCC), CEZ (CEZ), Firma Oponiarska Dębica (DBC), Dektra (DKR), Dom Development (DOM), ED Invest (EDI), Korporacja Gospodarcza Efekt (EFK), Elektrotim (ELT), Eurocash (EUR), Eurotel (ETL), Euro-Tax.pl (ETX), Ferro (FRO), Fabryka Sprzętu i Narzędzi Górniczych Fasing (FSG), Giełda Papierów Wartościowych w Warszawie (GPW), Przedsiębiorstwo Hydrauliki Siłowej Hydrotor (HDR), IFIRMA (IFI), Introl (INL), KGHM (KGH), KRKA (KRK), Zakłady Tłuszczowe Kruszwica (KSW), Grupa Kęty (KTY), Lena Lighting (LEN), LPP (LPP), Neuca (NEU), Oponeo.pl (OPN), Bank Polska Kasa Opieki (PEO), PGS Software (PSW), Powszechny Zakład Ubezpieczeń (PZU), Fabryka Obrabiarek Rafamet (RAF), Silvano Fashion Group (SFG), Fabryka Farb i Lakierów Śnieżka (SKA), Sanok Rubber Company (SNK), Sonel (SON), Stalprofil (STF), Talex (TLX), Unibep (UNI), Wawel (WWL), WODKAN Przedsiębiorstwo Wodociągów i Kanalizacji (WOD), Grupa Azoty Zakłady Azotowe Puławy (ZAP), Grupa Żywiec (ZWC). The authors of this paper indicate that the research included particularly unusual year 2020, which was dominated by the worldwide SARS-CoV-2 pandemic and its impact on the individual companies' operation and dividend payments, and on the investment decisions made by investors.

Additionally, the research included, from the perspective of managed assets value, the largest dollar-settled ETFs replicating the prices of precious metals (gold and silver) and the real estate market. Two ETFs (namely ETC, or Exchange Traded Commodity) replicating gold (iShares Physical Gold ETC and Invesco Physical Gold ETC) and silver (WisdomTree Physical Silver ETC and iShares Physical Silver ETC) market, which invest funds in physical precious metals, were selected for this analysis. The research also included two of the largest ETFs investing in REITs (hereafter ETF REIT), owning real estate located across the globe (Vanguard Real Estate ETF – office buildings, hotels, other real estates and iShares Developed Markets Property Yield UCITS ETF – broadly understood real estate market excluding the Greek market). Including ETFs investing in global REITs in the research is motivated by the need for a well-diversified real estate portfolio. Global coverage of the assets in their portfolios eliminates the risk that the real estate location and the REITs listing location will influence stock prices, which is the case for precious metals listings, are not determined by the asset location risk.

The research was carried out in the following stages:

1. Stage one – to identify companies with value and growth potential and make comparisons in terms of rates of return and risk among the WSE listed companies that have been paying dividends continuously in the 2017-2020 period.
2. Stage two – to analyze stock price movements of the Polish dividend-paying companies with value potential during the turbulent economy of 2020 and portfolio variants that include financial instruments replicating precious metals and real estate price behavior.

4. Investment strategy and investor behavior analysis – research findings for the 2017-2020 period

To select companies with value (portfolio 1), and growth (portfolio 2) potential, a P/BV ratio analysis of WSE listed, dividend-paying companies was conducted. It was assumed that low P/BV companies, i.e. below 1, will be included in Portfolio 1. High P/BV companies, i.e. above 1, in contrast, will be allocated to portfolio 2. Both portfolios were compared in terms of the rate of return obtained over the considered period. Each portfolio featured 10 companies with the best P/BV ratios in the considered group. In this research, portfolios were kept for one year (early January to the end of December), then, the annual rates of return were calculated for each portfolio and afterwards the procedure was repeated in a similar manner. Investment portfolio compositions and the rates of return of individual constituent companies over the past 4 years are presented in table 1.

Table 1.

Compositions of portfolios 1 and 2 and the rates of return [%] of the respective companies in 2016-2020 – WSE listed issuers in Poland

Number of companies	1	2	3	4	5	6	7	8	9	10
Portfolio 1 ₂₀₁₇	WOD	CEZ	EFK	EDI	FSG	RAF	AQU	ACP	ZAP	ASE
Rate of return ₂₀₁₇	0.53	16.81	-11.52	4.19	18.73	-28.90	-9.94	-19.11	-11.63	42.86
Portfolio 2 ₂₀₁₇	ZWC	PSW	SFG	CCC	LPP	BDX	ETX	KRK	SKA	ACG
Rate of return ₂₀₁₇	7.27	12.41	-16.94	35.06	61.97	5.37	-0.71	-5.65	24.58	-1.42
Portfolio 1 ₂₀₁₈	WOD	CEZ	EFK	ZAP	FSG	EDI	RAF	STF	AQU	TLX
Rate of return ₂₀₁₈	-11.86	8.73	-7.56	-57.75	-1.19	-12.39	-19.84	-40.00	-1.24	-39.47
Portfolio 2 ₂₀₁₈	ZWC	SFG	PSW	CCC	ETX	KRK	LPP	BDX	ACG	SKA
Rate of return ₂₀₁₈	-2.12	-13.39	-39.60	-33.48	-9.09	5.13	-14.25	-43.76	5.12	-0.64
Portfolio 1 ₂₀₁₉	EFK	CEZ	WOD	FSG	RAF	STF	ZAP	INL	AQU	EDI
Rate of return ₂₀₁₉	-50.23	-5.84	21.90	-8.02	-7.29	-16.94	33.13	-23.07	1.28	26.70
Portfolio 2 ₂₀₁₉	ZWC	SFG	ETX	KRK	PSW	BDX	LPP	CCC	ACG	SKA
Rate of return ₂₀₁₉	6.06	-14.59	4.74	24.70	21.11	50.33	11.08	-43.88	7.83	5.81
Portfolio 1 ₂₀₂₀	CEZ	FSG	WOD	EFK	STF	ZAP	AQU	TLX	BHW	PEO
Rate of return ₂₀₂₀	5.26	-29.19	44.36	11.81	-4.68	-8.92	-3.16	-7.26	-33.55	-40.10
Portfolio 2 ₂₀₂₀	ZWC	CCC	SFG	ETX	KRK	BDX	PSW	LPP	IFI	SKA
Rate of return ₂₀₂₀	-2.81	-24.49	-31.43	-28.57	39.29	72.94	16.73	-6.33	68.57	9.20

Source: Own study.

Over the past 4 years, among dividend-paying companies on the Polish stock exchange, it was found that the higher average rates of return were generated by the companies with growth potential rather than value potential. For portfolio 2, made of 10 companies with the highest P/BV ratios, the average annual rate of return was 4.05% (see table 2).

Table 2.

Average annual rate of return generated by portfolios 1 and 2 made of 10 companies – Polish stock exchange

Portfolio variants	2017	2018	2019	2020	Average rate of return	Standard deviation of return
Portfolio 1 (companies with value potential)	0.20%	-18.26%	-2.84%	-6.54%	-6.86%	8.08%
Portfolio 2 (companies with growth potential)	12.19%	-14.61%	7.32%	11.31%	4.05%	12.62%

Source: Own study.

The 2020 analysis, however, as the world struggled with the SARS-CoV-2 pandemic and major turbulence, panic and consequent steep stock price declines developed in the financial markets, the average annual rate of return was higher for companies with growth potential at 11.31%, compared to -6.54% for companies with value potential (table 2). Polish dividend-paying companies with value potential in a turbulent 2020 economy were characterized by a considerably lower risk level (portfolio 1 standard deviation of $\sigma_{P1_GPW}=8.08$ p.p.) than dividend-paying companies with growth potential ($\sigma_{P2_GPW}=12.62$ p.p.).

In order to conduct the second stage of analyses, the listings of selected ETFs replicating gold and silver price movements in USD and PLN for the 2016-2020 period (rates of return for the 2017-2020 period) were presented in tables 3÷4.

Table 3.*Pricing of ETFs replicating gold price movements for the 2016-2020 period*

	Items/Year	2016	2017	2018	2019	2020
Price (USD)	iShares Physical Gold ETC	22.8425	25.5075	25.1725	29.775	36.9675
	Invesco Physical Gold ETC	113.41	126.5	124.85	147.735	183.45
	Gold (1 Oz)	1150.91	1303.33	1282.56	1517.31	1898.71
Price (PLN)	iShares Physical Gold ETC	95.61	88.78	94.17	112.96	138.06
	Invesco Physical Gold ETC	474.67	440.26	467.07	560.48	685.11
	Gold (1 Oz)	4817.10	4536.04	4798.12	5756.37	7090.92
USD (PLN)		4.19	3.48	3.74	3.79	3.73

Source: Own study.

Table 4.*Pricing of ETFs replicating silver price movements for the 2016-2020 period*

	Items/Year	2016	2017	2018	2019	2020
Price (USD)	WisdomTree Physical Silver ETC	15.46	16.01	14.6025	16.9675	24.745
	iShares Physical Silver ETC	15.8475	16.4313	14.9913	17.4425	25.44
	Silver (1 Oz)	15.95	16.95	15.49	17.85	26.39
Price (PLN)	WisdomTree Physical Silver ETC	64.71	55.72	54.63	64.37	92.41
	iShares Physical Silver ETC	66.33	57.19	56.08	66.17	95.01
	Silver (1 Oz)	66.76	59.01	57.96	67.73	98.55
USD (PLN)		4.19	3.48	3.74	3.79	3.73

Source: Own study.

Tables 5÷6, respectively, present the annual rates of return of the selected ETFs replicating gold and silver price movements in USD and PLN for the 2016–2020 period (rates of return for the 2017–2020 period).

Table 5.*Annual rates of return of the ETFs replicating gold price movements for the 2017-2020 period*

	Items/Year	2017	2018	2019	2020
Price (USD)	iShares Physical Gold ETC	11.67%	-1.31%	18.28%	24.16%
	Invesco Physical Gold ETC	11.54%	-1.30%	18.33%	24.18%
	Gold (1 Oz)	13.24%	-1.59%	18.30%	25.14%
Price (PLN)	iShares Physical Gold ETC	-7.15%	6.08%	19.95%	22.22%
	Invesco Physical Gold ETC	-7.25%	6.09%	20.00%	22.24%
	Gold (1 Oz)	-5.83%	5.78%	19.97%	23.18%

Source: Own study.

Table 6.*Annual rates of return of the ETFs replicating silver price movements for the 2017-2020 period*

	Items/Year	2017	2018	2019	2020
Price (USD)	WisdomTree Physical Silver ETC	3.56%	-8.79%	16.20%	45.84%
	iShares Physical Silver ETC	3.68%	-8.76%	16.35%	45.85%
	Silver (1 Oz)	6.30%	-8.62%	15.23%	47.81%
Price (PLN)	WisdomTree Physical Silver ETC	-13.89%	-1.96%	17.83%	43.56%
	iShares Physical Silver ETC	-13.78%	-1.93%	17.99%	43.57%
	Silver (1 Oz)	-11.61%	-1.77%	16.85%	45.51%

Source: Own study.

Tables 5 and 6 demonstrate substantial differences in the rates of return of precious metals and ETFs depending on whether ETF listing prices are quoted in USD or PLN. The differences are particularly apparent in the years 2017-2018. Including the PLN listings, however, makes perfect sense as portfolios comprise of stocks from dividend-paying companies listed on the Warsaw Stock Exchange and therefore listed in PLN. Selected ETFs replicating silver and gold prices are perfectly reflecting precious metal price movements – the Pearson's linear correlation coefficient of the funds' and precious metals' rates of return for both USD and PLN listings is at 1.

Tables 7 and 8 present the listings, the rates of return and dividend rates of the selected REIT ETFs replicating stock price movements for REITs with portfolios composed of real estates all over the world. Data for the 2016-2020 period is presented in a similar manner as the precious metals market, in USD and PLN.

Table 7.

Vanguard Real Estate ETF parameters in USD and PLN

	Items/Year	2016	2017	2018	2019	2020
Data for USD	Vanguard Real Estate ETF	67.72	71.04	66.76	86.06	82.09
	Dividends	2.31	2.96	3.11	2.88	3.18
	Rate of return		9.25%	-1.65%	33.23%	-0.91%
	Dividend rate		4.16%	4.66%	3.35%	3.87%
Data for PLN	Vanguard Real Estate ETF	283.46	247.23	249.73	326.48	306.58
	Dividends	9.67	10.29	11.63	10.93	11.87
	Rate of return		-9.15%	5.72%	35.11%	-2.46%
	Dividend rate		4.16%	4.66%	3.35%	3.87%
USD (PLN)		4.19	3.48	3.74	3.79	3.73

Source: Own study.

Table 8.

iShares Developed Markets Property Yield UCITS ETF parameters in USD and PLN

	Items/Year	2016	2017	2018	2019	2020
Data for USD	iShares Developed Markets Property Yield UCITS ETF	20.77	23.09	21.83	26.46	23.94
	Dividends	0.80	0.77	0.94	0.81	0.72
	Rate of return		14.86%	-1.37%	24.93%	-6.80%
	Dividend rate		3.32%	4.32%	3.07%	3.01%
Data for PLN	iShares Developed Markets Property Yield UCITS ETF	86.93	80.36	81.67	100.38	89.41
	Dividends	3.33	2.66	3.53	3.09	2.69
	Rate of return		-4.49%	6.02%	26.70%	-8.26%
	Dividend rate		3.32%	4.32%	3.07%	3.01%
USD (PLN)		4.19	3.48	3.74	3.79	3.73

Source: Own study.

Unlike ETFs replicating precious metals market, for REIT ETFs, the investor's rate of return is contingent not only on the fund's price movements but also on the dividends received, distributed by REITs to their investors. The average dividend rate for the Vanguard Real Estate ETF was 4.01%, and for the iShares Developed Markets Property Yield UCITS ETF was 3.43%. For the entire analyzed period, the dividend rate of both funds was still above 3%.

Table 9 presents the average ETF rates of return for each group, i.e. replicating gold, silver and REIT prices and risk measures. Data presented in the table was estimated for the prices expressed in PLN. The application of each average in further analyses aims to eliminate potential differences in the ETFs' listings within their respective groups.

Table 9.

Average rates of return and risk measures of the ETFs groups

ETFs groups averages	2017	2018	2019	2020	Average annual rate of return	Standard deviation of return	Coefficient of variation
Average ETF Gold	-7.20%	6.08%	19.98%	22.23%	10.27%	13.66%	1.33
Average ETF Silver	-13.84%	-1.94%	17.91%	43.57%	11.43%	25.11%	2.20
Average ETF Reit	-6.82%	5.87%	30.90%	-5.36%	6.15%	17.45%	2.84

Source: Own study.

The highest average annual rate of return can be found in the silver market (11.43%), with the highest standard deviation of (25.11 p.p.). The lowest average annual rate of return, in contrast, was generated by the REIT ETFs portfolio (6.15%), at a risk that was 3.79 p.p. higher than that of the gold market. It is worth noting that, in this case, higher risk levels didn't correlate with higher average annual rate of return (figure 1).

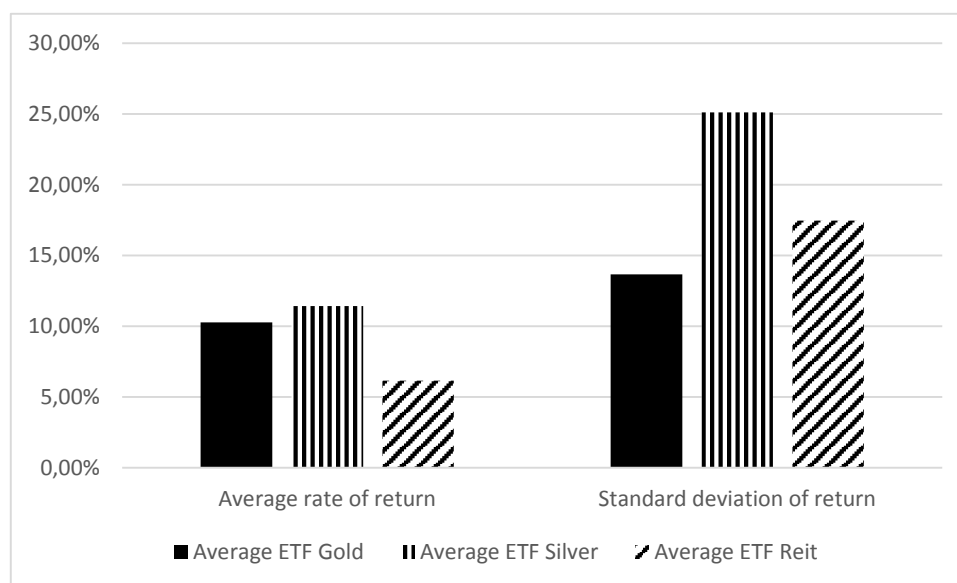


Figure 1. Parameters of the analyzed ETFs for the 2017–2020 period.

Source: Own study.

Among the asset groups analyzed, gold market has the lowest risk-return ratio (coefficient of variation at 1.33) and the highest – the REIT market (coefficient of variation at 2.84). The coefficients of variation presented for the ETF groups support the postulate of a well-balanced investor, who seeks to minimize risk and maximize return. Given the diversity of individual groups of ETFs, all of them will be included in the research concerning variants of portfolios made of dividend-paying companies with value potential (portfolio 1) and with growth potential represented by portfolio 2 (figure 2).

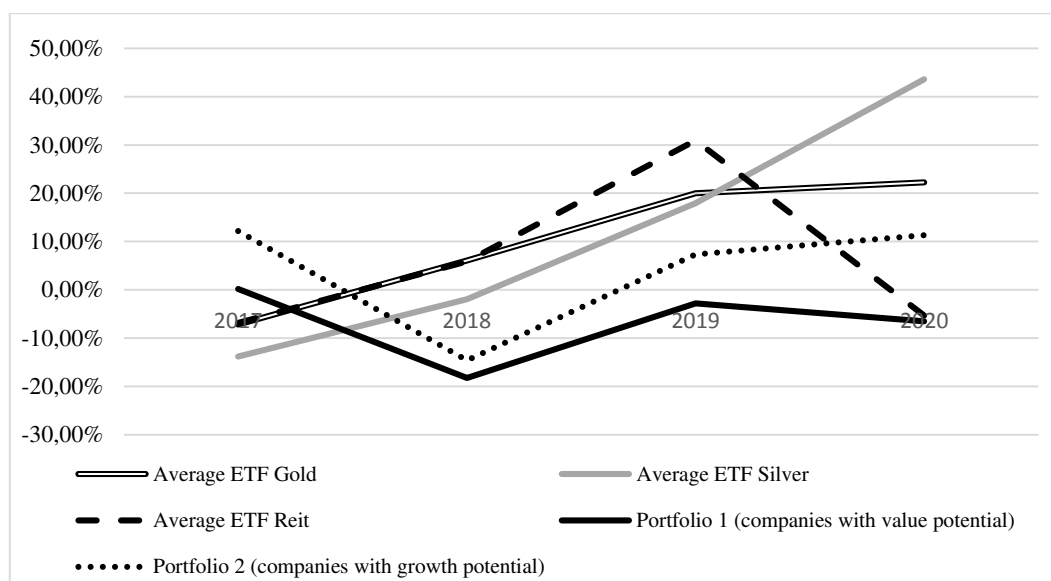


Figure 2. Returns of the analyzed portfolios and ETFs for the 2017–2020 period.

Source: Own study.

Table 10 presents portfolio variants that include dividend-paying companies with value (portfolio 1) and growth (portfolio 2) potential, along with ETFs representing gold and silver markets, and REITs. Equal participation of the individual portfolio components was assumed in the portfolio variants.

Table 10.

Average rates of return and risk measures of the portfolio variants

Portfolio variants	2017	2018	2019	2020	Average annual rate of return	Standard deviation of return	Coefficient of variation
Portfolio 1	0.20%	-18.26%	-2.84%	-6.54%	-6.86%	8.08%	-1.18
Portfolio 1/Etf Gold	-3.50%	-6.09%	8.57%	7.84%	1.71%	7.58%	4.45
Portfolio 1/Etf Silver	-6.82%	-10.10%	7.54%	18.51%	2.28%	13.26%	5.81
Portfolio 1/Etf Reit	-3.31%	-6.20%	14.03%	-5.95%	-0.36%	9.68%	-27.16
Portfolio 2	12.19%	-14.61%	7.32%	11.31%	4.05%	12.62%	3.11
Portfolio 2/Etf Gold	2.50%	-4.26%	13.65%	16.77%	7.16%	9.78%	1.36
Portfolio 2/Etf Silver	-0.82%	-8.28%	12.62%	27.44%	7.74%	15.72%	2.03
Portfolio 2/Etf Reit	2.68%	-4.37%	19.11%	2.98%	5.10%	9.94%	1.95

Source: Own study.

The investor could eliminate negative average annual rate of return of the companies with value potential by considering only precious metals assets in his portfolio (Portfolio 1/Etf Gold = 1.71% and Portfolio 1/Etf Silver = 2.28%). A portfolio of companies with growth potential, in contrast, saw an average annual rate of return increase in every case. The investor gained the highest annual average rate of return increase from Portfolio 1 and Portfolio 2, by incorporating ETF Silver funds by including the gold market in both dividend-paying companies portfolios, the investor reduced the portfolios' risk (the standard deviation of the rates of return for portfolio 1 was reduced from 8.08 p.p. to 7.58 p.p., while portfolio 2 was reduced from 12.62 p.p. to 9.78 p.p.). Among the portfolio variants analyzed, dividend-paying companies with growth

potential diversified by the gold market (Portfolio 2/Etf Gold) present the lowest risk-return ratio and dividend-paying companies with value potential diversified by the silver market (Portfolio 2/Etf Silver) present the highest risk-return ratio. Adding ETFs that replicate REITs to portfolio 1 and portfolio 2 improved the average annual rate of return to a lesser extent compared to the inclusion of precious metals. The diversification of all asset groups analyzed with ETFs reduced the coefficient of variation only for portfolio 2. Negative coefficient of variation values (Portfolio 1 and Portfolio 1/Etf Reit) are not to be interpreted.

The 2020 analysis, when panic and stock price declines impacted financial markets, diversification of portfolios with ETFs was a sensible solution by using precious metals (figure 3).

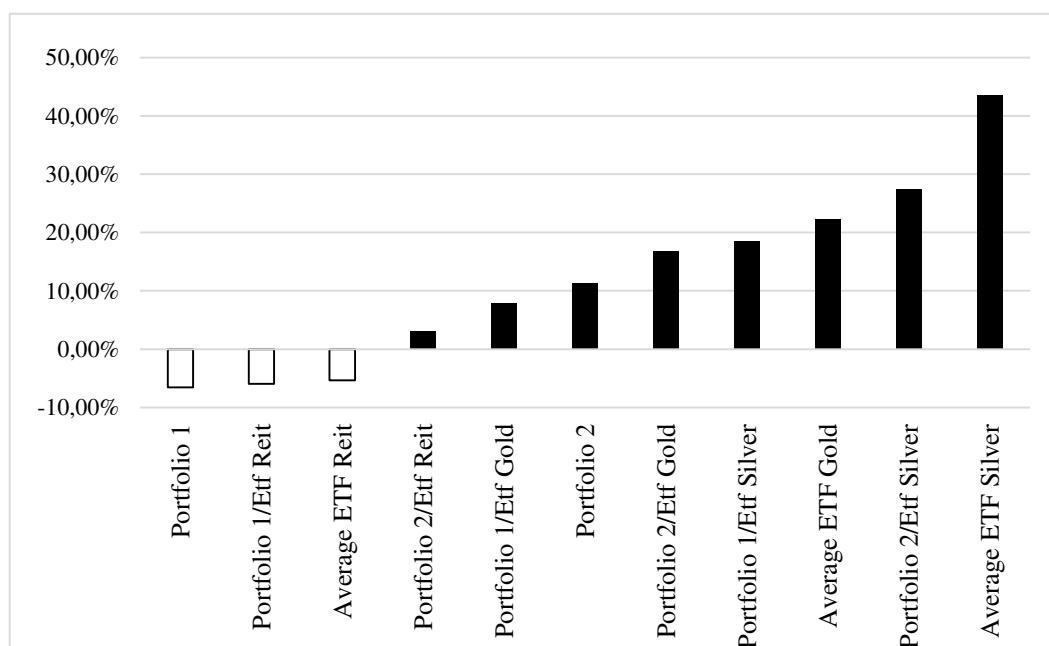


Figure 3. Ranked portfolio variants rates of return in 2020.

Source: Own study.

The highest rate of return in 2020 was generated by portfolios diversified by ETFs replicating silver and gold price movements. By including ETF Silver group assets, the profitability of portfolio 1 increased from -6.54% to 18.51% and portfolio 2 increased from 11.31% to 27.44%. Following the diversification of both dividend-paying companies' portfolios with gold, their profitability also increased, but to a lesser degree (Portfolio 1 saw an increase from -6.54% to 7.84% and Portfolio 2 from 11.31% to 16.77%). Including ETFs replicating REITs in the composition of portfolios proved to be a sensible solution only for portfolio 1 (increase in average annual rate of return from -6.54% to -5.95%).

Additional analyses were conducted to analyze the relationship between portfolios made of dividend-paying companies (Portfolio 1 and 2) and portfolios of ETFs (replicating gold, silver and REIT prices). Pearson's linear correlation coefficient and Spearman's rank correlation coefficient were chosen as measures of relationship. It was also assessed whether the estimated correlation coefficients were statistically significant through the use of a non-parametric

correlation coefficient significance test. A nonparametric t test was conducted to determine whether the estimated correlation was statistically significant. The closer the value of correlation coefficient is to 0, the weaker the relationship between the analyzed characteristics. Therefore, the following hypotheses were adopted:

H_0 : $\rho = 0$ (this is no relationship between the two characteristics in the sample),

H_1 : $\rho \neq 0$ (this is a relationship between the two characteristics in the sample).

Next, p-value calculated by a test statistic was compared with significance level of α (assumed α value=0.05), thus:

- if p-value $> \alpha$, there are no grounds to reject H_0 ;
- if p-value $\leq \alpha$, H_0 should be rejected by assuming H_1 (the correlation is significant).

The research reveals (see tables 11 and 12) that a moderate degree of Pearson's linear correlation ($\rho_{\text{Pearson}} = 0.3137$) was observed only between portfolio 2 (portfolio with growth potential companies) and portfolio made of ETFs replicating silver prices. There are no grounds to reject H_0 hypothesis claiming that the variables are independent (p-value = 0.6863). In other cases, it can be concluded that there is no linear relationship between the analyzed variables. The results are somewhat different in the case of Spearman's rank correlation. A moderate correlation ($\rho_{\text{Spearman}} = 0.4$) was observed between portfolio 1 (portfolio with value potential companies) and all the ETFs analyzed, and again there are no grounds to reject the H_0 hypothesis. A very high, negative correlation ($\rho_{\text{Spearman}} = -0.8$), and therefore the most interesting relationship, emerged between portfolio 2 and the ETFs REIT companies portfolio, with p-value=0.3333. It can be concluded that during the considered period, the portfolio of dividend-paying companies with growth potential performed to a large extent like the portfolio of companies replicating real estate market (but with an opposite sign). For the other two portfolios, however, the Spearman rank correlation was also slightly negative ($\rho_{\text{Spearman}} = -0.2$; p-value = 0.9167), meaning that there was no relationship between the analyzed portfolios.

Table 11.

Pearson's linear correlation coefficient, Spearman's rank correlation coefficient and p-value levels – Portfolio 1

2017–2020 Correlation	P1 and ETF gold		P1 and ETF silver		P1 and ETF Reit	
	rho	p-value	rho	p-value	rho	p-value
Pearson	-0.0987	0.9013	0.0170	0.983	0.0176	0.9824
Spearman	-0.4	0.75	-0.4	0.75	-0.4	0.75

Source: Own study in the R-CRAN statistical analysis package.

Table 12.

Pearson's linear correlation coefficient, Spearman's rank correlation coefficient and p-value levels – Portfolio 2

2017–2020 Correlation	P2 and ETF gold		P2 and ETF silver		P2 and ETF Reit	
	rho	p-value	rho	p-value	rho	p-value
Pearson	0.1055	0.8945	0.3137	0.6863	-0.1559	0.8441
Spearman	-0.2	0.9167	-0.2	0.9167	-0.8	0.3333

Source: Own study in the R-CRAN statistical analysis package.

5. Discussion and conclusions

A research, concerning the portfolio variants of the Polish dividend-paying companies diversified with ETFs replicating price changes of gold, silver or REITs in the years 2017-2020, was conducted, which revealed rates of return and risk differences, especially when the analysis is related to the financial market crisis and stock price declines. Most importantly, it should be demonstrated that the selected ETFs faithfully reflected the sentiment of the assets prevailing in a given group. The higher average annual rate of return of precious metals ETFs was accompanied by a higher risk and vice versa, which was proven by the coefficient of variation (average gold ETF of 1.33 and average silver ETF of 2.20). In light of the aim of the research and the hypotheses adopted, an analysis of the results obtained in 2020, as the world struggled with the COVID-19 pandemic, becomes important. By including precious metals assets in the portfolio, not only did the average annual rate of return of the Polish dividend-paying companies stocks increase, but it also had a positive impact on the annual rate of return in 2020 (with silver included, Portfolio 1 saw a rise from -6.54% to 18.51% and Portfolio 2 from 11.31% to 27.44%; with gold included, Portfolio 1 saw a rise from -6.54% to 7.84% and Portfolio 2 from 11.31% to 16.77%). Coefficient of variation applicable to the Polish dividend-paying companies stocks has also been reduced through the use of precious metals ETFs. Inclusion of ETFs replicating REITs in the investors' portfolios no longer show such positive developments, despite the fact that dividend payments from these companies were also included. Moreover, during the considered period, a portfolio made of dividend-paying companies with growth potential was characterized by a high negative correlation with the portfolio of companies that replicate real estate market.

Based on the conducted research, the adopted research hypotheses were verified, and on this basis, it was concluded that:

- H₁: The average annual rate of return of dividend-paying companies portfolios with value and growth potential is not higher, but instead it is lower than ETFs replicating precious metals. This hypothesis was verified negatively.
- H₂: During the turbulent economy of 2020, the inclusion of precious metal assets boosted the rates of return of the Polish dividend-paying companies' portfolios. In the case of ETFs including REITs, no increase in the rate of return of the Polish dividend-paying companies' portfolios was observed. This hypothesis was verified negatively in part.
- H₃: During the considered period, a portfolio made of dividend-paying companies with growth potential was the only one to be characterized by a strong negative correlation with a portfolio of companies that replicate real estate market. This hypothesis was verified negatively in part.

Based on the comparisons carried out, concerning variants of portfolios made of dividend-paying companies, further divided into companies with value potential and with growth potential, including the precious metals market and REITs, recommendations for capital market investors can be indicated. Irrespective of the variants of the Polish dividend-paying companies' portfolios, their average annual rates of return were significantly elevated, when the precious metals ETFs were included. Those investors, who expect higher rates of return, should include precious metals in a physical form or the ETFs replicating fiduciary metal behavior in their portfolios.

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LOGISTICS CAPABILITIES AS POTENTIALS FOR FIRM'S SUCCESS

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Purpose: Presentation of the share of logistic capabilities in shaping the firm's success potential.

Design/methodology/approach: The indication of the share of logistic capabilities in shaping the success potential of the enterprise presented in this article is based on the conducted literature review.

Findings: Presentation of the share of logistic capabilities in achieving success by an enterprise, apart from the structuring of existing knowledge in the area of enterprise success, can be a starting point for identifying key logistic capabilities leading directly to success.

Originality/value: The literature on the subject describes the issues of enterprise success in a narrow scope. Indicating the share of logistic capabilities in achieving the success of an enterprise systematizes knowledge and can be a starting point for further research on logistic capabilities in the context of achieving success leading to competitive advantage.

Keywords: success potentials, logistical capabilities, success.

Category of the paper: Conceptual paper.

1. Introduction

Every firm operating in the market wants to achieve success that will ensure the acquisition and, above all, maintenance of a competitive advantage in the long term. Due to significant competition and ever-changing customer expectations, finding a way to achieve a competitive advantage is a complicated task for which not only business practice, but also science is trying to find a solution.

According to the solutions developed within the framework of strategic management, the way to achieve the success of an enterprise is through success potentials. The success potentials of a firm, which consist of success factors, include the resources, capabilities and competencies of a firm that contribute significantly to the achievement of the enterprise's goals.

Success is a specific issue that can be captured depending on the chosen point of view in both economic and social life. In the context of an firms, success manifests itself in the achievement of certain market and economic effects by the firm, which are determinants of

success. The achievement of market and economic effects by the firm in accordance with the established goals is the basis for achieving competitive advantage.

Due to the important role of logistics in the operation of firms, this article focuses on the contribution of logistics in shaping the success of a firm. In the field of logistics, it is possible to distinguish the existence of logistical success potentials, which are one group of success potentials of an firms that lead to success.

2. The essence of the success potentials of the firm

The success of a firm is a rather complex issue that can be considered from different points of view. Within the framework of strategic management, the success of a firm is related to the concept of success potentials, which have a direct contribution to the success of the firm, regardless of what form this success takes.

The success potentials of a firm are based on assumptions that are part of the strategic management stream, in particular, on solutions within the resource concept. Success potentials contribute to the success of the firm, so making it possible to achieve and maintain a competitive advantage. Therefore, success potentials are a set of factors leading to the achievement, planned by the firm, of success. The indicated success factors that are components of success potentials are the resources, capabilities and competencies of the enterprise, so its strategic potentials.

Strategic potentials consist of the resources, capabilities and competencies of a firm, as pointed out by, among others, G. Gierszewska and M. Romanowska (2002, p. 14), presenting that, it is the strategic potential of the firm in the form of resources and capabilities that leads to success. Also R. Krupski (2006, pp. 53-65) recognizes resources and competencies as components of the firm's potential. Strategic potentials are the basis for the development of the potential for success, or can transform into it if certain resources, capabilities and competencies become factors that lead to this success. Strategic potentials can contribute not only to success but can also lead to the achievement of the assumed competitive position or market success, which is not the same as the success of the firm (Matwiejczuk, 2019).

With regard to the issue of firm potentials, in the literature, in addition to strategic potentials, there also appears the term competitive potential, the purpose of which is to provide, maintain or strengthen the firm's competitive advantage (Radziejowska, 2011). The indicated competitive potential is defined as tangible and intangible resources used by an enterprise to create and strengthen its position relative to its competitors (Stankiewicz, 2002, p. 93). The contribution of competitive potential to achieving an advantage is also discussed by M. Gorynia, B. Jankowska and P. Tarka (2011), arguing that it is the basic determinant of gaining, maintaining and strengthening a competitive advantage. Such a treatment of

competitive potential indicates that it is the third type of firm potential, and does not constitute a treatment of a firm's success potentials.

The strategic potentials of a firm do not directly lead to competitive advantage, but form the basis of success potentials that will contribute to competitive advantage through the achievement of market and economic effects. On the other hand, the success potentials leading to the achievement of competitive advantage can be defined by the competitive potential, as it provides the firm with a competitive advantage.

As mentioned earlier, the success potentials of firm consist of its strategic potentials, i.e. resources, capabilities and competencies. However, in order for an firm's strategic potentials to become success potentials, certain resources, capabilities and must become key success factors (Stankiewicz, 2005, p. 93).

Key success factors contribute to the achievement by the firm of a certain competitive position, as well as participate in the development of the firm (Gierszewska, Romanowska, 2014, p. 128). Key success factors are considered as a set of factors, which are the basis for the implementation of the established strategic objectives of the firm (Sebora, Lee, Sukasame, 2009). They are defined as the resources and skills of an enterprise that lead to a certain value.

The relationship between success potentials, strategic potentials and firm success is presented in Figure 1.

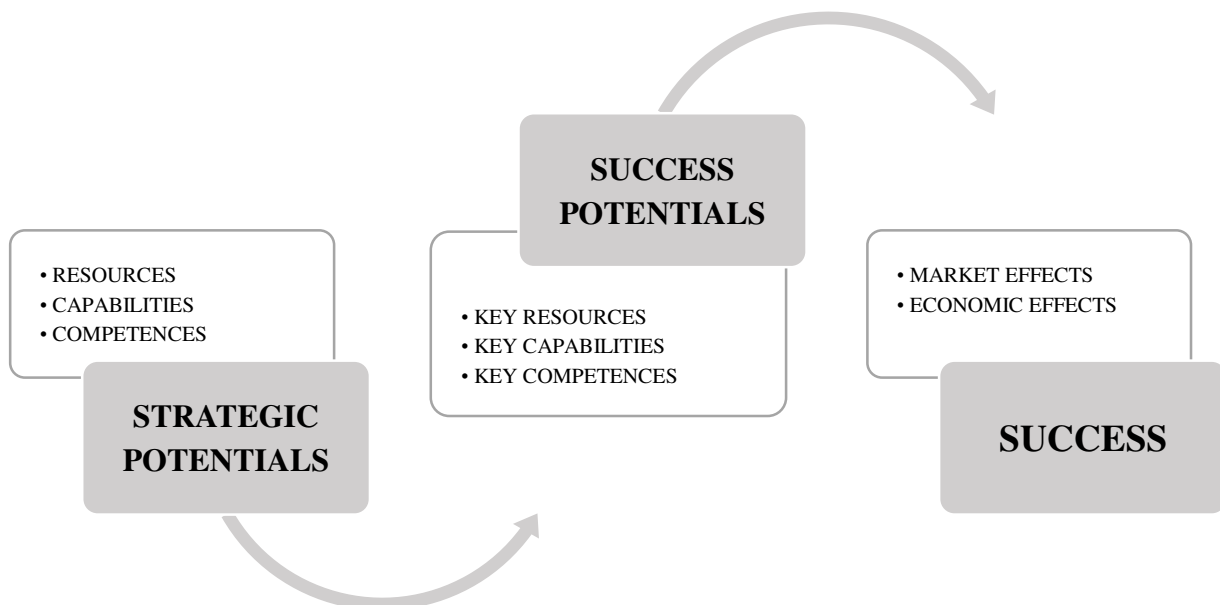


Figure 1. The relationship between success potentials, strategic potentials and firm success.

Source: Matwiejczuk, 2015.

In order for a firm to properly utilize the key success factors, it is important to identify and integrate them to take advantage of the total potential of the success factors. Here R. Matwiejczuk (2015) points out two concepts that allow for the proper identification of success factors of an enterprise. The first concept, the Concept of Key Success Factors, is based on the VRIN criteria developed by J.B. Barney, i.e. the features of identifying key resources

that have been implemented to assess capabilities and competencies. Using J.B. Barney's method, it is possible to extract from the set of success factors those with VRIN characteristics, i.e. valuable, rare, difficult to imitate and non-substitutable resources, abilities and competencies that will become key success factors.

The second concept, the Concept of Key Factors of Success based on product development issues, involves the identification of key success factors related to the achievement of market outcomes from the perspective of customers. The concept does not directly identify resources, capabilities and competencies, but instead focuses on market success created as a result of meeting the needs and preferences of customers, who do not point to specific resources, capabilities and competencies, but only evaluate the market offering of the company as a result of the use of strategic potentials (Matwiejczuk, 2015).

Specific success factors of a firm lead to the achievement of success, which, as mentioned earlier, can be captured in different contexts. With regard to strategic management, the success of a firm is considered in market and economic terms, as the ability to achieve the expected market and economic effects, i.e. the determinants of success.

Success in market and economic terms has been described mainly through G.S. Day and R. Wensley (1998), who, within the framework of their concept of creating a competitive advantage, identified the most significant, in their opinion, market and economic effects that demonstrate the success of a firm. The cited concept assumes that firm focuses on the development and use of a set of resources and capabilities specified for a given firm, which together can become a source of performing activities much better than the competition, which will lead to the achievement of competitive advantage. The authors point out that an firm transforms specific success factors, or more precisely, key success factors into specific determinants of success, which leads to the achievement of competitive advantage. The concept of competitive advantage according to G.S. Day and R. Wensley is presented in Figure 2.

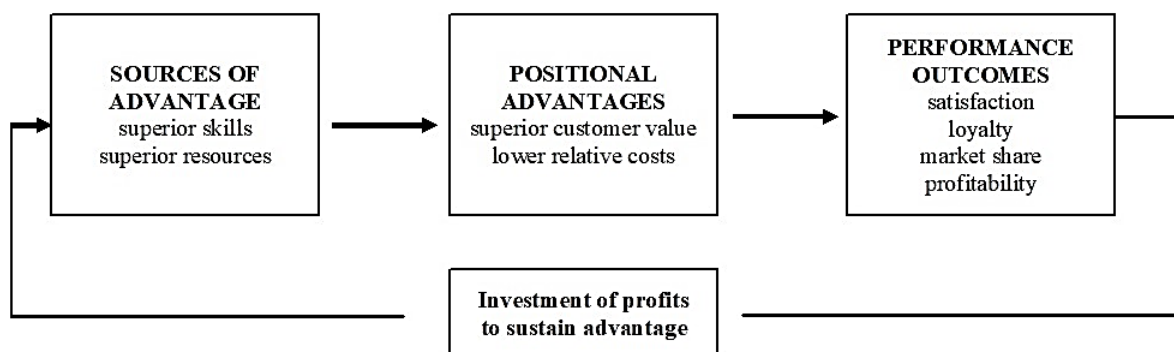


Figure 2. Elements of competitive advantage in research. G.S. Day and R. Wensley.

Source: Day, Wensley, 1988.

The authors consider two groups of effects - market effects and economic effects - as manifestations of success for a firm. The market effects researchers included customer satisfaction, loyalty from customers and market share. In turn, the most important economic

effects are profit, profitability and return on invested capital (Day, George, Wensley, 1988). The determinants of success outlined, like the success factors, should be properly defined and planned by the firm. Only previously established goals will allow alignment of the defined success factors with the selected market and economic effects, and thus make it possible to achieve the planned success.

3. The concept and significance of logistics capabilities

When analysing the structure of success potentials, special attention should be paid to the capabilities of the firm, which are a set of skills and knowledge that allow the effective use of resources (Morash, Droge, Vickery, 1996). The literature on the subject indicates that the capabilities of the firm formed on the basis of the resource approach can be of many types, depending on the adopted criterion for division. For the purposes of this article, the functional criterion was adopted as the distinguishing criterion, on the basis of which logistical capabilities were distinguished due to the significant participation of logistics in the functioning of the firm.

Logistics capabilities are the capabilities of firms developed in the area of logistics. E.A. Morash, C.L.M. Droge and S.K. Vickery (1996) define logistics capabilities as "the attributes, capabilities, organizational processes, knowledge and skills that enable a firm to achieve superior performance and sustainable competitive advantage over its competitors". D.M. Gligor, and M.C. Holcomb (2012) consider logistics capabilities to be complex bundles of skills that are the result of knowledge. T. Mentzer, S. Min, L.M. Bobbitt (2004), explaining the idea of logistics capabilities, refer to the components of capabilities, i.e. skills indicating that logistics capabilities are unique skills, acquired, maintained and strengthened in competition based on time and quality. On the other hand, T.L. Esper, B.S. Fugate, B. Davis-Sramek (2007) in identifying the concept of logistics capabilities refer directly to the functions they perform, depicting that logistics capabilities make it possible to deliver orders within a certain time, reduce response times in the supply chain, as well as to integrate the supply chain and exchange information among chain participants.

Logistics capabilities, based on the use of logistics resources, are related to the implementation of logistics processes and tasks, so as to lead to the achievement of the goals set by the firm and ensure the generation of value (Matwiejczuk, 2014a, p. 50), so the concepts of logistics resources and capabilities are strongly related. Although in the literature there are approaches to capabilities as a specific type of resource, as evidenced, among others, by the works of P.J. Daugherty, T.P. Stank and A.E. Elinger, (see more extensively 1998), the concept of logistics resources and logistics capabilities should be treated in separate categories, which have an important level of integration.

Logistics capabilities can be considered both internally and externally. Logistics capabilities from an internal perspective relate to the planning, coordination and integration of the processes of the various functional units of the firm. On the other hand, capabilities from an external perspective are related to customer service and supplier relations. The combination of both aspects of logistics capabilities ensures the coordination of processes inside the firm as well as in extended structures outside the firm (Gligor, Holcomb, 2014).

Logistics capabilities based on logistics resources are characterized by the difficulty of imitation and reproduction moreover, they can also meet the condition of rarity and high value (Olavarrieta, Ellinger, 1997). However, the literature indicates that among the most important characteristics of logistics capabilities contributing to the success of the firm is their participation in the integration process. J.T. Mentzer, S. Min, L.M. Bobbitt (2004) argue that it is logistics capabilities that are crucial in the integration process, contributing to productivity growth, long-term profitability and enterprise survival. It is important not only to use logistics capabilities in the process of integrating processes within the firm, but also to combine logistics capabilities themselves into specific sets, as evidenced by the work of S.Y. Ponomarov and M.C. Holcomb (2014). The authors believe that a single capability of an enterprise will not provide the enterprise with a competitive advantage, so it is important to integrate logistics capabilities into properly configured sets of capabilities leading to a specific goal.

An important feature of logistics capabilities, which indicates their importance in achieving the firm's intended goals, is their contribution to providing customers with high-quality products at low cost. Logistics capabilities enable the implementation of tasks focused on providing goods and services to customers in accordance with their preferences, as well as ensuring the implementation of logistics service at a high level (Matwiejczuk, 2014). The creation, development and effective use of logistics capabilities is a complex process that, thanks to the specificity of logistics capabilities, brings a number of benefits, especially in highly competitive markets (Hofer, Jin, Knemeyer, 2021).

When considering the contribution of capabilities to the success of the firm, it should be noted that these capabilities are the primary source of competitive advantage (Grant, 1991). S. Olavarrieta, A.E. Ellinger (1997) considered logistics capabilities as distinctive capabilities due to the fact that they contribute to the creation of added value and possess the characteristics of rarity and difficulty of imitation. Also D.F. Lynch, S.B. Keller, J. Ozment (2000) see logistics capabilities as sources of competitive advantage.

J.T. Mentzer, S. Min, L.M. Bobbitt (2004) prove in their research that logistics capabilities have a stake in achieving competitive advantage by achieving cost leadership and differentiation manifested in customer service. C. Defee and B. Fugate (2010), on the other hand, argue that the creation of distinctive logistics capabilities is a prerequisite for firms that want to be competitive by adopting diverse logistics service as a competitive element. T. Stank and C. Lackey (1997) referring to logistics performance consider that logistics capabilities regarding integration and agility are very important for logistics performance.

Also P.J. Daugherty, T.P. Stank and A.E. Elinger (1998) show the association of logistics capabilities with competitive advantage and higher profitability. The authors argue that achieving the benefits of a firm's capabilities should lead to high levels of customer satisfaction. Here they point to logistics capabilities as an example of capabilities, and more specifically, logistics capabilities related to the improvement of distribution services.

4. The role of capabilities in the structure of success potentials of the firm

Logistics capabilities lead to a number of benefits, including contributing to competitive advantage, and therefore to the success of the firm. As mentioned earlier, a single logistics capability on its own cannot directly lead to the success of an enterprise, and thus to competitive advantage. That is why it is so important to place logistics capabilities in the sets of factors that lead to the success of the enterprise.

Relating success potentials to the field of logistics, it is necessary to focus on the issue of logistic success potentials, which are one of the groups of success potentials of an enterprise. Logistics success potentials consist of logistics resources, logistics capabilities and logistics competencies, which are key factors in the success of an firm (Matwiejczuk, 2015).

Logistics capabilities, together with logistics resources and logistics competencies, form a hierarchy of strategic potentials, which consists of the strategic profile of potentials for the success of the firm, which consists of factors leading to the achievement of competitive advantage. These determinants are divided into two groups, namely normative determinants relating to the management of the enterprise as a whole and functional determinants, considered in terms of individual functional areas of the enterprise (Matwiejczuk, 2014b). Logistics is one such area, which is why logistical success potentials belong to the functional strategic profile of firm.

Logistics capabilities that are success factors, which are the focus of this article, have been placed in the structure of success potentials twice - as part of the strategic potential and part of the success potency of the firm. The placement of logistics capabilities in the structure of success potentials is shown in Figure 3.

Logistics capabilities as part of strategic potentials are located along with resources and competencies in the set of success factors. The role of capabilities here is twofold; first, the capabilities themselves must be developed in the firm in order for the firm's strategic potential to be formed. Second, logistics capabilities form the basis for the development of logistics competencies. Logistics competencies are developed on the basis of logistics capabilities developed in the firm, so they are necessary for the formation of logistics competencies and thus the entire strategic potential.

Logistics capabilities as a component of logistics success potentials indicates that key logistics capabilities, i.e. capabilities that have the greatest contribution to success, become necessary for the formation of key logistics competencies, which are directly related to key logistics capabilities, as well as becoming a necessary element for the formation of logistics success potentials, which make up the success potentials of the firm.

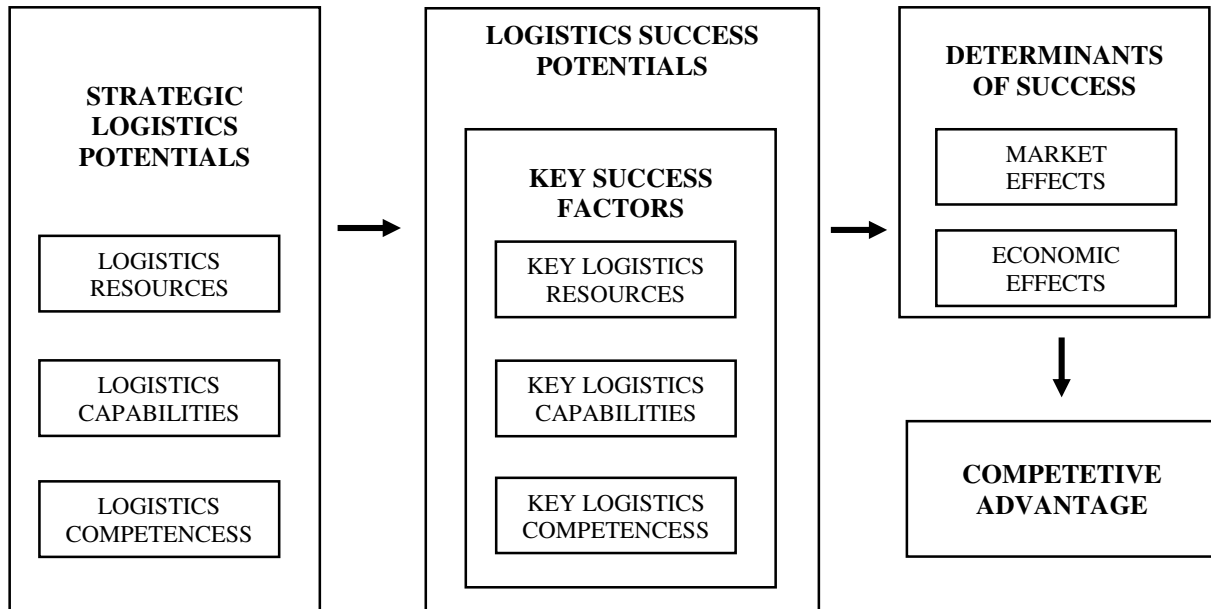


Figure 3. Logistics capabilities in the structure of success potentials.

Source: Matwiejczuk, 2014.

Logistics potentials for success have two basic features, namely they determine gaining and maintaining a competitive advantage and strengthen and balance the competitive position of the firm (Blaik, Matwiejczuk, 2011).

A feature of logistics capabilities that is important in creating success potentials is their inability to acquire, so each firm can create its own, unique set of logistics capabilities that will become success factors. In order to identify key logistics capabilities, the Concept of Key Success Factors described in this article, as well as the Concept of Dynamic Capabilities, may be useful.

The concept of dynamic capabilities identifies two groups of capabilities - operational and dynamic capabilities. In the context of a firm's logistic potential for success, dynamic logistic capabilities may prove crucial, as they focus not only on the company's existing potential, but primarily on the possibilities of creating success potential in the development perspective. These capabilities allow for the effective use of logistics resources and operational capabilities, which enables response to ongoing changes as well as consolidation and coordination of resources and capabilities, which allows the development of logistics competencies contributing to achieving a competitive advantage (Matwiejczuk, 2014b).

In addition to identifying logistics capabilities as well as other success factors, it is crucial to place them in the firm's strategy, as well as to determine the appropriate orientation of the firm, which will allow determining the directions of using logistics success potentials (Matwiejczuk, 2015). The firm's logistics strategy, which is one of the functional strategies, must be integrated with the company's management strategy so that all tasks related to the use of success factors are consistent with the processes implemented in all areas of the company. Moreover, if logistic potentials of success become key determinants leading to the success of a firm, it seems reasonable that the logistics strategy should become the basic strategy of the enterprise, setting the principles of operation of the enterprise in order to make maximum use of the opportunities offered by logistic potentials of success.

5. Conclusions and directions of further research

Logistics success potentials, which consist of key success factors in the form of logistics resources, capabilities and competences, lead to achieving specific market and economic effects, which include customer satisfaction and loyalty, market share, profit, level of profitability and return on investment capital.

Achieving the market and economic effects specified by firm is possible through not only the use of key success factors but also their proper identification and integration. Moreover, firms should focus not only on linking factors within specific groups, but also on including them in the firm's strategy, so that not only logistics processes focus on shaping specific logistics potentials for success, but also that all tasks within the firm contribute in the formation and use of success potentials.

In order for the owner to use the success factors, they must be properly identified, therefore, further research on logistic success potentials, and more precisely, potentials such as logistic capabilities, should focus on identifying key logistic capabilities and creating mechanisms for their effective design and use.

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THE EXCESS MARKET VALUE ADDED FUNCTIONALITY FOR EXPECTATIONS BASED MANAGEMENT

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Purpose: The research presented in this article aims to investigate the usefulness of the excess measures of created value for the needs of Expectations Based Management. The theoretical and methodological objective is to propose extending the scope of classical measures of value by including shareholder expectations. The utilitarian objective is to measure value creation using excess market value added to equity WIG30 companies of the Warsaw Stock Exchange in 2017–2022, and its relations with companies capitalisation and market value added.

Design/methodology/approach: The proposed measure of excess market value added to equity compares expected value as an increase in companies capitalization related to a minimum rate of return on equity equivalent to its cost, decreased by this capital, with the actually achieved value. The analysis makes use of mathematical statistics tools, including non-standard ones, the measure of concentration, and the taxonomic measure of similarity.

Findings: Firstly, the research shows that excess measure does not distort market information and is an appropriate tool for assessing the effectiveness of shareholder value creation. Secondly, the managers of WIG30 WSE companies did not meet shareholder expectations in a satisfactory way. Value management in the analysed companies was given a negative assessment, both in terms of effectiveness and efficiency.

Research limitations/implications: The application of this method is limited by the availability of information but only in external analyses, and it only reduces the frequency of analyses. The trend for further research is the analyses of companies representing various industry indexes and the comparative analyses of individual entities from the perspective of above average values in relation to benchmarks.

Practical implications: The utilitarian value of the research study is the proposal of a method for measuring value creation which includes shareholder expectations for the needs of EBM. Moreover, the research offered an unbiased assessment of whether shareholder value in WSE WIG30 companies is created and simultaneously reflected in an increased value of shares (capitalization) to a higher degree than expected by shareholders.

Originality/value: The presented study mitigates a methodological gap in the area of unbiased assessments of measuring value creation which considers shareholder expectations. The study presents empirical evidence of shareholder value creation. As yet, similar research has not been conducted for Polish and foreign capital markets.

Keywords: Excess value, Expectations-based management, Value creation.

Category of the paper: Research paper.

1. Introduction

A company's development is based on its efficient and effective management. The effects of development can take various forms. The basis financial effect of development is corporate value creation (Copeland et al., 2020). Continuous efforts aimed to create corporate value are the main determinants of management activities. Generally, a company's performance is measured by its ability to adapt to change and its resilience to threats (Fijorek et al., 2021). These assumptions lay the foundations for the concept of Value Based Management (VBM). The key role in this concept is played by a standard measurement and assessment of corporate performance, which motivates managers to implement strategies aimed to create and maximise value (Black et al., 2001). It is shareholders who set a given objective and assess the degree of achieving value creation, but an increase in shareholder value must be coupled with an increase in stakeholder value (Rappaport, 2006).

The measurement of value creation has greatly evolved in past years and is currently based on market categories (Kaczmarek, 2019). The main internal measure of created value is Economic Value Added (EVA) and Market Value Added (MVA) as an external measure. The latter measure meets the requirement of an unbiased, market assessment. It is useful, but it has some deficiencies. They can be related to a specific measurement objective or its level (a point of observation, a group of information recipients). Generally, the effects of a company's development are measured by stakeholders expectations (Srivastava et al., 1998). However, it can be questioned whether MVA is a sufficient measure for assessing shareholder value creation. This issue can be understood in two ways: 1. Are expectations met (a minimum return covering capital costs)? 2. Is the level of value creation sufficient (at least average as compared with the benchmark)? This doubt can be expressed in the following way: do managers, implementing a specific corporate value management strategy (related to stakeholders), give sufficient attention to shareholder expectations?

The subtilizing of shareholders expectations is a basis for Expectations Based Management (EBM) (Copeland et al., 2020). The key role is played here by the way in which we measure shareholder value. Therefore, the article aims to assess the usefulness of excess market value added on the capital market in Poland. The assessment is presented in the context of relations with market value (company capitalisation) and market value added. The result of the assessment leads to the conclusion whether the management of the companies in question meets shareholder expectations with regard to value creation (the answer to the first question). The research comprised 30 companies (WIG30 index) with the highest capitalization (over 1/3) on the Warsaw Stock Exchange (WSE). The research period was 2017-2022, and the presentation of results on a quarterly basis.

The presented research has narrowed a methodological gap in the area of unbiased assessments of measuring value creation which considers shareholder expectations. Moreover, the research objectively examined in practice whether shareholder value in WSE WIG30 companies is created and simultaneously reflected in an increased value of shares (capitalization) to a higher degree than expected by shareholders. As yet, similar research has not been conducted for Polish and foreign capital markets. Unambiguously, the research methodology possesses utilitarian value and application in Expectations Based Management.

2. Literature Review

MVA is a tool for measuring the ability to increase shareholder value – the effect of managers' operations and, consequently, an assessment of the effectiveness and efficiency of management. As a difference between market value and invested capital, it should have a positive value, generating a premium. The market value of listed companies is reflected in company capitalisation. Therefore, MVA represents a difference between capitalization and equity. MVA is an external measure of created value, but it is correlated with EVA (internal measure): it is the sum of the net present value of a series of EVA values (O'Hanlon, Peasnell, 2002). The calculation of EVA for listed companies should give consideration to equity and its cost.

Generally, MVA represents a market opinion, and, unlike EVA, it does not measure results and has several drawbacks (Banerjee, 2000):

- it can be determined only at a company level (not at the level of a company's business entities),
- shareholders can benefit only from company capitalization (so without cash distributions to shareholders),
- as an absolute measure, it limits comparative assessments (in time and between companies),
- it does not consider shareholder expectations with regard to future value creation.

From the point of view of the scope and objective of this article, the last drawback on the above list is critical and has a major impact on the capital market. Despite positive value creation, return on investment below shareholders' expectations results in reduced share prices, and vice versa (Copeland, Dolgoff, 2006) (Table 1).

Table 1.
Correlations between value added and share prices

	Return on capital < cost of capital	Return on capital > cost of capital
Return on capital: actual > expected	Value added: negative Increase in share prices	Value added: positive Increase in share prices
Return on capital: actual < expected	Value added: negative Reduction in share prices	Value added: positive Reduction in share prices

Source: (Copeland, Dolgoff, 2006).

This correlation results from differences in understanding the idea of corporate value creation (generally) and shareholder value creation (the perspective of company owners) (La Porta, 1996). In order to create shareholder value, it is necessary to both generate and realize value added. This realization is done through an increase in the value of shares – the effect of achieving results exceeding shareholders' expectations. Expected value is predicted by the market (the shareholders' market) and included in market share prices (the value of future increase). Therefore, the necessary consideration given to the difference between the actual value added (the achieved value) and the expected value directs us towards excess market value added. This criterion is more restrictive than market value added.

The concept of excess market value added stems from the combination of two measures: excess return and value added. In reality, excess return represents return on investment above the benchmark or index at a similar level of risk. Such a measure was proposed by A. Rappaport in the form of Cumulative Abnormal Return (Capron, Pistre, 2002). It was the effect of referring to the idea of Total Shareholder Return (TSR) (Fernandez, 2001), and Alfa Ratio M. Jensen (François, Hübner, 2020). In a broader sense, value added was practically applied as EVA (Stern et al., 1996), currently defined as Systemic Value Added (Magni, 2003). The idea was initiated by the works of A. Marshall (1890) and G. Preinreich (1936), and developed by K. Peasnell (1982) and J. Ohlson (1995). Within the framework of Expectations Based Management (EBM), these two approaches were combined as excess residual income (Copeland, Dolgof, 2006). It represents the difference between the actual and expected annual economic profit. The concept was developed for the needs of multi-year periods by J. O'Hanlon and K. Peasnell (2002).

Empirical research studies of value added were conducted on stock exchanges (Perotti, Wagenhofer, 2011; Baker et al., 2011) and bond markets (Bosse et al., 2013), including emerging markets (Gilmore, Hayashi, 2011) and Far East markets (Nurwati, Ramdi, 2013). The studies focused on 'classic' value added measures and the relationship between MVA and company performance, and the impact of planning on shareholder value (Quintiliani, 2018), the relationship of MVA and EVA and their impact on the stock rate of return (Johan, 2019; Udiyana et al., 2022).

Generally, the literature review points to gaps in defining and measuring market value added creation from the perspective of shareholders, and more precisely – the simultaneous assessment of the effectiveness of value added creation and the efficiency of the desired value

as defined by the concept of excess value. Some other research gaps are clearly visible in empirical research on excess market value added.

3. Research methods

The integration of shareholders expectations into the concept of MVA is done in a similar way as in the case of TSR (Superior Shareholder Return) (Kaczmarek, 2018). A positive value of TSR indicates the achievement of a superior return in relation to the benchmark (McTaggart et al., 2004). In turn, the actual return which exceeds the expected level results in Excess TSR (Rappaport, 2006). If it is expressed by equity capital cost, excess return is the rate of return that exceeds what was expected or predicted by models like CAPM (Capital Asset Pricing Model) (Capron, Pistre, 2002).

Invested equity (IC_E^C with equivalents) and the sum of future EVAs represent Market Value to Equity (MV_E), in other words, market capitalization. Therefore, if MVA_E is the difference between MV_E and IC_E^C , a positive value occurs when return on invested equity capital ($ROIC_E^C$) exceeds equity capital cost (ECC^C) (Pfeiffer, 2004).

$$MVA_E = MV_E - IC_E^C; MV_E = IC_{Et-1}^C + \sum_{t=1}^{\infty} \frac{EVA_{Et}}{(1 + ECC_t^C)^t} \quad (1)$$

$$ROIC_E^C > ECC^C \rightarrow MVA_E > 0$$

To extend the concept of MVA_E by integrating it with shareholders expectations (Mikołajek-Gocejna, 2014; Danielson, Dowdell, 2001), the presented analysis defines excess market value added to equity (MVA_{EN}). It is the difference between the expected value (MVA_{EP}) and the actual value (MVA_{ER}). MVA_{EP} indicates an increase in MV_E in relation to the expected minimum return on invested equity capital ($ROIC_E^C$), equivalent to the cost of capital (ECC^C), decreased by this capital (IC_E^C). A positive value of MVA_{EN} indicates achieving excess value created (abnormal/superior). It should be noted that MVA_{EN} is not comparable with MVA_E but delta MVA_E (the difference in values in subsequent periods, which indicates value creation). Comparative analyses (rankings, benchmarks) should relativise delta MVA_E and MVA_{EN} , for example using the amount of invested capital (IC_E^C).

$$MVA_{EP} = MV_{Et-1} \cdot (1 + ECC_t^C) - IC_{Et-1}^C; MVA_{EN} = MVA_{ER} - MVA_{EP} \quad (2)$$

$$MVA_{EN} > 0 \rightarrow \text{excess value}$$

Two research hypotheses are formulated in connection with the objective of the article:

- H1 excess market value added to equity is correlated with changes in companies capitalisation in the degree similar to increases in market value added,
- H2 the degree of market value added creation in listed companies meets their shareholders' expectations.

If H1 is confirmed, the value of correlation $r(MVA_{EN}, dMV_E)$ should be close to $r(dMVA_E, dMV_E)$. In turn, if H2 is confirmed, correlation $r(MVA_E, dMVA_P)$ should be almost complete.

To verify H1, it was necessary to use non-standard mathematical statistics tools. The analysis made use of Williams' test statistic (T_2) for the equality of two correlated r -Pearson coefficients (Meng et al., 1992; Steiger, 1980). H2 was verified using a test for r -Pearson single correlation coefficient¹.

The applied concentration measure (ZG) corresponds to the surface of the ellipse which covers the analysed set of objects (companies). A higher value of ZG indicates greater dispersion (Kaczmarek, 2022).

The applied taxonomic measure of similarity (TMS) calculates the sum of minimum shares of objects (companies) in the compared structures. Values closer to unity indicate greater similarity (Kolegowicz et al., 2022).

The expected rate of return on invested equity ($ROIC^C_E$) was determined in CAPM (an increase in risk-free rate by the product of systemic risk measure *beta* and equity risk premium *ERP*)².

The study comprised all 30 companies representing WIG30 Warsaw Stock Exchange. They represent a major share of market capitalization (37.2%). The analysis covered the years 2017-2022. The article presents quarterly data (transformed from weekly data) and then transformed into annual data. The data was collected from emis.com, notoria.pl, gpw.pl, stockwatch.pl, and ekrs.ms.gov.pl. (commercial access). The scope of value calculation corrections is confined to information available in financial statements.

4. Results

4.1. Capitalization and value added creation

The capitalization of 30 WIG30 companies at the end of 2022 reached the level of PLN 446.4 bn (MV_E), which represents 37.2% of the WSE main trading floor. Until 2019, this figure was stable (annual average). A decrease in the lock down period (2020, -17.7%), a quick recovery in the following year, and another decrease pointed to the projections of steady growth according to path 'W' instead of a more optimistic path 'V'.

However, the readings of market value added to equity (MVA_E) present a different picture – a steady deterioration in value creation until 2019, and a real collapse in 2022, even more dramatic than during the lock down period. The worst performance in the analysed group is recorded for manufacturing companies. 22/24 quarters recorded MVL (market value lost), and the year 2022 was characterised by a drastic breakdown. In 2017–2022, the loss amounted to PLN 103.1bn (MVA_E , representing 64.3% of the analysed group). Finance companies were hardest hit, their total MVL amounting to PLN -40.9 bn. Trade companies always recorded a positive value of MVA_E , and their losses were the lowest (PLN -16.4 bn). Generally, the decreasing values of dMV_E (2017-2022, PLN -43.0 bn) indicate a negative assessment of the analysed indicators and a clear signal to investors (shareholders). Simultaneously, a decrease in $dMVA_E$ by PLN -160.4 bn represents an almost fourfold loss of shareholder value added (Figure 1).

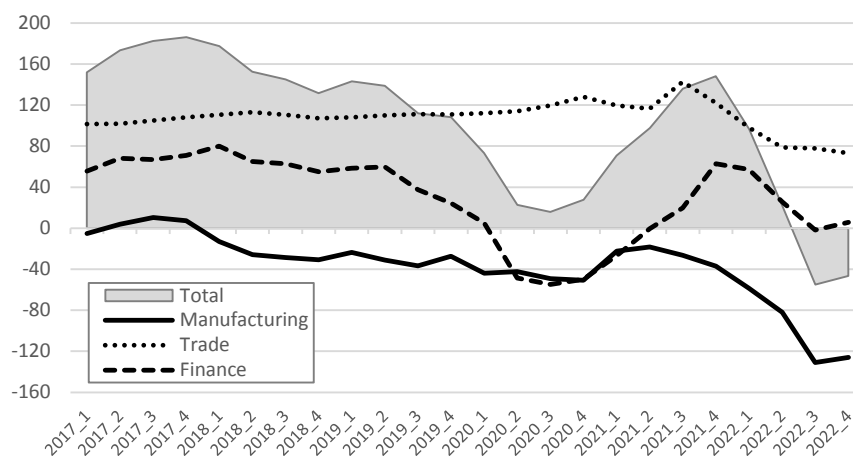


Figure 1. Market value added to equity (MVA_E) of WSE WIG30 listed companies in 2017-2022 (PLN billion, quarterly data).

Source: author's research based on data bases of limited access (commercial data bases): emis.com, notoria.pl, gpw.pl, stockwatch.pl, ekrs.ms.gov.pl. Available online: <https://www-1emis-1com-1v9owocmt1833.hanbg.uek.krakow.pl/php/home>, <https://uekr-1notoria-1pl-1y3wmvzmt1837.hanbg.uek.krakow.pl/companies/dashboard/WIG30>, <https://www.gpw.pl/archiwum-notowan>, <https://www.stockwatch.pl/gpw/indeks/wig30,sklad.aspx>, <https://ekrs.ms.gov.pl/>.

The particular companies varied in terms of dMV_E and $dMVA_E$ values. Positive values for dMV_E were recorded in 11 companies (PLN +51.9 bn), while the remaining 19 entities had negative values (PLN -94.8 bn). The majority of value creators were manufacturing companies (7/11), while the best entity represented the trade sector. A positive value of $dMVA_E$ was achieved only in 8 companies (PLN +38.5 bn), and the remaining 22 entities recorded a considerable negative value (PLN -198.9 bn). The composition of the first 10 positions with regard to dMV_E and MVA_E was different only in two cases. In-depth comparative analyses are presented in other research studies and discussed in other articles. The main destructors and creators of value in WSE WIG30 companies are presented in Table 2.

Table 2.

Changes of capitalization (dMV_E) and market value added to equity ($dMVA_E$) of the first and last five WSE WIG30 listed companies in 2017-2022

$dMVA_E$			dMV_E			$dMVA_E$			dMV_E		
Ticker	Rank position	PLN billion	Ticker	Rank position	PLN billion	Ticker	Rank position	PLN billion	Ticker	Rank position	PLN billion
DNP	1	24.5	DNP	1	27.4	KGH	26	-11.9	CCC	26	-6.1
LPP	2	5.7	LPP	2	7.3	SPL	27	-13.3	SPL	27	-6.3
CDR	3	4.1	CDR	3	5.3	PGE	28	-16.5	PZU	28	-7.9
LVC	4	1.3	KGH	4	3.3	ALE	29	-32.7	PEO	29	-8.5
KTY	5	1.2	OPL	5	2.3	PKN	30	-48.7	ALE	30	-31.3

Note. A stock ticker was used to identify the companies. There is an explanation of it in the Appendix.

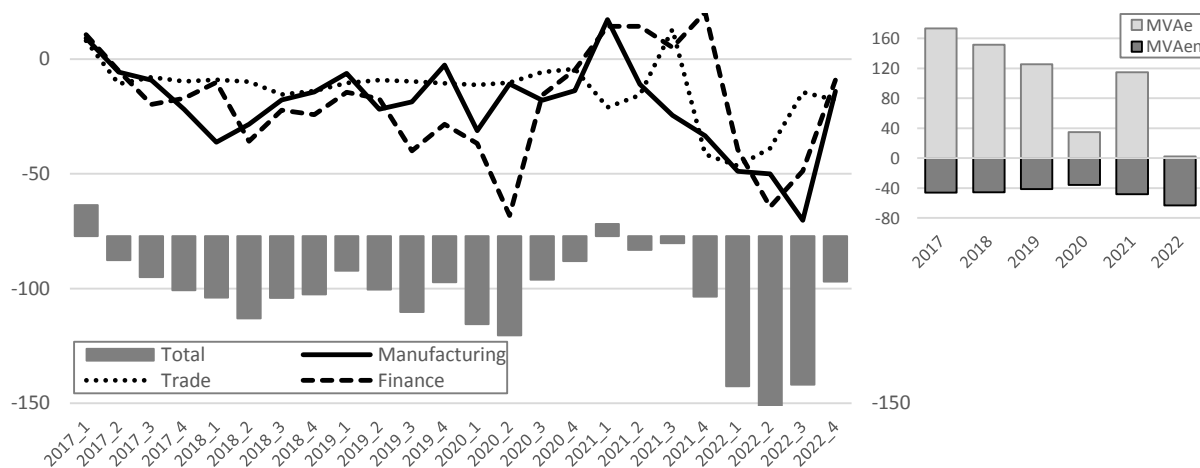
Source: as in Fig. 1.

4.2. Assessment of shareholder expectations

The article proposes excess market value added to equity (MVA_{EN}) as the main measure for assessing the degree of meeting shareholder' expectations. In 2017-2022, their investments in WSE WIG30 companies resulted in the loss of PLN -160.4 bn of value added (MVA_E). There are other aspects of this negative assessment. The gap in value measured by MVA_{EN} amounted to PLN -280.7 bn (75.0% more). This level of value creation was expected by shareholders (the condition to be met was $MVA_{EN} = 0$). Unfortunately, their expectations were not met, and in addition to that, companies recorded losses of value ($MVA_{EN} < 0$).

The relative size of the gap (MVA_{EN} to IC^C_E) as the average in the period 2017-2022 amounted to -13.2%. In relation to capital market capitalization (MVA_{EN} to MV_E), it reached the level of -10.3%.

The biggest gap of value (PLN -107.7 bn) was recorded for finance companies (38.4% of the total gap), manufacturing (PLN -96.0 bn) and trading entities (PLN -77.0 bn). Interesting figures were recorded in the year 2020 – in the context of pessimistic predictions, the companies' results were not that bad, which resulted, quarter after quarter, in a reduced gap. However, in 2021, the conditions reversed. In the context of a quickly expected recovery, business conditions deteriorated. There were indications of the lock down recession being transformed into a more serious crisis caused by general disturbances in economic relations and the loss of hopes for embarking on path 'V' instead of path 'W'. Therefore, as of the middle of 2021, the gap increased dramatically, exceeding the lock down level by 71.7% in 2022 (peak Q2.2020 PLN -83.9 bn, Q2.2022 PLN -153.3 bn) (Figure 2).



Note. Left panel – for the total figure of excess market value added to equity (MVA_{EN}), the right axis is appropriate. Right panel – excess market value added to equity (MVA_{EN}) vs. market value added to equity (MVA_E) (PLN billion, annual data).

Figure 2. Excess market value added to equity (MVA_{EN}) of WSE WIG30 listed companies by type of activity in 2017–2022 (PLN billion, quarterly data – left panel, annual data – right panel).

Source: as in Fig. 1.

In 2017–2022, companies presented in the coordinate system were dispersed and they changed their positions ($dMVA_E$; MVA_{EN}). The dispersion, as measured by ZG, increased 2.7-fold (annual average), and its quarterly changes with a linear growth tendency were weakly reversely proportional to MVA_{EN} ($r = -0,28$). Increased dispersion indicates greater differences between companies (increased distances between them, marking greater differences). Generally, changes in positions were not favourable, moving towards the quadrant ($-dMVA_E$; $-MVA_{EN}$). In conclusion, value losses increased, which was accompanied by widened gaps between expectations and the achieved results (Figure 3).

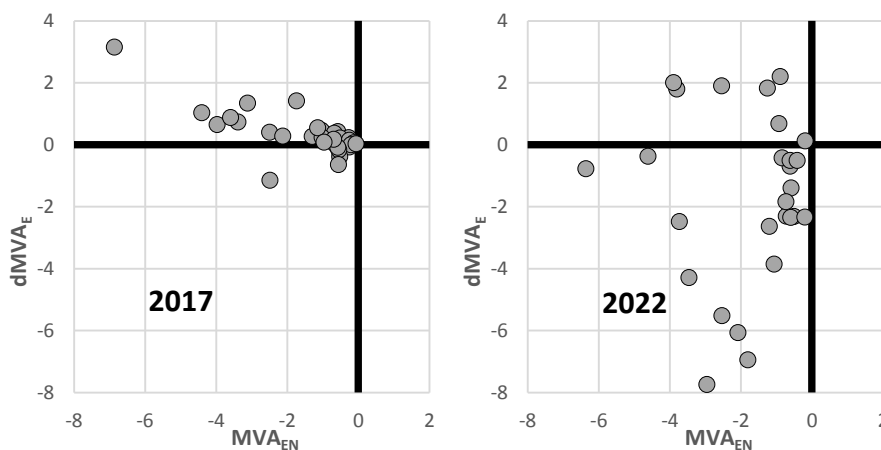
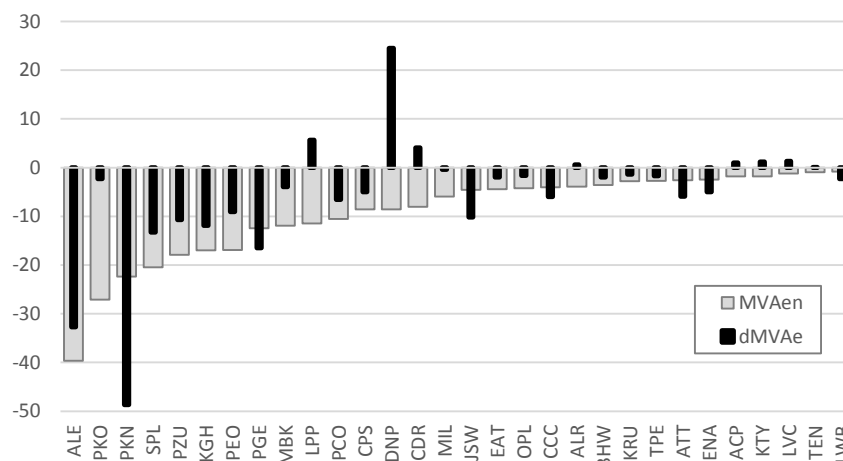


Figure 3. Position of companies in relation to excess value added to equity (MVA_{EN}) and changes in market value added to equity ($dMVA_E$) in 1997 and 2022 (PLN billion).

Source: as in Fig. 1.

MVA_{EN} (the difference as excess value/gap) can be compared with changes in value added, i.e., $dMVA_E$ (the difference as an increase/decrease). These values had a different distribution in time and in the particular companies. A positive value of $dMVA_E$ occurred in 8 companies (5 manufacturing, 2 trade entities, and 1 finance company), while 22 companies recorded value losses. With regard to MVA_{EN} , no companies recorded a positive result (abnormal/excess value) (Figure 4).



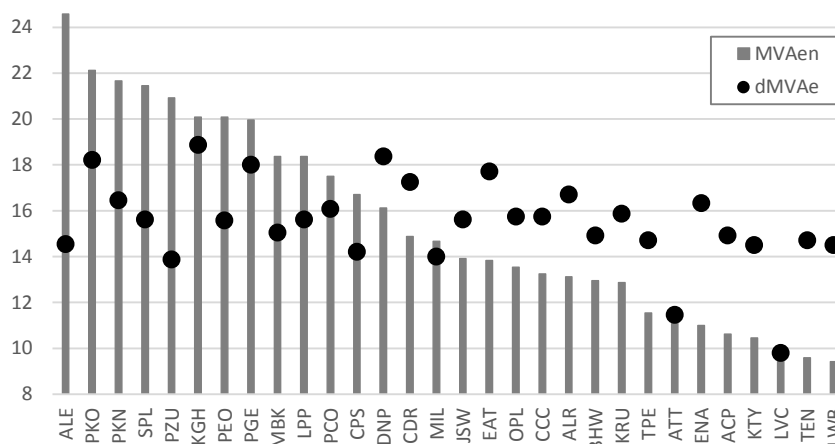
Note. A stock ticker was used to identify the companies. There is an explanation of it in the Appendix.

Figure 4. Cumulative excess value added to equity (MVA_E) and changes in market value added to equity ($dMVA_E$) in 1997-2022 (PLN billion).

Source: as in Fig. 1.

Differences in companies' rank positions with respect to $dMVA_E$ and MVA_{EN} remained stable. In 13 cases the average rank position (ARP) was higher in terms of $dMVA_E$, and in 15 cases in terms of MVA_{EN} . Only two companies occurred proximity by ARP terms. The similarity measure IPS of rank positions showed a slightly increasing tendency, with a greater intensity recorded in 2020-2021 (0.92 compared to 0.85 in 2017). Gaps between minimum and maximum ARPs were greater for MVA_{EN} (9.4 : 24.6) than for $dMVA_E$ (9.8 : 18.9) (Figure 5).

Detailed comparative analyses of companies are presented in other research studies and articles.



Note. A stock ticker was used to identify the companies. There is an explanation of it in the Appendix.

Figure 5. Average rank position (ARP) WSE WIG30 companies by excess value added to equity (MVA_E) and changes in market value added to equity ($dMVA_E$) in 1997-2022.

Source: as in Fig. 1.

4.3. Verification of the hypotheses

H1 was verified on the basis of the analysis of two correlations: dMV_E and $dMVA_E$, and dMV_E and MVA_{EN} . The correlations were expected to be similar. William's test (T2) showed a generally high, positive and statistically significant correlation (as the average for 30 companies, with each p-value < 0.000), respectively 0.941 and 0.875 (min = 0.715, max = 0.995, sd = 0.071). The difference between correlations is low (7.0%).

In light of the above, the first hypothesis is positively verified: H1 – excess market value added to equity is correlated with changes to companies capitalisation in a similar degree as increases in market value added. It indicates that MVA_{EN} is an appropriate (not deforming) measure for assessing the effectiveness of shareholder value creation.

The verification of H2 was based on the analysis of $dMVA_E$ and $dMVA_{EP}$ correlations. The expected result was close to unity. The obtained result $r = 0.145$ indicates a weak correlation (as the average for 30 companies, with each p-value < 0.000, min = -0.44, max = 0.406, sd = 0.09).

The above considerations allow for rejecting the second hypothesis as a null hypothesis and accepting an alternative hypothesis: the degree of market value creation in listed companies did not meet shareholder expectations.

5. Discussion

The markets provide information on market value as primary information. Decreases in share prices were caused by strong turbulences related to the pandemic and the nervousness of the capital market (Zhang et al., 2021). The revaluation of shares on the WSE was a short-term phenomenon, similarly to other emerging markets (Rakshit, Neog, 2022). In 2017-2022, the capitalization of WSE WIG30 decreased by 9.4%. Moreover, market value added, which took into account the capital invested by shareholders, showed a decreasing trend, but remained positive in all the analysed years. It distorted a true picture of the effectiveness of investments in shares (Johnson et al., 2020), and, therefore, did not cause investors' concern.

Excess market value added to equity (MVA_{EN}), used to measure effectiveness, revealed a huge value gap in each analysed year, which widened in the last two years. It represented 68.0% of the capital invested by shareholders and 61.6% of the companies' market value.

It should be noted in this context that the impact of the pandemic and lock down was not as great as originally expected, and the main indexes recovered quickly (Lento, Gradojevic, 2021). It resulted from a number of factors including unprecedented bailout policies. It should also be stressed that the largest value gap occurred in finance companies (banks and insurance companies). It was caused by the specificity of this sector (Demirgüç-Kunt et al., 2021). Neutral results were achieved by trade companies, which quickly and effectively implemented online trade systems (Kubiczek, Derej, 2021). On the other hand, manufacturing companies did not record large value gaps until the first half of 2022 (the cooling of economies, supply chain disruptions) (Graves et al., 2022).

The discussion should also give attention to the interpretation of results achieved by particular companies. Detailed comparative analyses are presented in other research studies and papers. It should be noted, however, a positive value of MVA_{EN} can be accompanied by a negative value of MVA_{ER} (actual value) as a result of a lower, also negative, value of MVA_{EP} (expected value). It leads to ambiguities in assessments (Du, 2019).

6. Conclusions

Undoubtedly, the years 2017–2022 mark a period of turbulent changes in capital markets. Despite these circumstances, the performance of WSE WIG30 in terms of capitalization cannot be regarded as extremely unsatisfactory. A decrease in capitalization, i.e., market value creation, amounts “merely” to PLN -43.0bn (-9.4%). This statement can be misleading because market value lost in this period reaches the level of as much as PLN -160.4 bn in the form of market value added loss, which takes into account invested capital. This statement is not the

final assessment, either, because the effectiveness of invested capital is measured from the perspective of expected benefits. In this context, unfortunately, the loss measured by excess market value added amounted to PLN -280.7 bn, representing -13.2% of invested capital.

The reliability of the above assessment is confirmed in the article by two analytical steps. Firstly, it was proved (a positive verification of H1) that excess market value added, as a measure based on a broader perception, taking into account shareholder expectations, does not distort the content provided by original market information.

Secondly, it was proved (a negative verification of H2) that the degree of market value creation in WSE WIG30 companies in 2017-2022, did not meet shareholder expectations. It is the basis for a negative assessment of both the effectiveness and efficiency of corporate value management in the analysed entities.

The measure proposed in the article requires a special source of information. It does not create any barriers in internal analyses – measurements can be continuous, as required by the application of Expectations Based Management. With regard to external analyses, information barriers limit periodization conducted more frequently than on a quarterly basis. A highly representative character of the research sample does not hinder the formulating of general conclusions.

Recognising a market-based assessment as a basis for assessing the effectiveness of corporate management is controversial. This issue is the subject of debates, and the position stated in the article is based on the assumption that it is only the markets that express unbiased opinions and, moreover, discount the ability to create value in the future.

The presented study opens the way for further research focused on companies representing various industry indexes, the analyses of above-average values compared to benchmarks, i.e., the comparative analyses of individual companies.

Acknowledgements

The publication was financed from the subsidy granted to the Krakow University of Economics – Project No 058/ZZE/2022/POT.

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Footnotes

1. The strengths of r–Pearson correlations used: <0.1 slight; 0.1-0.3 weak; 0.3-0.5 average; 0.5-0.7 strong; 0.7-0.9 very strong; >0.9 nearly perfect. Probability value (p–value) lower than critical significance level $\alpha = 0.05$ allows for temporary proceedings based on the assumption that the null hypothesis on the lack of correlation is rejected, which is the basis for accepting an alternative hypothesis on the existence of a correlation (Wasserstein, Lazar, 2016; Hubbard, Bayarri, 2012).
2. The *beta* measure was calculated on the basis of the rates of return of a given company in relation to the rates of return on the WIG30 portfolio (weekly rates, 2012-2022). ERP was calculated as the difference between the average annual rate of return on S&P500 in the last 30 years and the average yields of US 30-year treasury bonds. It was then increased by a sovereign risk premium as the difference of 10-year treasury bond yields in the USA and Poland.

Appendix

Table 3.

Stock ticker and business sector of the studied WSE WIG30 listed companies

Company	Ticker	Business sector	Company	Ticker	Business sector
Allegro.eu S.A.	ALE	E-commerce	LPP S.A.	LPP	Fashion trade
AmRest Holdings S.E.	EAT	Hospitality	Orange Polska S.A.	OPL	Telecommunications
Asseco Poland S.A.	ACP	Software systems	Pepco Group N.V.	PCO	Commerce
Grupa Azoty S.A.	ATT	Chemical industry	Polska Grupa Energetyczna S.A.	PGE	Coal mining and power
LW Bogdanka S.A.	LWB	Coal mining	Polski Koncern Naftowy Orlen S.A.	PKN	Oil refining
CCC S.A.	CCC	Footwear trade	Tauron Polska Energia S.A.	TPE	Energy sales
CD Projekt S.A.	CDR	Computer games	Ten Square Games S.A.	TEN	Computer games
Cyfrowy Polsat S.A.	CPS	Telecommunications	Alior Bank S.A.	ALR	Banking
Dino Polska S.A.	DNP	Commerce	Bank Millennium S.A.	MIL	Banking
ENEA S.A.	ENA	Energy sales	Bank Handlowy w Warszawie S.A.	BHW	Banking
Jastrzębska Spółka Węglowa S.A.	JSW	Coal mining	mBank S.A.	MBK	Banking
Grupa Kęty S.A.	KTY	Aluminum manufacturing	Bank Pekao S.A.	PEO	Banking
KGHM Polska Miedź S.A.	KGH	Copper mining	PKO BP S.A.	PKO	Banking
Kruk S.A.	KRU	Receivables management	Santander Bank Polska S.A.	SPL	Banking
LiveChat Software S.A.	LVC	Software systems	Powszechny Zakład Ubezpieczeń S.A.	PZU	Insurance

Source: as in Fig. 1.

COMPONENTS OF THE POLISH LPI IN RELATION TO MACROECONOMIC VARIABLES. COINTEGRATION ANALYSIS

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Purpose: The aim of the article is to analyze Poland's logistics potential measured by the means of the LPI (Logistics Performance Index). The impact of trade volume, infrastructure development and service quality on individual LPI components was assessed. Estimating the relationship between the components of the Polish LPI index and macroeconomic variables enables the assessment of the strength of the relationship and sensitivity to the economic situation. It allows to draw conclusions about possible areas that are more sensitive or require repair. It also enables to indicate how the economy influences the TSL sector (Transport–Shipping–Logistics).

Design/methodology/approach: The analysis was carried out using the rules and methods of time series cointegration, which enable the analysis of long- and short-term relationships. This enabled the identification of areas most sensitive to the influence of particular factors. To obtain consistent time series, interpolation methods were also used.

Findings: The development of infrastructure and an increase in the level of services has a positive impact on all aspects measured by LPI components. In turn, the increase in trade exchange, as an increase in demand for the TSL sector, affects four of the six components. In two cases, border services and on-time delivery, the relationship is negative. This highlights the main points limiting the growth of LPI ratings and indirectly limiting trade and economic development of Poland.

Research limitations/implications: Limited data availability influenced the choice of method used in the study. Moreover, short time series and data interpolation used in the study may result in the inaccuracy of estimations.

Practical implications: Econometric analysis indicates weaknesses in the Polish logistics sector. Improvements in customs regulations and expansion of infrastructure may improve the functioning of the TSL sector. It should be of particular interest to policy makers, for which economic growth and the LPI rating should be very important.

Originality/value: This is the first paper that uses econometric tools to compare the components of LPI with macro variables.

Keywords: Components of Logistics Performance Index (LPI), Data interpolation, Cointegration analysis.

Category of the paper: Research paper.

1. Introduction

Trade and transport play a pivotal role in driving economic development and fostering national competitiveness. Efficient logistics serves smooth movement of goods and services, reducing costs, improving market access, and enhancing overall economic efficiency. Investments in infrastructure, technological advancements, streamlined customs procedures, and policy reforms aimed at improving logistics and trade facilitation are crucial for enhancing national competitiveness. Countries that prioritize and invest in these areas often experience accelerated economic growth, improved global competitiveness, and better integration into the global economy.

The article analyzes six components of the Logistics Performance Index (LPI) and their relationship to macroeconomic variables affecting the assessment and functioning of the entire logistics system in Poland. Three key macroeconomic variables were mainly assessed: the volume of international exchange of goods, expenditure on infrastructure and prices. The analysis was carried out using the rules and methods of time series cointegration, which enable the analysis of long- and short-term relationships. This enabled the identification of areas most sensitive to the influence of particular factors. To obtain consistent time series, interpolation methods were also used.

2. Methods

World Bank's LPI is a crucial tool for evaluating and comparing the trade and transport facilitation of different countries. It provides a comprehensive framework to assess various dimensions of logistics performance, including customs efficiency, infrastructure quality, ease of arranging shipments, timeliness of shipments, and more.

The methodology used in constructing the LPI score involves principal component analysis, a statistical technique that simplifies and condenses a dataset's dimensionality. Normalizing scores by averaging them across respondents and then standardizing them helps in creating a comparable measure across different countries.

The resultant LPI score, derived from these components, serves as a comprehensive indicator, enabling international comparisons and offering insights into a country's overall logistics performance. It is a valuable tool for policymakers, stakeholders, and businesses to identify areas of improvement and formulate targeted strategies to enhance trade and transport facilitation.

The LPI consolidates various aspects crucial for evaluating logistics sector performance into a single composite measure. These six core components provide a holistic view of a country's logistics and trade facilitation:

1. **Customs:** Focuses on the efficiency of customs and border management clearance processes, which greatly impacts the speed and ease of goods movement across borders.
2. **Infrastructure:** Assesses the quality of trade and transport infrastructure, including roads, ports, railways, and airports, which are essential for efficient logistics operations.
3. **Shipment:** Evaluates the ease of arranging competitively priced international shipments, reflecting the accessibility and affordability of logistics services.
4. **Equality:** Measures the competence and quality of logistics services, crucial for ensuring reliable and efficient movement of goods.
5. **Timeliness:** Considers the frequency with which shipments reach their destinations within scheduled or expected delivery times, reflecting reliability and predictability in logistics operations.
6. **Tracking:** Assesses the ability to track and trace consignments, which is important for transparency and accountability within the supply chain.

The LPI's ability to analyze these components helps pinpoint areas for improvement within logistics and trade systems. By understanding the strengths and weaknesses in these different aspects, countries can develop targeted strategies and policies to enhance their overall trade and transport efficiency.

The publications of the World Bank clearly emphasize the significant relationship between the level of economic development of the assessed countries and the overall assessment expressed in the LPI. The logistics system of economies with a higher level of development is rated much higher. This leads to frequent analyzes and attempts to assess the relationship between the LPI and commonly used measures of economic development, such as GDP. Conclusions are also drawn that improving the LPI assessment may lead to an increase in trade and, therefore, economic growth (Ojala, Celebi, 2015).

The main benefit of the LPI is that it offers a comprehensive, open-source cross-country data set that can be further exploited in logistic performance evaluation. Desan (2013) relied on the LPI data to determine whether small or medium enterprises that trade internationally have better performance. Coto-Millan et al. (2013) proposed global dynamic aggregate production function to determine the contribution of logistic performance to world economic growth. Gunter and Coskun (2012) analyze the relationship of economic and social factors with logistics performance of countries. Tundys (2011) uses the LPI as useful tool and instrument for identifying the potential of the region and for the indication of bottlenecks in the logistics area in the international context. Gogoneata (2008) used regression to analyze the influence of chosen macroeconomic on a domestic LPI in Central and Eastern European countries. Grzelakowski (2018) analyzed the transport-oriented factors and conditions of logistics macro-systems development as integral components of the global logistics system with special

attention paid to the Polish logistics system. He identified transport infrastructural and regulatory barriers hindering effectiveness and efficiency of the Polish logistics system. It was to indicate its development potential by reviewing it with logistics macro-systems of neighboring countries and leading countries in the global scale. The universality of the LPI indicator can also be a source of analyzes in more general areas, e.g., human development (Varma, Shah, 2021).

More detailed analysis of the LPI components for individual countries can be a very helpful policy tool and support economic development. Studies that compared not only the main LPI index but also its components were conducted, e.g., for Russia (Andriianowa, 2017), Bulgaria (Varbanowa, 2017), Uzbekistan (Yusufkhonov et al. 2021) or Poland (Niedzielski et al., 2021; Sowa, Wysocka, 2012). This study hypothesized that analyzing the relationship between macroeconomic variables and specific LPI components could identify sensitive sections of logistic system. Areas in which infrastructure investment policy should be most effective in improving the functioning of the TSL sector and elements of the system that work properly or fail because of increased trade or changes in the quality of services.

The proposed study puts forward the assumption that the rating of the LPI logistics system depends on macroeconomic variables directly related to the logistics process. Each of the six LPI components is sensitive to specific variables, such as the volume of trade, the quality and development of infrastructure and competitiveness of the services offered (1):

$$LPI_j = f(Trade; Infrastructure; Services) \quad (1)$$

where LPI_j are $j = 1, \dots, 6$ components of the LPI.

There are many factors that can be distinguished, but due to the length of the sample and the measurability of some effects, the study focuses only on these three most important elements.

A factor that directly influences LPI is the volume of transported products (*Trade*), the impact of which may have a stimulating or limiting effect. On the one hand, the increase in the volume of transported cargo causes an increase in demand for logistics services and has a positive impact on the development of the logistics system, the quality of services and LPI components. On the other hand, in the event of system failure, excessive transport volume or failure to keep up with global competitors, it leads to discouragement of suppliers, drop in demand, and cased lower LPI rating. The study used the sum of the volume of exports and imports of goods (constant prices for 2015) as a measure of trade volume.

The basic factor influencing the operation of logistics is the level and development of the generally understood logistics infrastructure (i.e., buildings, civil engineering structures, machinery and the IT technologies used). The assessment of the infrastructure itself is also influenced by the ability to handle the volume of trade and the entire set of services related to its maintenance and efficiency. There is no uniform measure that would reliably reflect each of the factors, let alone and/or all these factors together. The study assumes that the main factor influencing the development and general level of transportation facilities are investment

expenditures in land and sea structures. For this reason, to assess infrastructure data of the volume of construction and assembly production of civil engineering facilities were used (constant prices for 2015).

Even more difficult to measure and evaluate is the overall level and quality of logistics services. While effectiveness can be measured by the efficiency of the transport and warehousing services sector, this value cannot be a measure of quality in the opinion of respondents. The study assumed that in a highly competitive market such as the logistics market in Poland, price increases best reflect the increase in the quality of services offered. For this reason, the value-added deflator in the transport and warehousing services sector (2015 = 1) was used.

One of the research hypotheses was that the variables are integrated I(1) and the cointegration analysis will allow to identify the relationship between LPI components and selected macro categories. Statistical tests indicated the non-stationarity of the analyzed time series¹. Cointegration analysis methods allow to identify long- and short-term relationships. The two-stage Engel-Granger procedure was used in the estimation. The general form of models for individual LPI components can be written as follows (2):

$$\Delta LPI_j = \alpha_j(\beta_{0j} + \beta_{1j}t_{-1} + \beta_{2j}i_{-1} + \beta_{3j}p_{-1}) + \gamma_{1j}\Delta t + \gamma_{2j}\Delta i + \gamma_{3j}\Delta p \quad (2)$$

where:

t – logarithm of sum of export and import of goods volume,

i – logarithm of volume of construction and assembly production of civil engineering facilities,

p – logarithm of value-added deflator in the transport and warehousing services sector,

α_j – Error Corection Term of j -th LPI component,

β_{kj} – k -th long-term relation of j -th LPI component,

γ_{kj} – k -th short-term relation of j -th LPI component.

Similar specification of equation (2) was applied to all LPI components. This procedure was aimed at statistical verification of relationships that, despite the emphasis placed on selected elements of the logistics system. It was assumed that the assessment of the LPI components depends on all the distinguished factors. For example, the efficiency of customs and border management or the assessment of infrastructure quality is also influenced by trade, the overall quality of services and the level of infrastructure utilization.

3. Results

3.1. LPI data and interpolation results

The LPI and its components were published for 2007, then every two years between 2010 and 2018, and finally because of the pandemic the last publication was for 2022. Due to irregularities in published rates, the data was interpolated into an annual data set. An example of the use of data disaggregation methods for quarterly to monthly data can be found in Welfe and Karp (2017). Methods used to estimate data for the years between published values were linear, log-linear, cubic spline, and cardinal spline.

The discrepancies between the linear and cubic spline interpolation methods were most significant in the sample intervals between 2007-2010 and 2018-2022 (the furthest periods between publications). Despite these discrepancies, the differences in the LPI didn't exceed 0.07p (Figure 1). This suggests that while there were variations in the estimated values obtained from different interpolation methods, these discrepancies were within a relatively small range and might not significantly impact the overall interpretation of the LPI components.

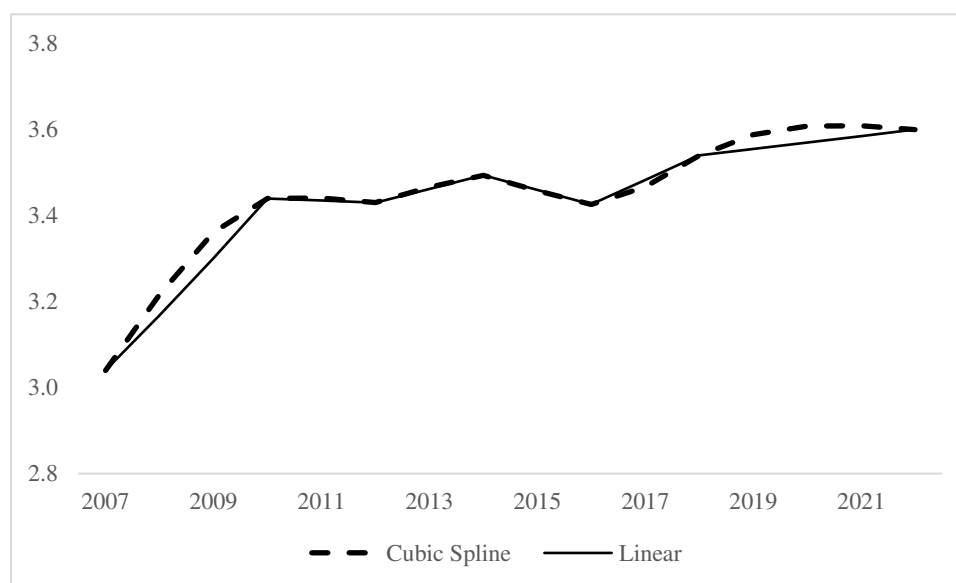


Figure 1. LPI interpolation results.

Source: own calculations.

In the case of individual LPI components, the largest discrepancies were obtained between the interpolation results for Timelines, which exceeded 0.2 points for 2009, and for Shipment, which slightly exceeded 0.1 points in 2019 (Fig. 2). The choice of interpolation method can influence the accuracy and smoothness of the estimated values, particularly when dealing with sparse or irregularly sampled data points. The fact that the differences remained within a limited range indicates that despite variations in the methods used, the overall trend and interpretation of the LPI might not be substantially affected.

The differences in the obtained results resulting from the interpolation methods used were insignificant and negligible. Therefore, in further analyses, the results were presented only for interpolation using the cubic spline method.

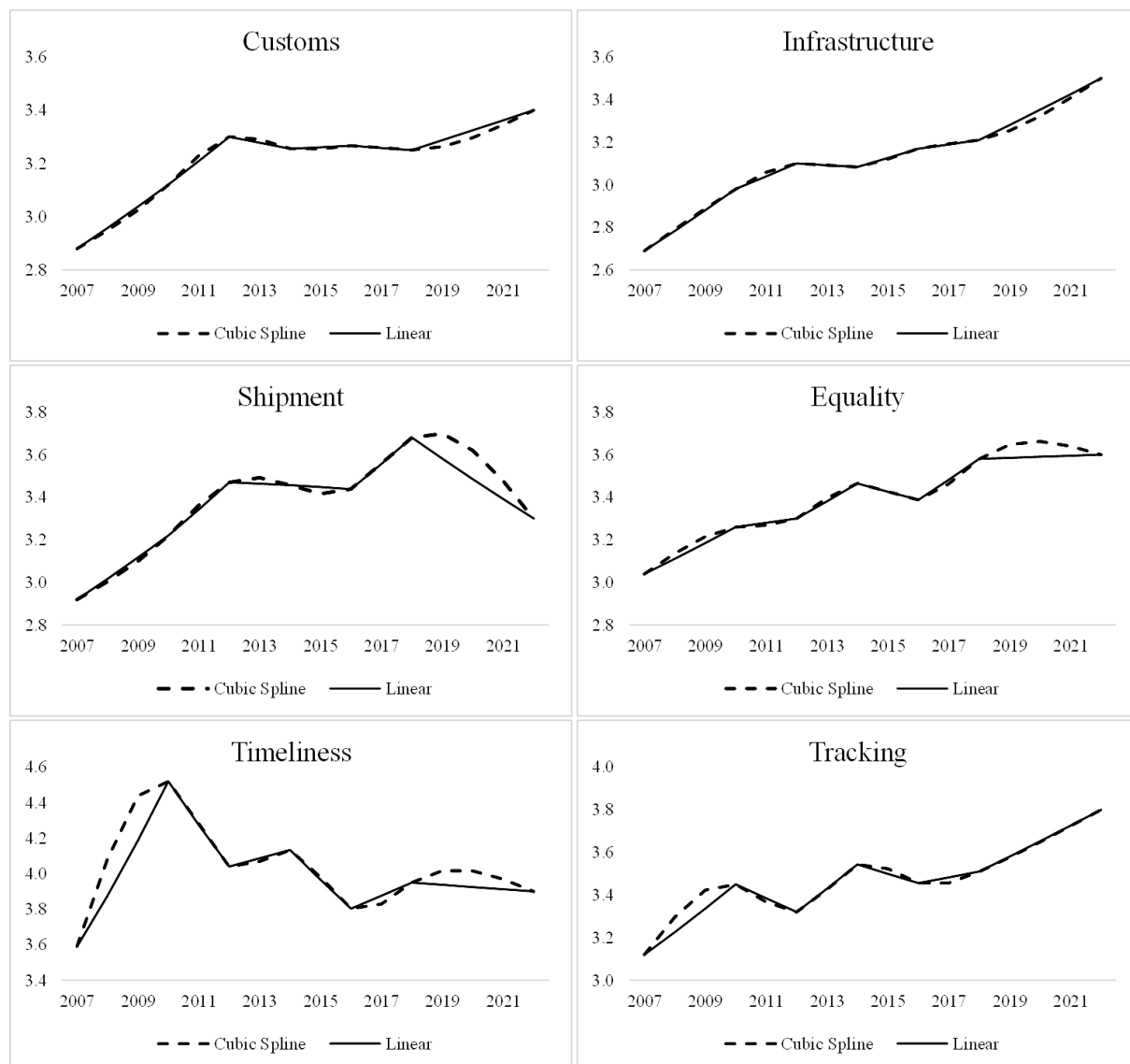


Figure 2. Interpolation results of the LPI components.

Source: own calculations.

The overall LPI increased during the period under review. Poland advanced from 40th position in 2007 to 26th position in 2022. Most components of the LPI index showed an increasing trend.

The most significant and visible growth can be observed in the Infrastructure rating, which increased by as much as 0.8 points to 3.5 in 2022. Poland's dynamic development, construction of expressways, expansion of sea and airport ports and modernization of the entire logistics infrastructure were appreciated by respondents. Customs, Equality and Tracking scores also increased during this period. After increasing in 2007-2018 to the level of 3.7, in the 2022 study the Shipment indicator dropped significantly to 3.3. It can be assumed that the assessment is

the result of global turmoil, in particular the pandemic and the war in Ukraine, as other data do not confirm such a decline.

A clearly different picture is associated with Timeliness. The high score that Poland received in 2010, ranking second in the world with a value of 4.52, proves the very efficient Polish logistics system. However, the Timeliness rating has been systematically decreasing since 2010 to 3.9 in 2022. This decline does not represent a decline in local service quality, but rather reflects the expected delivery times and increased logistics efficiency in other countries compared to Poland. Despite this decline, Polish punctuality is still rated very highly. This component was still the highest compared to other components of the Polish LPI.

Table 1.

Correlogram of the LPI and components

	LPI	Customs	Infrastru.	Shipment	Equality	Timelin.	Tracking
LPI	1						
Customs	0.90	1					
Infrastructure	0.93	0.95	1				
Shipment	0.90	0.91	0.96	1			
Equality	0.90	0.81	0.91	0.95	1		
Timeliness	0.60	0.34	0.29	0.23	0.26	1	
Tracking	0.93	0.76	0.83	0.78	0.89	0.57	1

Source: own calculations.

The differences in the impact and relationships between the LPI and its components are also illustrated in the correlation table (Table 1). What is particularly noticeable is the low correlation between Timeliness and the other components.

3.2. Estimation results

Six models were obtained for each LPI component. The results are presented in Table 2. The estimates of the parameters of long- and short-term relationships are semi-elasticity. Of particular importance is the statistically significant long-term relationships (ECT) and the stationarity of all residuals, which confirms cointegration of variables in every case. As follows from testing the hypothesis regarding nonstationarity, all stochastic processes generating the variables used in the models are integrated at the first degree I(1). All ECT estimates range from 0.65 to 0.94, which indicates a relatively quick adjustment to long-term relations.

Table 2.

Estimation results (The t-statistic values are shown in parentheses)

LPI component	ECT $\hat{\alpha}_j$	Explanatory variables					
		Trade $\hat{\beta}_{1j}$	Investm. $\hat{\beta}_{2j}$	Prices $\hat{\beta}_{3j}$	Trade $\hat{\gamma}_{1j}$	Investm. $\hat{\gamma}_{2j}$	Prices $\hat{\gamma}_{3j}$
Customs	-0.65 (-6.47)	-0.16 (-1.29)	0.27 (2.22)	0.51 (2.47)	0.05 (0.77)	0.10 (2.54)	0.30 (4.41)
Infrastructure	-0.82 (-2.87)	0.23 (2.71)	0.31 (3.55)	0.36 (2.42)	0.34 (2.87)	0.21 (2.79)	0.40 (3.45)

Cont. table 2.

Shipment	-0.91 (-4.62)	0.47 (2.20)	0.62 (3.20)	-0.10 (-0.28)	0.59 (3.27)	0.55 (5.60)	-0.56 (-3.31)
Equality	-0.74 (-3.08)	0.35 (3.41)	0.23 (2.30)	0.27 (1.57)	0.11 (0.85)	0.22 (3.01)	0.36 (2.28)
Timeliness	-0.94 (-3.04)	-1.33 (-3.87)	0.94 (2.71)	0.24 (0.41)	-1.10 (-2.12)	1.14 (3.32)	0.44 (0.90)
Tracking	-0.67 (-2.05)	0.24 (1.86)	0.25 (2.03)	0.29 (1.35)	0.42 (2.01)	0.16 (1.35)	0.69 (3.34)

Source: own calculations.

Construction and assembly production of land and maritime infrastructure facilities is the only variable that is largely subjected to political decisions. Therefore, it can be treated as an instrument. It is interesting that both the estimates of long- and short-term relationships mean that the increase in expenditure on the construction and development of infrastructure has a positive impact on all LPI components. Even those relating to regulation and evaluation of the effectiveness of services. The change in infrastructure development expenditure has the greatest impact on Timeliness, followed by Shipment. In turn, the change in the level of investment outlays does not have a dominant impact on the Infrastructure ranking. All three explanatory variables of the model determine this ranking to a similar extent. Even the price impact is the strongest. This indicates that the infrastructure level ranking is basically most dependent on services ensuring the correctness and efficiency of its operation. Therefore, better infrastructure also requires better service, which is accepted and involves an increase in costs.

Generally, prices, as an indicator relating to the assessment of the quality of logistics services, indicate a positive relationship with most LPI components. Only in the case of Shipment this impact is negative. This is justified because in this component the World Bank respondents are explicitly asked to assess shipping costs. Therefore, in this case, prices cannot be an assessment of the quality of services but refer directly to service costs and both the long- and short-term impact is negative.

Trade, as the volume of exported and imported goods, is a demand factor and positively affects the development and ranking of four of the six LPI components. The growth in trade exchange is the strongest driver of the Shipments rating, both in the long and short term. In the case of Customs and Timeliness, this impact is negative. The results obtained indicate the emergence of bottlenecks in these logistic areas. The increase in trade leads to overload and reduced efficiency of the logistics system, which cannot keep up with the volume of orders, which is reflected in the LPI assessments and parameter estimates.

Particularly noteworthy is the fact that Timelines, which have the highest ranking in the Polish LPI, are the most sensitive to changes in the volume of trade and investment expenditures (highest semi-elasticities). This leads to the conclusion that, at least in terms of on-time deliveries, the functioning of the Polish TSL sector may be seriously threatened if expenditure on infrastructure development does not keep pace with the increase in economic openness.

4. Conclusions

Interpolation of the LPI and its components allows obtaining consistent time series that were used for further analyses. They enable several methods that cannot be used for the output data. At the same time, it should be emphasized that in the analyzed case the choice of interpolation method has a negligible impact on the results and conclusions obtained.

The use of cointegration methods enabled the estimation of long- and short-term relationships. This confirmed the initial research hypothesis that the variables are integrated and the cointegration analysis should allow identifying the relationship between the LPI components and selected macro categories. The results indicate a strong and clear impact of infrastructure expenditure on the assessment of Poland's logistics system. At the same time, the further increase in international exchange and the flow of goods currently indicates two LPI components whose functioning may limit the efficiency of the logistics system, i.e., Customs and Timeliness. The result may provide an indication to policy makers which aspects of the functioning of the logistics system are failing in the respondents' opinion. These are places where improving efficiency can bring the greatest benefits for TSL services, the growth of trade and the entire economy.

Due to the short-time series, the analysis of the LPI components for Poland does not consider more factors. In particular, the set of explanatory variables should be expanded to include macro categories describing the world situation and the international climate. The LPI assessment and the final ranking depend on the subjective impressions of respondents who compare different markets.

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Footnotes

In most cases, the tests clearly indicate the non-stationarity of the series used in the study. Due to the low power of tests for small samples, it was assumed that all series were non-stationary. Ultimately, the estimation results confirmed the cointegration of the variables.

EVALUATING THE IMPLEMENTATION OF RURAL HROMADS DEVELOPMENT STRATEGIES IN UKRAINE

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Purpose: This study addresses the lack of standardized evaluation procedures for rural hromada development strategies in Ukraine. The conceptual foundations of the effectiveness of local partnerships for improving efficient rural development have been explored. The study is particularly relevant in contemporary circumstances marked by a high degree of uncertainty due to the influence of military actions by the Russian Federation on the territory of Ukraine. Another significant factor contributing to the relevance of the research in the field of rural development is the demand for adopting European experience on the path of Ukraine's integration with the European community.

Design/methodology/approach: This study addresses the lack of standardized evaluation procedures for rural hromada development strategies in Ukraine. By employing a structured methodology involving critical analysis, comparative assessment, and statistical techniques, the research examines key indicators within the three hromadas of Lviv Oblast. Notably, the study offers a proposal to evaluate strategy implementation and goal achievement, utilizing readily available national and regional indicators, including those outlined in the examined strategies.

Findings: The findings underscore that the formulated proposal enables progress measurement towards goal attainment, even in the absence of explicit targets set by hromadas in Ukraine.

Originality/value: A methodology for monitoring the implementation of development strategies for hromadas in Ukraine has been developed. It is based on a dynamic rating that assesses the current state and strategic decisions regarding rural development.

Keywords: territorial communities, development strategy, territorial partnership, Ukraine.

1. Introductions

Rural areas are an important component of economic development and play a significant role in every country. The detailed study encompasses issues related to rural territories and the effective development of local strategic documents. The theoretical framework presents the main challenges of sustainable development and governance of rural territories in the European Union, as well as in the two analyzed countries, Poland and Ukraine. The main focus is on

comparing conditions, support mechanisms, and evaluating the current level of strategic documents for the sustainable development of rural territories.

In the European Union, popular associations and networks of non-governmental organizations are engaged in rural territory development. Poland also provides a good example in this field (Kołodziejczak, 2011; Szczepońska, 2021).

The aim of the research is to assess the functioning of rural communities and territorial partnerships, utilizing the potential of Local Action Groups (LAGs) as an additional instrument that enhances multifunctional rural territory development. The scientific problem for the study lies in the fact that monitoring and evaluation of community-led local development strategies (LDSs) formulated by LAGs are highly standardized compared to the evaluation of development strategies for Polish gminas. Therefore, it is necessary to standardize the monitoring and evaluation of community development strategies in Ukraine, which will help initiate the correct formulation of goals in the strategies and lay the groundwork for formulating community-led local development strategies in Ukraine in the future.

The research results in the assessment of the management and monitoring system of sustainable rural development in Ukraine. The ultimate outcome is a proposal for the improvement of support and management systems, as well as the monitoring of rural development strategies in Ukraine, following the example of Poland.

The research focused on studying Poland's experience in order to prepare proposals for Ukraine as EU candidate state.

2. Materials and methods

Intersectoral partnership is a voluntary cooperation between entities from three sectors (governmental, economic, and social) in the process of identifying societal issues and jointly developing ways to address them. Decentralization of public services combined with the implementation of the subsidiarity principle makes local policy a natural realm for such partnership. Intersectoral partnerships in Poland represent a distinct next stage in the genesis of the trend of governing public policies, which has been evolving since the 1990s, as well as a mechanism for decision-making in the European Union and supporting the implementation of its policies (Musiał-Malago, Marcisz, 2019).

A strategy is a roadmap for community development that is formulated to achieve important long-term goals and a formed vision, taking into account the community's internal strengths and weaknesses, external existing opportunities and threats, and reducing the level of uncertainty about the future. According to this perspective, researchers (Boryshkevych, Yakubiv, Zawicki, 2022) have developed a methodology for assessing the level of effectiveness of a hromada development strategy based on expert criteria evaluation. However, the objective

of the methodology is to enhance accountability for the implementation of the formulated strategy.

However, based on the trend of local partnerships, the study utilizes the evaluation algorithm of LDS indicators proposed by researchers Baran and Gdakowicz (2016). Using this as a foundation, an attempt has been made to analyze the strategies of Ukrainian hromadas as potential candidates for creating local partnerships.

International commitments, as well as the need to improve citizens' lives, compel both countries to develop an effective system that will efficiently combine economic development programming to enhance the functioning of rural areas (Pawłowska, Gąsior-Niemiec, Kołomycewa, 2014). To achieve this, it is necessary to establish formal foundations and a set of relevant tools that will enable the effective implementation of policies in rural development management at various levels of territorial division.

The research sample was selected based on regulatory acts, strategic documents and materials posted on the official websites of individual territorial units. The subject of a detailed study was the development strategies of individual hromadas in the Lviv Oblast of Ukraine. The territorial units were selected based on the following criteria:

- the region of Ukraine must have a direct border with the EU,
- three hromadas were selected in one of the rayons of Lviv Oblast, which should be located nearby (to be able to propose a local partnership and a common strategy in the future),
- all three hromadas should have an up-to-date strategy.

The research requires consideration of various sources of information, methods, tools and techniques. As part of the work, a review of literature and regulations was conducted, as well as an assessment of existing development strategies from different levels of territorial division of both countries. A comparative analysis of strategic documents was conducted. The characteristics also provide examples from the experience of local governments and their associations. The study made it possible to present the advantages and disadvantages of the existing systems in both countries, to formulate conclusions and recommendations.

The following methods were used in the study:

- critical analysis (review and evaluation of problematic literature),
- comparative analysis (list of activities in rural areas of Ukraine),
- monographic method (study of individual experience with the strategies for the development of rural Communities in Poland),
- case study (characterization of the directions prepared in the strategies and their effectiveness in Ukraine),
- abstract and logical method (formulation of concepts, conclusions and recommendations),
- statistical methods (processing of data from hromadas in Ukraine).

The research requires consideration of various sources of information, methods, tools and techniques. As part of the work, a review of literature and regulations was conducted, as well as an assessment of existing development strategies and rural development programs at different levels of territorial division of Ukraine. The characteristics also provide examples from the experience of local governments and their associations. The study made it possible to present the advantages and disadvantages of the existing system in Ukraine, to formulate conclusions and recommendations.

At the local level, three hromadas in Lviv Oblast - Radekhiv, Velyki Mosty, Dobrotvir - were selected, each with an up-to-date development strategy, but no separate rural development program. Their strategies have been drawn up for the period up to 2027 inclusive, so our monitoring is preliminary and can be seen as a rough attempt to assess the strategies of the newly created Ukrainian territorial communities, which can be improved and after the expiration of the strategies - a final evaluation of their implementation can be conducted. At the same time, since we do not use specific numerical targets, as they are not specified in the strategies, and for most indicators we use regional or national averages, which will also change until 2027, such monitoring can be conducted regularly, which can help draw the attention of communities to problem areas in the implementation of the indicators specified in their strategies, as well as demonstrate whether they are moving in the right direction from year to year.

In accordance with the criteria set out in the research methodology, the objects for the study were selected from Ukraine (Fig. 1).

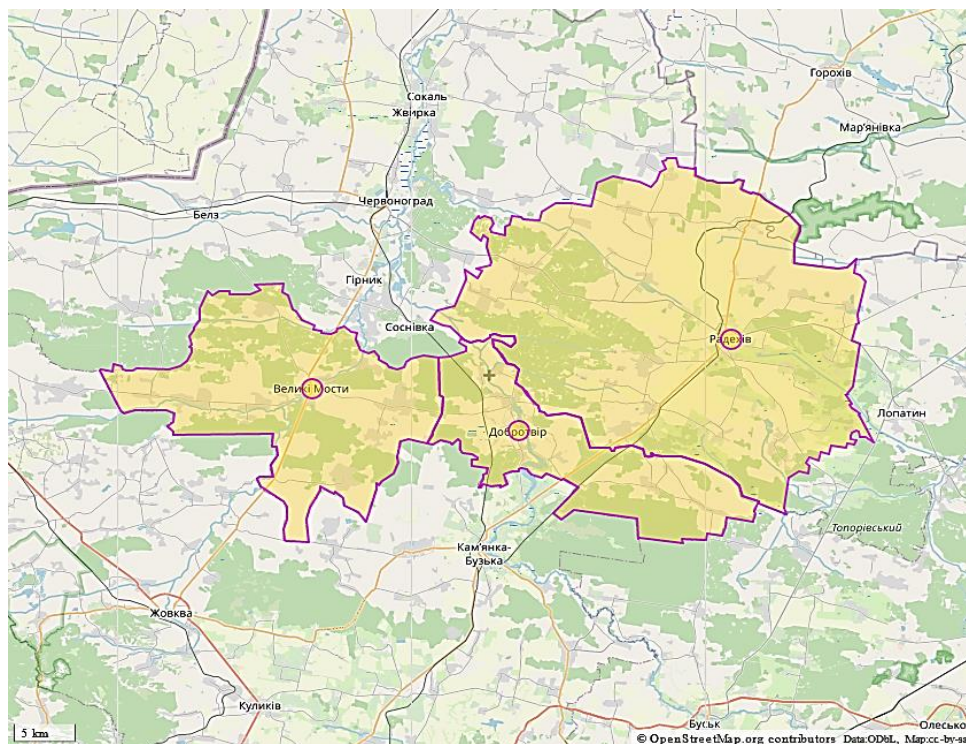


Figure 1. Target groups of the study on maps.

Source: <https://www.google.com/maps/>

To assess the state of implementation of individual goals, it is necessary to calculate the fulfillment of these indicators (in %) using the formula:

$$i_k = \frac{\text{actualindicatorlevel}}{\text{targetindicatorlevel}}$$

where i_k is the implementation index for the k-th indicator.

The value of the calculated index below 1 means that the target is lagging behind, if the value is equal to one, it means that the target is achieved, and if the value of the index exceeds one, it means that the target is exceeded - however, in further calculations we will use the value 1 for all target indicators that are met or exceeded.

The next stage of the evaluation is to calculate the aggregate indicators of the implementation of goal 1 (w_1 , Developed and Competitive Economy), goal 2 (w_2 , Human Development) and the entire strategy (w_s):

$$a_1 = \frac{\sum_{k=1}^8 i_k w_k}{\sum_{k=1}^8 w_k}, a_2 = \frac{\sum_{k=1}^3 i_k w_k}{\sum_{k=1}^3 w_k}, a_s = \frac{\sum_{k=1}^{11} i_k w_k}{\sum_{k=1}^{11} w_k}, \quad (1)$$

where:

a_1 is the aggregate indicator for goal 1,

a_2 is the aggregate indicator for goal 2,

a_s is the aggregate indicator for the entire strategy,

i_k is the evaluation of the implementation of the k-th indicator for goal 1, goal 2 or the entire strategy,

w_k is the weight of the k-th indicator for goal 1, goal 2 or the entire strategy.

As it can be seen from formula (1), goal 1 includes 8 indicators, goal 2 includes 3 indicators, and the entire strategy includes 11 indicators.

The target values cover both intuitive thresholds (100% self-sufficiency or positive population growth rate (100% or more)) and average (median for individual indicators) values for Lviv Oblast or Ukraine as a whole (the choice of the basis for comparison was often based on the availability of relevant data in the public domain under martial law). The average target for the region or country was chosen because individual hromada strategies clearly state that monitoring of strategy implementation is based, in particular, on the analysis of key indicators characterizing the situation in Ukraine as a whole and in Lviv Oblast that are strategically important for hromadas.

The calculated aggregate indicators range from 0 to 1 and actually indicate the % of the goal (or strategy) implementation.

We have selected 11 indicators for which data are available. All of these indicators were mentioned in the strategies of 1, 2 or even 3 of the 3 analyzed hromadas. Thus, the weights for individual indicators were set to 1, 2, and 3, depending on the number of hromadas that mention these indicators in their strategies.

3. Empirical findings

In line with the current global challenges faced by society, the main trend in socio-economic policy at all levels of international and national in developed countries is the concept of sustainable development. It envisages a balance of economic, environmental and social vectors of sustainable development. In Ukraine, the percentage of the rural population is 31% of the total population (which is one of the lowest in Europe), and agricultural land accounts for 70% of the country's land fund, so the sustainability of rural development largely determines the sustainable socio-economic development of the country as a whole.

A key component in the development of the country's agricultural sector is the comprehensive development of rural areas aimed at ensuring sustainable agricultural production, improving working and living conditions, and preserving the natural environment.

The effective start of the rural development process began in early 2015 with the adoption of the Law of Ukraine "On Voluntary Amalgamation of hromadas", according to which, as of October 1, 2020, 907 amalgamated hromadas were established, of which 409 are rural and 205 are mixed (rural/urban), ie. hromadas with rural areals account for 67.7% of total hromadas. The empowerment of hromadas requires harmonization of the development of agricultural production and rural communities, the interests and initiatives of each villager to ensure high production and environmental efficiency and, on this basis, to improve the quality and safety of their lives (Kostetska, 2021).

The main document that lays down the model of rural development in Ukraine is the Concept of Rural Development (valid until 2025), approved by the Cabinet of Ministers of Ukraine on September 23, 2015, No. 995. The basic, regulatory and conceptual directions of the Concept are aimed at solving problems in the light of the Sustainable Development Goals, the State Strategy for Regional Development of Ukraine for the period up to 2020 approved by the Cabinet of Ministers of Ukraine (Resolution No. 385 of August 6, 2014) and the State Strategy for Regional Development for 2021-2027 (Resolution No. 695 of August 5, 2020), developed by the Ministry of Agrarian Policy and Food of Ukraine and supported by the National Reform Council of Ukraine - the Unified Comprehensive Strategy for the Development of Rural Areas.

Information on the implementation of the action plan for the implementation of the Concept of Rural Development in 2020 is published on the official website of the Ministry of Agrarian Policy and Food of Ukraine (dated 12.11.2021). According to the analysis, it should be noted that in the context of the political course of deepening reforms, decentralization of power and European integration, the demand for agricultural consulting has increased significantly. As of January 01, 2021, according to the Register of Agricultural Advisory Services (hereinafter - the Register), there are 30 advisory services. During 2020, 15 agricultural advisory services were included in the Register, which is twice as many as in the previous year.

According to the criteria set out in the research methodology, Lviv Oblast was selected for the regional level. The Comprehensive Program of Support and Development of Agriculture in Lviv Oblast for 2021-2025 is aimed at implementing the State Strategy for Regional Development for 2021-2027, approved by the Cabinet of Ministers of Ukraine dated 5.08.2020 No. 695, the State Program for the Development of the Ukrainian Carpathian Region for 2020-2022, approved by the Cabinet of Ministers of Ukraine dated 20.10.2019 No. 880, the Development Strategy of Lviv Oblast for 2021-2027 and the Action Plan for its implementation in 2021-2023, approved by the decision of the Lviv Oblast Council dated 24.12.2019 No. 948.

In accordance with the development strategies of Radekhiv, Velyki Mosty and Dobrotvir hromadas, the key performance indicators mentioned in these strategies were selected based on the availability of relevant publicly available statistics (Table 1). In particular, to assess the indicators of local budget revenues and expenditures, data were taken from the dashboards of the Lviv Oblast Military Administration; to assess the tax capacity index, data were taken from the Verkhovna Rada; to assess the level of self-sufficiency, capital expenditures per capita, the share of administrative expenditures, and the average cost of education per student, data were taken from the decentralization.gov.ua government portal; to assess the average score of the National Multi-Subject Test (NMT), data were taken from the Ukrainian Center for Educational Quality Assessment; to assess the number of registered legal entities and individual entrepreneurs, data were taken from the State Statistics Service of Ukraine; to assess the population growth rate - data from the State Statistics Service of Ukraine (for 2022) and from the strategies of individual hromadas (for 2020).

Table 1.

Performance indicators of Radekhiv, Velyki Mosty and Dobrotvir hromadas

Indicator	Radekhiv	Velyki Mosty	Dobrotvir
Rank in terms of general fund revenues of the hromada budget (without transfers) per capita among 73 hromadas in Lviv Oblast (1st place = 73 points, 73rd place = 1 point)	51	65	60
Tax capacity index for 2023	0.76	1.8	1.1
Rank in terms of local budget expenditures per capita for the first quarter of 2023 among 73 hromadas in Lviv Oblast (1st place = 73 points, 73rd place = 1 point)	57	50	49
Level of self-sufficiency (100% - level of subsidization for the 4th quarter of 2021)	95.5%	89.7%	100.2%
Capital expenditures per capita in the 4th quarter of 2021	623.5	960.5	1684.2
Percentage of the general fund revenues of the hromada budget in the 4th quarter of 2021 that are not spent on administration (100% - % of administrative expenditures in the amount of general fund revenues)	84.6%	80.4%	70.6%
Average cost of education per student in the 4th quarter of 2021	44813.7	35925	36135.1
Average NMT score in 2022 among the 2022 graduates	470	463	482
Number of registered legal entities as of January 1, 2022 per 10 thousand population	180.57	108.78	114.56
Number of registered individual entrepreneurs as of January 1, 2022 per 10 thousand population	249.89	169.78	216.7
Population growth rate in 2022 compared to 2020	0.99	0.97	0.99

In terms of revenues of the general fund of the hromada budget per capita, the situation is the best in the Velyki Mosty hromada, the worst in the Radekhiv hromada, and the situation with the tax capacity index is similar. Instead, in terms of expenditures per capita, the situation is the best in Radekhiv hromada, and the worst is in Dobrotvir hromada.

At the same time, in terms of self-sufficiency, the Dobrotvir hromada is the only one among the analyzed hromadas that exceeded the 100% threshold. The level of subsidization in the Velyki Mosty hromada exceeds 10%.

Capital expenditures per capita are the highest in the Dobrotvir hromada, while in the Radekhiv hromada they are more than 2.5 times lower. At the same time, the percentage of expenditures on administration is also the highest in Dobrotvir hromada, and the lowest in the Radekhiv hromada among the analyzed hromadas.

The average cost of education per student is the highest in Radekhiv hromada, while in Velyki Mosty hromada this amount is the lowest among the analyzed hromadas. However, the average NMT score in 2022 was the highest among the graduates in Dobrotvir hromada, but the lowest again among the graduates in Velyki Mosty hromada.

In terms of the number of registered legal entities per 10 thousand people, Radekhiv hromada is the leader, and Velyki Mosty hromada is the outsider. The situation is similar with the number of registered individual entrepreneurs.

Velyki Mosty hromada recorded also the largest drop in population (in %) among the analyzed hromadas. However, none of hromadas managed to increase its population in 2022 compared to 2020.

Table 2.
Criteria and weights for evaluation indicators

Indicator	Target value	Weight of the indicator
Rank in terms of general fund revenues of the hromada budget (without transfers) per capita among 73 hromadas in Lviv Oblast (1st place = 73 points, 73rd place = 1 point)	Me = 36 points	3 (Dobrotvir, Radekhiv, Velyki Mosty)
Tax capacity index for 2023	The average index in Ukraine is 0.7	1 (Velyki Mosty)
Rank in terms of local budget expenditures per capita for the first quarter of 2023 among 73 hromadas in Lviv Oblast (1st place = 73 points, 73rd place = 1 point)	Me = 36 points	1 (Dobrotvir)
Level of self-sufficiency (100% - level of subsidization for the 4th quarter of 2021)	100%	1 (Velyki Mosty)
Capital expenditures per capita in the 4th quarter of 2021	The average level in Ukraine is UAH 74.89	2 (Radekhiv, Velyki Mosty)
Percentage of the general fund revenues of the hromada budget in the 4th quarter of 2021 that are not spent on administration (100% - % of administrative expenditures in the amount of general fund revenues)	The average level in Ukraine is 100% - 28.37% = 71.63%.	1 (Velyki Mosty)
Average cost of education per student in the 4th quarter of 2021	The average level in Ukraine is 9364.05 UAH	1 (Velyki Mosty)

Cont. table 2.

Average NMT score in 2022 among the 2022 graduates	The average Ukrainian score for secondary school graduates in 2022 is 462	2 (Radekhiv, Velyki Mosty)
Number of registered legal entities as of January 1, 2022 per 10 thousand population	In Lviv Oblast, the indicator is 313	2 (Radekhiv, Velyki Mosty)
Number of registered individual entrepreneurs as of January 1, 2022 per 10 thousand population	In the Lviv Oblast, the indicator is 368	2 (Radekhiv, Velyki Mosty)
Population growth rate in 2022 compared to 2020	1 (100%)	2 (Dobrotvir, Velyki Mosty)

As it can be seen from Table 2, the highest weight (3 points) is given to the indicator of general fund revenues per capita, which was mentioned in the strategies of all analyzed hromadas. The indicators of the average cost of education per student, administrative expenditures, the level of self-sufficiency and the tax capacity index were mentioned only in the strategy of the Velyki Mosty hromada, and the indicator of expenditures per capita was mentioned only in the strategy of Dobrotvir hromada, so they were assigned the lowest weight (1 point).

Table 3 shows the degree of target indicator achievement for assessing the fulfillment of individual goals and the entire strategy of the three above-mentioned hromadas.

Table 3.

Target achievement percentages for selected indicators in three hromadas of Chervonohrad district of Lviv Oblast

Overall goal	Separate indicator	hromada		
		Radekhiv	Velyki Mosty	Dobrotvir
Developed and competitive economy	Higher than the median position in terms of revenues of the general fund of the hromada budget (without transfers) per capita among all communities in Lviv Oblast	1	1	1
	Exceeding the average level of the tax capacity index in Ukraine	1	1	1
	Ranked above the median in terms of local budget expenditures per capita among all hromadas in Lviv Oblast	1	1	1
	100% self-sufficiency (0% subsidization)	0.955	0.897	1
	Capital expenditures per capita are higher than the national average	1	1	1
	Lower than the national average % of apparatus expenditures to general fund revenues	1	1	0.986
	Above the average number of registered legal entities per capita in Lviv Oblast	0.578	0.348	0.366
	Higher than the average number of registered individual entrepreneurs per capita in Lviv Oblast	0.679	0.461	0.589

Cont. table 3.

Development of human potential	No negative population growth	0.989	0.972	0.987
	Higher than the average cost of education per student in Ukraine	1	1	1
	Higher than the national average NMT score in 2022	1	1	1

Of the 11 indicators we evaluated, all hromadas managed to achieve seven targets (64%). Other targets were accomplished in the range from 35 to 99%, which requires a more detailed analysis and attention to the indicators with the lowest percentage of target achievement or changing the target indicators to more appropriate ones. For example, the worst situation is with the number of registered legal entities per 10 thousand people, but it should be borne in mind that the target value was chosen as the average regional value, which is higher due to the significantly higher number of registered legal entities (even taking into account the larger population) in the regional center, Lviv.

All hromadas have reached the target level in terms of general fund revenues per capita, tax capacity index, local budget expenditures per capita, capital expenditures per capita, expenditure on education per student, and the NMT score. Only the Dobrotvir hromada did not achieve the target in terms of administrative expenditures.

Based on the partial degree of target achievement for some indicators, the level of fulfillment of individual goals and the entire strategy was calculated (Table 4).

Table 4.

Degree of target achievement for individual goals and the entire strategy in three hromadas of the Chervonohrad district, Lviv Oblast

The entire strategy	Goals	The level of fulfillment					
		of individual goals			of the entire strategy		
		Radekhiv	Velyki Mosty	Dobrotvir	Radekhiv	Velyki Mosty	Dobrotvir
The entire strategy	Developed and competitive economy	0.882	0.809	0.838	0.914	0.859	0.882
	Development of human potential	0.996	0.989	0.995			

Both goals and the strategy were implemented to the fullest extent in Radekhiv hromada, and to the least extent in Velyki Mosty hromada. The first goal — Developed and Competitive Economy — was achieved by 81% in Velyki Mosty hromada, which is a satisfactory result. The second goal - Human Potential Development - in Radekhiv hromada was achieved by 99.6%, which is very close to full achievement. In other communities, the indicators are also very close to full target achievement, but the lowest one - 98.9% - is in the Velyki Mosty hromada.

4. Conclusions

The article evaluates the implementation of the strategies of three Ukrainian hromadas in Chervonohrad district of Lviv Oblast: Radekhiv, Velyki Mosty and Dobrotvir. The hromadas are located in the region bordering on Poland, have developed strategies, and largely consist of rural areas. Unfortunately, the strategies of Ukrainian hromadas only descriptively mention the indicators that should be used to evaluate the implementation of the strategies without clearly setting targets to be achieved.

We managed to select 11 key indicators, based on which we assessed the effectiveness of the strategies' implementation - eight indicators to assess the achievement of Goal 1 (Developed and Competitive Economy) and three indicators to assess the implementation of Goal 2 (Human Potential Development).

The target values used to assess the degree of implementation of the strategies (in %) include both intuitive thresholds (in the case of 2 key indicators) and average (or median) values for the region or the country as a whole (the choice of the basis for comparison was mostly based on the availability of relevant data in the public domain).

The weights for individual indicators were assigned values of 1, 2, and 3, depending on the number of hromadas that mention these indicators in their strategies.

Of the 11 indicators we assessed, all hromadas managed to achieve seven targets (64%). Other targets are achieved in the range from 35 to 99%, which requires a more detailed analysis and attention to the indicators with the lowest percentage of implementation or changing the target indicators to more appropriate ones.

Based on the partial degree of achievement of some targets, the level of achievement of individual goals (1 and 2) and the entire strategy was calculated.

Both goals and the strategy were implemented to the fullest extent in Radekhiv hromada, and to the least extent in Velyki Mosty hromada. The first goal - Developed and Competitive Economy - was achieved by 81% in Velyki Mosty hromada, which is a satisfactory level, so we can conclude that these hromadas of Chervonohrad district, Lviv Oblast are generally on the right track and are able to partially or fully implement the strategies they have developed by the end of their validity period.

However, it should not be forgotten that not all Ukrainian hromadas have developed strategies, and that Lviv Oblast, due to its proximity to the EU border and distance from the front line, is a favorable place for territorial development. We also recommend that Ukrainian hromadas set clear targets in their strategies to be achieved, which will facilitate monitoring of their strategy implementation and eliminate the shortcomings of the methodology we have proposed, which involves using average regional or national indicators as targets, even if such targets are obviously imperfect.

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THE IMPACT OF ENVIRONMENTAL TAXES ON THE FINANCIAL SECURITY OF THE LOGISTICS SECTOR

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Purpose: The main aim of this paper is to assess the impact of environmental taxes on the financial security of the logistics sector in Poland from 2008 to 2020.

Design/methodology/approach: We normalize diagnostic variables into synthetic indicators to verify the hypothesis. We use the classical least squares method (OLS).

Findings: The results indicate a positive trend in the financial security of the logistics sector in Poland from 2008 to 2020. However, in 2020, there was a certain breakdown in financial security caused by the outbreak of the COVID-19 pandemic. Moreover, environmental taxes statistically significantly impact the logistics sector's financial security ($p < 0.05$).

Research limitations/implications: The availability of data, the choice of normalization method and the estimation method for the model.

Practical implications: The research results indicate that the logistics sector should analyze regulations in shaping the EU environmental protection policy, including, above all, environmental taxes.

Social implications: Environmental taxes are an important element influencing the development of the logistics sector, including issues related to residents' quality and living conditions.

Originality/value: The novelty in the paper is the creation of models of the impact of environmental taxes on the financial security of the logistics sector. The paper addresses many recipients interested in the logistics sector's financial situation and environmental taxes.

Keywords: environmental taxes, financial security, logistic sector.

Category of the paper: research paper.

1. Introduction

Environmental taxes play a key role in the broader sustainability strategy, encouraging a shift to greener practices and technologies. The effectiveness of these taxes depends on their design, enforcement and the broader regulatory framework that supports environmental protection.

Meanwhile, a company's financial security is a continuous process that requires strategic planning, adaptability and a proactive approach to risk and opportunity management. Companies that make financial security a priority are better prepared to withstand economic fluctuations and ensure long-term success.

The impact of green taxes on the financial security of the logistics sector depends on how well companies adapt to changing regulations and market dynamics. While there may be initial challenges, there are opportunities for innovation and efficiency gains that can contribute to the long-term stability and financial security of the logistics industry. Successful adaptation may require strategic planning, investment in sustainable technologies and a commitment to meeting changing environmental standards.

The main aim of this paper is to assess the impact of environmental taxes on the financial security of the logistics sector in Poland from 2008 to 2020. We normalize diagnostic variables into synthetic indicators to verify the hypothesis. We use the classical least squares method (OLS).

The study includes an introduction, materials and methods, research methodology, results, discussion, and conclusion. The review of scientific publications was based on the Scopus and Web of Science lists. The data for the analysis come from Eurostat databases. For the calculations, we used Statistica and Gretl software.

The research results indicate that the logistics sector should analyze regulations in shaping the EU environmental protection policy, including, above all, environmental taxes. Environmental taxes are an important element influencing the development of the logistics sector, including issues related to residents' quality and living conditions. The novelty in the paper is the creation of models of the impact of environmental taxes on the financial security of the logistics sector. The paper addresses many recipients interested in the logistics sector's financial situation and environmental taxes.

2. Environmental taxes – definition

Environmental taxes are a category of taxes designed specifically to address environmental issues and encourage sustainable practices. These taxes aim to internalize the external costs of

environmental degradation and promote a more environmentally friendly environment. The main objectives of environmental taxes are to reduce pollution, protect resources, and promote the efficient use of natural resources (Hakonsen, 2001; Turner et al., 1998). Their main group are the so-called Pigovian taxes. These environmental taxes are often inspired by the Pigovian economic concept of taxes, named after economist Arthur Pigou. Pigovian taxes aim to correct market failures caused by externalities, such as environmental pollution. By taxing activities that generate negative externalities (e.g., air and water pollution), governments can encourage businesses and individuals to consider the environmental costs of their actions (Fleischer, 2015; Sandmo, 1978; Lange et al., 2000).

Below are some other examples of environmental taxes.

- Carbon taxes – taxing the carbon content of fossil fuels to discourage greenhouse gas emissions. The goal is to reduce carbon dioxide emissions and combat climate change (Metcalf et al., 2020; Zhou et al., 2021; Laeven et al., 2023).
- Eco Taxes, taxes levied on products or activities that have a significant impact on the environment, such as plastic bags or hazardous chemicals (Barde et al., 1996; Runst et al., 2022).
- Landfill waste taxes to encourage recycling and waste reduction (Martin et al., 2003; Lee, 2023).
- Water use taxes, taxes levied on excessive use of water resources to promote water conservation (Wang et al., 2023).
- Congestion Charges for Congested Urban Areas - charges imposed on vehicles entering congested urban areas to reduce traffic and air pollution (Shatanawi et al., 2020; West et al., 2020; Bernardo et al., 2021).

While green taxes can generate revenue for governments, their main purpose is often to change behavior and encourage environmentally sustainable practices. The revenue generated can be used to finance environmental projects or offset other taxes (Kasayanond et al., 2019). The implementation and enforcement of environmental taxes can be complex and requires effective monitoring and enforcement mechanisms (Steinebach, 2022). Many environmental problems, such as climate change, require global solutions. Unilateral environmental taxes in one country may have limited impact without international cooperation. Environmental taxes are just one tool in a wider spectrum of environmental policy measures. They can be effective if carefully designed and implemented, taking into account economic, social, and environmental considerations (Najarzadeh et al., 2021; Fu et al., 2020; Ferrari et al., 2021).

The European Union (EU) is actively engaged in developing and implementing a comprehensive environmental policy. Environmental policy aims to address various environmental challenges, promote sustainable development, and ensure the well-being of present and future generations. It covers a wide range of issues, including air and water quality, waste management, biodiversity, climate change, and more (Burns et al., 2020; Camilleri, 2020). The EU adopts directives and regulations that set environmental standards and

requirements for its member states. These legal instruments aim to achieve specific environmental objectives and ensure consistency across the EU (Tankosić, 2023). The EU itself has set ambitious goals to combat climate change. This includes reducing greenhouse gas emissions, increasing the share of renewable energy, and improving energy efficiency. The European Green Deal, announced in 2019, sets out the EU's strategy to become the world's first climate-neutral continent by 2050. The EU places great emphasis on protecting biodiversity. Efforts are underway to protect and restore ecosystems, combat biodiversity loss, and promote sustainable land use practices (Fetting, 2020; Sikora, 2021). A key initiative in this regard is the EU 2030 Biodiversity Strategy (Hermoso et al., 2022). The EU has established air and water quality standards to protect human health and the environment. This policy includes measures to reduce air pollutants, improve water management, and prevent water pollution (Kuklinska et al., 2015; Tankosić, 2023; Kehinde et al., 2023). The Regulation on the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) is an important part of the EU's chemicals management policy (Ingre-Khans et al., 2019; Széchy, 2011). The purpose of this is to ensure the safe use of chemicals and to protect human health and the environment. The EU requires member states to carry out environmental impact assessments on certain projects to assess their potential impact on the environment before approving them (Jagadeeswaran et al., 2022). The EU has established waste management targets and regulations to promote waste reduction, recycling, and proper disposal. The key initiative in this area is the closed circuit arks economic action plan (Chioatto et al., 2023; Rezania et al., 2023). The EU provides funding and support for environmental projects and initiatives through programmes such as LIFE (Rigo et al., 2022). These funds contribute to projects focussing on nature conservation, climate action, and environmental innovation. The EU is also committed to international cooperation to address global environmental challenges. This includes participating in international agreements and cooperation to address issues such as climate change and loss of biodiversity (Andriollo et al., 2023; Rodríguez-Pérez et al., 2023).

3. Financial security of the enterprise

The financial security is a key aspect that affects its stability, ability to function, and development. There are many factors that affect the financial security of a company (Shkolnyk et al., 2020; Alnadzhar, 2023; Bolek et al., 2021). Regular financial analysis is crucial to monitoring the company's financial health. It is worth analyzing the balance sheet, profit and loss account, and cash flows (Palepu et al., 2020; Aziz et al., 1980). Appropriate management of financial liquidity is very important, especially in the case of companies operating in very volatile economic conditions. The company should be able to meet its current liabilities and also be able to deal with sudden financial needs (Nasihin et al., 2022; Bolek et al., 2023).

Monitoring debt levels and leverage ratios is important in assessing debt risk. Cost control, on the other hand, is crucial to maintaining profitability. The company should regularly analyze and optimize its costs and look for ways to reduce them (Hussain et al., 2022; Hasanudin, 2023). Diversifying your business can help minimize the risk associated with one sector or market. The diversity of products, services, or geography of operation may be beneficial in terms of the occurrence of various shocks in individual markets (James et al., 2022). The company should identify and manage various types of risk, such as market, operational, and credit risk. Compliance with legal regulations and the application of accounting standards is the key to avoiding legal problems and maintaining financial credibility (Ko et al., 2019; Gallati, 2022; Abdullah et al., 2023). Investments in research and development, new technologies, and innovations can contribute to the long-term profitability of a company. A conscious approach to dividend policy, i.e. the distribution of profits between shareholders and reinvestment in the company's development, affects relations with investors. A good image in the eyes of investors and lenders can make it easier to raise capital and use various forms of financing (Kilincarslan, 2021; Abdullah et al., 2023; Ahmed et al., 2023).

A company's financial security depends on a complex combination of the above-mentioned factors. Regular monitoring and adaptation of the company's management strategy to changing market conditions are key elements of maintaining financial stability (Vovchenko et al., 2017; Delas et al., 2015).

4. Research methodology

Financial security is extremely important for market survival, investment and development of the corporate sector. Financial security is influenced by several factors, both from the company's environment and company managers' skills and operational efficiency.

The primary aim of the research is to assess the impact of environmental taxes on the financial security of the logistics sector from 2008 to 2020. Environmental taxes include energy taxes, pollution taxes, resource taxes, and transport taxes, the role of which is to reduce the negative impact of business on the natural environment.

The main research hypothesis is as follows: "Environmental taxes significantly impact maintaining financial security in the logistics sector from 2008 to 2020 in Poland". Additionally, we asked the following research questions:

- How did the level of financial security develop between the financial crisis and the Covid-19 pandemic?
- Which environmental taxes burden the logistics sector the most?
- Which type of environmental tax has the highest statistically significant impact on the financial security of the logistics sector?

The research includes the following stages:

1. Synthetic indicators for assessing the financial security of enterprises were created based on:
 - stimulants: current ratio, quick ratio, ROS, ROA, ROE, total assets turnover/productivity of assets, assets structure ratio,
 - destimulants: inventories cycle, receivables cycle, operating cycle, debt ratio, debt-to-equity ratio;
2. The indicators were normalized based on the method:
 - for the stimulants:

$$SFS_{ij} = \frac{x_{ij}}{\max x_{ij}}, Z_{ij} \in [0; 1] \quad (1)$$

- for the destimulants:

$$DFS_{ij} = \frac{\min x_{ij}}{x_{ij}}, Z_{ij} \in [0; 1] \quad (2)$$

where:

BFS_{ij} - 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.

To calculate the indicator of the financial security of the logistics sector (FS) we use the formula:

$$FS = \frac{\sum_{j=1}^n (SFS_{ij} + DFS_{ij})}{n}, FS_{ij} \in [0; 1] \quad (3)$$

3. We created a two different linear equation, which we estimated using the classic least squares method, based on formula:

$$FS_{ij} = \alpha_0 + \alpha_1 \text{Envtax} + \varepsilon_i \quad (4)$$

$$FS_{ij} = \alpha_0 + \alpha_1 \text{Entax} + \alpha_2 \text{Entax}(t-1) + \alpha_3 \text{Polltax} + \alpha_4 \text{Polltax}(t-1) + \alpha_5 \text{Restax} + \alpha_6 \text{Restax}(t-1) + \alpha_7 \text{Trtax} + \alpha_8 \text{Trtax}(t-1) + \varepsilon_i; \quad (5)$$

$$s(\hat{\alpha}_0, \dots, \hat{\alpha}_5) = \sum_{i=1}^n e_i^2 = \sum_{i=1}^n (FS_i - \widehat{FS}_i)^2 \rightarrow \min \quad (6)$$

where:

t – time;

Entax – energy taxes;

Polltax – pollution taxes;

Restax – resource taxes;

Trtax – transport taxes.

5. Research results

Table 1 presents selected indicators for assessing the financial security of the logistics sector in 2008-2020. In the analyzed period, this sector is characterized by an increase in financial liquidity and relatively low levels of profitability of sales, assets and equity. The level of debt increases from 55% to 68%, which indicates a relatively high level of debt financing of operations.

Table 1.
Indicators for assessing the financial security of logistics sector

	Current ratio	Quick ratio	ROS	ROA	ROE	Inventories cycle	Receivables cycle	Operating cycle	Total assets turnover/Productivity of assets	Debt ratio	Debt-to-equity ratio	Assets structure ratio
2008	1.31	1.17	0.01	0.01	0.01	8.31	56.65	64.96	0.90	0.55	1.24	2.56
2009	1.24	1.11	0.02	0.01	0.03	8.41	59.32	67.73	0.85	0.55	1.20	2.65
2010	1.30	1.17	0.03	0.02	0.05	7.20	56.63	63.83	0.87	0.55	1.21	2.65
2011	1.33	1.21	0.03	0.02	0.06	6.60	57.91	64.51	0.87	0.57	1.34	2.58
2012	1.31	1.20	0.03	0.02	0.05	6.11	56.72	62.84	0.85	0.59	1.46	2.67
2013	1.39	1.29	0.03	0.02	0.06	6.02	59.23	65.25	0.81	0.60	1.49	2.64
2014	1.42	1.31	0.03	0.02	0.06	6.36	60.02	66.38	0.76	0.63	1.69	2.77
2015	1.52	1.41	0.04	0.03	0.07	6.06	63.33	69.39	0.73	0.64	1.78	2.89
2016	1.62	1.49	0.04	0.03	0.09	8.23	63.31	71.55	0.70	0.66	1.92	2.67
2017	1.52	1.39	0.04	0.03	0.08	7.94	63.97	71.91	0.72	0.66	1.93	2.69
2018	1.51	1.38	0.04	0.03	0.08	7.64	65.61	73.25	0.75	0.66	1.90	2.63
2019	1.48	1.35	0.04	0.03	0.09	7.55	63.52	71.07	0.75	0.67	2.05	2.72
2020	1.58	1.45	0.02	0.01	0.04	7.71	64.87	72.58	0.66	0.68	2.08	2.79

Source: wskaznikibranzowe.pl, 27.12.2023.

Figure 1 shows the integrated financial security indicator of the logistics sector. Its trend is positive, which means that the situation in the sector is improving, but there is a visible decrease in its level in 2020, which is the result of the outbreak of the COVID-19 pandemic and the closure of the economy.

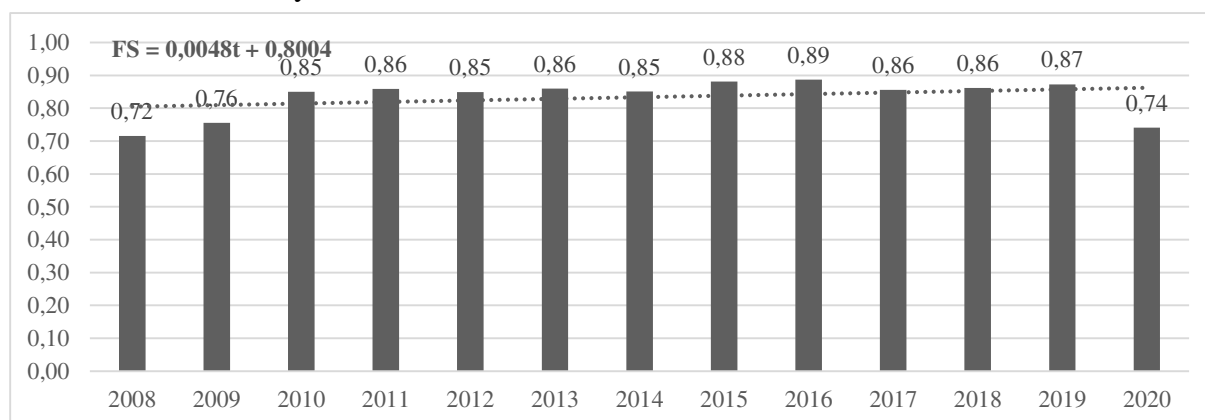


Figure 1. The indicator of financial security of the logistics sector.

Source: <https://wskaznikibranzowe.pl>, 27.12.2023.

Table 2 shows environmental taxes and their types in the logistics sector. The amount of environmental taxes in the analyzed period varies, with the largest tax share being taxes on energy and the smallest being taxes on natural resources.

Table 2.*Environmental taxes in the logistics sector in Poland from 2008 to 2020*

Year	Total environmental Taxes	Energy taxes	Pollution taxes	Resource taxes	Transport taxes
2008	2 403.14	2 192.59	94.61	7.74	108.21
2009	2 004.39	1 833.47	81.88	7.44	81.59
2010	2 248.91	2 073.44	85.92	8.37	81.19
2011	2 259.58	2 055.36	89.87	8.47	105.88
2012	2 256.22	2 071.54	70.72	7.72	106.23
2013	2 305.57	2 149.86	36.06	5.79	113.85
2014	2 503.42	2 324.65	67.96	6.35	104.46
2015	2 673.73	2 471.16	80.61	5.06	116.9
2016	2 715.23	2 561.5	61.73	4.27	87.73
2017	2 969.04	2 815.05	63.32	2.03	88.63
2018	3 210.22	3 061.57	64.66	2.95	81.04
2019	3 245.27	3 082.89	69.1	2.39	90.88
2020	2 541.36	2 415.9	72.63	5.53	47.31

Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_tax_statistics.

The Ordinary Least Square estimation results indicate a statistically significant positive impact of environmental taxes from the current period and a negative, although insignificant, impact of environmental taxes from two years ago on the financial security of the logistics sector (Table 3).

Table 3.*The OLS estimation (dependent variable: BF)*

	Coefficient	Std.dev.	t-Student	p-value	R ²
const	0.907456	0.0485941	18.67	<0.0001	0.8
Envtax	9.31574e-05	2.10758e-05	4.420	0.0022	
Envtax (t-2)	-0.000120027	2.20210e-05	-5.451	0.0006	
The White test: LM = 0.639016; p = P(Chi-square(5) > 0.639016) = 0.986147					
Chi-square(2) = 2.23441; p = 0.327193					
LMF = 2.14747; p = P(F(1.7) > 2.14747) = 0.186227					

Source: own calculations.

Table 4 presents the results of estimating the impact of individual types of environmental taxes on the financial security of the logistics sector in Poland. The results indicate that taxes on energy and natural resources from the previous period positively impact financial security.

Table 4.*The OLS estimation (dependent variable: BF; explanatory variables: Entax, Polltax, ResTax, Trtax)*

	Coefficient	Std.dev.	t-Student	p-value	R ²
const	0.184876	0.105938	1.745	0.1149	0.81
EnTax	0.000199363	3.20448e-05	6.221	0.0002	
ResTax (t-1)	0.0312406	0.00555157	5.627	0.0003	
LM = 8.42295; p = P(Chi-square(5) > 8.42295) = 0.134415					
Chi-kwadrat(2) = 0.299018; p = 0.861131					
LMF = 0.876466; p = P(F(1.8) > 0.876466) = 0.376568					

Source: own calculations.

The research results show that environmental taxes affect financial security, but it should be emphasized that they do not play a key role in maintaining its appropriate level. However, they should be taken into account in business activities because, apart from financial security, they affect the environmental development of enterprises and the costs of running a business.

6. Discussion and conclusions

Financial security is an essential factor influencing enterprises' functioning and development. It means a state where it is possible to perform economic functions related to raising capital, dividing it and using it appropriately in operational, investment and financial activities. Financial security is assessed using various financial indicators, both accrual and cash. Liquidity, solvency and profitability are assessed.

An appropriate level of financial security enables the implementation of new investments and is, therefore, one of the basic elements influencing enterprises' sustainable and stable development. Financial security depends on some factors, external and internal. In our analyses, we decided to check whether environmental taxes, whose role is to reduce the negative impact of business activities on the natural environment, affect the level of financial security.

The results of our research indicate that environmental taxes have a statistically significant impact on the financial security of the logistics sector. Therefore, the main hypothesis of the study is true. Moreover, it should be noted that this impact, although statistically significant, is relatively small, and therefore, an increase in environmental taxes, which is good for the protection of the natural environment, should not have a very negative impact on the liquidity, profitability, operational efficiency and debt of the logistics sector in Poland.

The level of financial security is increasing (the first research question), although the dynamics are not high, and what is more, in the analyzed period, there were years in which its level decreased. A particularly large decline in its level was visible in 2020, the year of the outbreak of the COVID-19 pandemic, which was the result of restrictions on business activity and temporary lockdowns.

In answer to the second research question, the largest share in environmental taxes in the logistics sector are energy taxes, followed by transport taxes.

It should also be emphasized that the results of the OLS estimation indicate that the greatest statistically significant impact on the logistics sector comes from taxes on energy and taxes on natural resources from two years ago.

The study results indicate that company managers should consider fiscal aspects in their analyses, including those related to environmental taxes. The amount of these taxes is relatively low and, therefore, does not significantly impact the analysis of costs incurred by enterprises.

The research limitation is assessing the level of financial security only to the level of accrual indicators, which results from the need for more availability of cash data at the level of business sectors.

We will devote further research to assessing the impact of environmental taxes on the logistics sector in other European Union countries, allowing us to conduct a comparative analysis of the logistics sectors and the determinants of their development.

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SUSTAINABLE DEVELOPMENT OF POLISH HEALTHCARE DETERMINED BY THE COVID-19 PANDEMIC

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Purpose: The acceleration of the digitization of the healthcare sector, forced by the pandemic, and the extensive use of e-services prevented is collapsed. But it was also created a space for innovative medical and medical-related solutions, development of staff competences, greater focus on the patient and his environment. The aim of the article is to determine the state and directions of sustainable development of Polish health care in connection with the COVID-19 pandemic.

Design/methodology/approach: According to the World Commission on Environment and Development, sustainable development makes it possible to meet the needs of the present generation without compromising the ability of future generations to meet their needs. The 2030 Agenda aims to “ensure healthy lives and promote prosperity for all people of all ages”. The coronavirus pandemic has challenged global healthcare systems to cope with an unprecedented crisis while pursuing sustainable development as defined above.

Findings: The pandemic has led healthcare leaders to act with agility, build resilience and adopt smarter ways of working to help future-proof care. It has also pushed them to rethink how care is delivered.

Originality/value: An identification the main directions of sustainable development of Polish healthcare in connection with the COVID-19 pandemic.

Keywords: sustainable development, healthcare, pandemic.

Category of the paper: Conceptual paper.

1. Introduction

Nowadays, among all the resources, no longer financial capital nor technology, but people are becoming more and more important resources. We are meeting at a time of immense challenges to sustainable development. Global health threats, more frequent and intense natural disasters, spiraling conflict, violent extremism, terrorism and related humanitarian crises and forced displacement of people threaten to reverse much of the development progress made in recent decades.

To promote physical and mental health and well-being, and to extend life expectancy for all, we must achieve universal health coverage and access to quality healthcare. No one must be left behind. United Nations commit to accelerating the progress made to date in reducing newborn, child and maternal mortality by ending all such preventable deaths before 2030. They are committed to ensuring universal access to sexual and reproductive healthcare services, including for family planning, information and education. They will equally accelerate the pace of progress made in fighting COVID-19, malaria, HIV/AIDS, tuberculosis, hepatitis, Ebola and other communicable diseases, epidemics and pandemics, including by addressing growing anti-microbial resistance and the problem of unattended diseases affecting developing countries. They are committed to the prevention and treatment of non-communicable diseases, including behavioral, developmental and neurological disorders, which constitute a major challenge for sustainable development (United Nation, 2016).

Healthcare units, like most organizations, function in a very unstable environment – especially in pandemic time, and are formed by the determination of factors which refer to both distal and near surroundings (mostly because of underfunding, staff shortage, operating a social mission resulting from the nature of these units, etc.). Aspects like patient orientation and demands, high standards of medical services performed and the escalation of the performance of these organizations within the budget add to a growth of the conditions for medical units. (Krawczyk-Sołtys, 2018b).

According to Polish health policy the main objective of healthcare units is to ensure patients effective healthcare by providing medical services, considering patients' values and expectations.

The aim of the article is to determine the state and directions of sustainable development of Polish healthcare in connection with the COVID-19 pandemic.

2. Sustainable development of healthcare according the United Nations 2030 Agenda

Sustainable development as a concept should be perceived in a very broad context, including many spheres of human activity (economy, social issues, environment). Currently, sustainable development, as one of the main subjects of economic and ecological research, is undertaken mainly by ecological economics, energy analysis, environmental economics, and other related disciplines. Due to its extensive nature, there are numerous definitions of the term 'sustainable development'.

The first definition of sustainable development was formulated by the United Nations in 1987 (United Nations, 1987) - Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two key concepts within it:

- the concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future need.

Sustainable development has been one of the main goals of EU policy for many years. Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs. It is an overarching objective of the European Union set out in the Treaty, governing all the Union's policies and activities. It is about safeguarding the earth's capacity to support life in all its diversity and is based on the principles of democracy, gender equality, solidarity, the rule of law and respect for fundamental rights, including freedom and equal opportunities for all. It aims at the continuous improvement of the quality of life and well-being on Earth for present and future generations. To that end it promotes a dynamic economy with full employment and a high level of education, health protection, social and territorial cohesion and environmental protection in a peaceful and secure world, respecting cultural diversity (Council of the European Union, 2006).

In Agenda for Sustainable Development United Nations set up seventeen significant goals (United Nation, 2016):

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts.

14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Moving on with the considerations on the implementation of Sustainable Development Goal 3 (Good health and well-being) (United Nations, 2021) UN pointed such targets:

- By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.
- By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births.
- By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.
- By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing.
- Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.
- By 2020, halve the number of global deaths and injuries from road traffic accidents.
- By 2030, ensure universal access to sexual and reproductive healthcare services, including for family planning, information and education, and the integration of reproductive health into national strategies and programs.
- Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.
- By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.
- Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate.
- Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related

Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.

- Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing states.
- Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

The COVID-19 pandemic has revealed and exacerbated existing inequalities. The latest findings of the 2021 Sustainable Development Report revealed that the COVID-19 pandemic is an obstacle to sustainable development worldwide. Suppressing the pandemic through non-pharmaceutical interventions and global access to vaccines must remain the top priority of any government. As long as the pandemic was raging, there could be no sustainable development or economic recovery (Żbikowska-Rydz, 2022).

Many health indicators were heading in the right direction before the COVID-19 threat emerged. Maternal and infant health had improved, immunization coverage had increased, and infectious diseases had declined, though not fast enough to meet the 2030 targets. The pandemic halted or reversed health progress and poses a serious threat beyond the disease itself. About 90% of countries still report one or more disruptions to basic health services, and available data from several countries show that the pandemic has shortened life expectancy. No wonder the virus disproportionately affects disadvantaged groups (World Health Organization, 2021a). The pandemic has underlined the importance of universal health insurance and multi-sectoral coordination for health preparedness. In addition, to design effective pandemic policy interventions, governments are tasked with improving and strengthening the collection of basic demographic and epidemiological data. COVID-19 has impacted health outcomes and mortality worldwide, and has led to shorter life expectancies, even in many developed countries (World Health Organization, 2021b). Europe and North America recorded the largest loss, close to 1.7 million, followed by Latin America and the Caribbean, with around 1.2 million, and Central and South Asia with just under half a million (Sachs et al., 2019). COVID-19 can have long-term health effects, including disability due to scarring of the lungs and damage to the heart, as well as mental health problems that can affect people for long periods. The indiscriminate use of antibiotics during the pandemic could further increase antimicrobial resistance. While it is too early for existing data to reflect this impact, the COVID-19 pandemic threatens to reverse years of progress towards better health worldwide, no matter the place on the map or the state of development (Żbikowska-Rydz, 2022).

The COVID-19 pandemic is an obstacle to sustainable development in Europe and around the world. It is obvious that the pandemic was more than a health crisis. It is a crisis - socio-economic, humanitarian, security and human rights. It has affected us as individuals,

families, communities, and societies. It has had an impact on every generation, including those not yet born. The crisis has highlighted fragilities within and among nations, as well as in systems for a coordinated global response to shared threats.

The UN's response to COVID-19 and its impact consists of three main components:

1. A largescale, coordinated and comprehensive response to health, supervised by the World Health Organization (WHO) and its Strategic Preparedness and Response Plan to mobilize all sectors and communities to respond to all threats, control and suppress virus transmission, reduce mortality by providing care to those affected, and develop safe and effective vaccines and drugs that can be delivered on a large scale and available as needed. Part of that response is a new global collaboration – the Access to COVID-19 Tools (ACT) Accelerator – which aims to accelerate the development, production, and fair access to COVID-19 testing, therapies, and vaccines (World Health Organization, 2021c).
2. Extensive action to protect lives and livelihoods by addressing the destructive short-term aspects of the socio-economic, humanitarian, and human rights crisis, focusing on those most affected. The main target is to save lives, maintaining access to critical services, corporate solvency, supply chains, strong institutions, public service delivery, and human rights in the foreground. This is achieved through immediate humanitarian aid to the most affected population in the most vulnerable 63 countries with life-saving aid under the Global Humanitarian Response Plan (GHRP), as well as support for over 120 countries for an immediate socio-economic response guided by the framework of the UN development system (United Nations Office for the Coordination of Humanitarian Affairs, 2021).
3. A transformation process that leads to a better post-COVID-19 future by addressing fundamental weaknesses and identifying opportunities for a transformation towards fairer, equal and resilient societies and economies. Overcoming this crisis should be seen as an opportunity to mitigate the climate crisis, inequalities, exclusion, gaps in social protection systems, and many other injustices that have been revealed and aggravated (United Nations, 2020).

Along with that if we look at the health systems we can see that it's being confronted with rapidly increasing demand generated by the COVID-19 outbreak and more recently, the influx of refugees from war-torn Ukraine especially in Poland. A well-organized and prepared health system has the capacity to maintain equitable access to essential service delivery throughout an emergency, limiting direct mortality and avoiding increased indirect mortality (Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2022).

3. Sustainable development of healthcare in Poland during COVID-19 pandemic

Life expectancy at birth in Poland increased by more than four years between 2000 and 2014 to reach 78 years, and fluctuated around this level until 2019, when the gap between life expectancy in Poland and the EU average was about three years. The gap was largely caused by greater exposure to modifiable risk factors among men, such as smoking and alcohol consumption. In 2020, the very high level of excess deaths – many due to COVID-19 – caused life expectancy at birth to decrease temporarily by 1.4 years compared to 2019, which was among the largest reductions recorded within the EU. As a result, the gap in life expectancy between Poland and the EU widened to four years (OECD, European Observatory on Health Systems and Policies, 2021).

In Poland, as in many other countries, the actual number of deaths from COVID-19 is likely to be higher than the number of reported deaths because of limited testing and issues related to the attribution of causes of death. The number of COVID-19 deaths also does not include possible increase in deaths from other causes that may arise during or after the pandemic, such as reduced access to health services for non-COVID-19 patients and fewer people seeking treatment because of fear of catching the virus (indirect deaths). The indicator of excess mortality (defined as the number of deaths from all causes over what would have been expected based on the experience baseline from previous years) can provide a broader measure of the direct and indirect deaths due to COVID-19 that is less affected by issues related to testing and causes of death registration.

Polish health system is based on social health insurance (SHI). The Ministry of Health plays a central role in health sector governance, although it shares this responsibility with three levels of territorial government: municipalities oversee primary care; counties are responsible for (often) smaller county hospitals; and voivodeships (regions) are responsible for generally larger regional hospitals. The Ministry of Health supervises the highly specialised tertiary care providers. The Ministry also played a major role in coordinating the country's response to the COVID-19 pandemic. Private facilities provide mainly outpatient care, while most inpatient care is provided in hospitals, which are public. This high level of fragmentation of health system governance presents considerable challenges for achieving effective coordination of activities across the health system, although recently efforts have been made to improve the situation. The National Health Fund (NHF) is the sole purchaser in the SHI system. It operates through its 16 voivodeship branches, which manage the purchasing of healthcare services in their regions.

Poland's COVID-19 response was led by the central government, with the involvement of relevant ministries, including the Ministry of Health. The Minister of Health led the health system response, supported by a dedicated Crisis Management Team within the Ministry.

This body consists mainly of representatives from various state authorities rather than independent public health specialists or scientists. Unlike its neighbors, Poland did not declare a state of emergency, which would have provided the government with a choice of ready-made restrictive measures and other special powers to address the pandemic under the Constitution. Instead, in March 2020 the government declared a lower “state of epidemiological emergency” and then a “state of epidemic”, which meant that all extraordinary measures had to be introduced via special provisions and resolutions enacted through parliament (Sowada et al., 2022).

Poland’s healthcare system is affected by large imbalances in the provision of services, with infrastructure concentrated in the hospital sector; insufficient provision of outpatient care, diagnostics and long-term care; and weak coordination between inpatient and other care. The number of hospital beds is high, at 6.2 beds per 1000 population in 2019 compared to an EU average of 5.3, but these are unevenly distributed across the country. Current reform plans anticipate transformation of acute hospital beds into other types of beds, such as long-term care beds, rather than reducing their number (OECD, European Observatory on Health Systems and Policies, 2021).

According to Eurostat data, Poland has the lowest number of practicing doctors per 1000 population (2.4) in the EU, and the number of nurses (5.1 per 1000 population) is also among the lowest. While the official national estimates appear to be higher – ranging from 3.4 to 4.4 doctors per 1 000 inhabitants (Kowalska-Bobko et al., 2021) – shortages of health workers have been reported in several regions, leading to difficulties in accessing health services. Shortages are particularly severe in small counties around large cities and in rural areas.

Polish hospitalization rates for conditions that could have been effectively managed in outpatient settings are among the highest in the EU (OECD Health Statistics, 2021). These high rates point to deficiencies in the provision of primary and outpatient specialist care. Since 2018, a new organizational model has strengthened the role of primary health care in management of the 11 most prevalent chronic conditions – including chronic heart failure and diabetes – and is expected to contribute to reducing avoidable hospitalization rates.

As in many other countries in Europe, all non-emergency hospital procedures were cancelled in the early months of the COVID-19 crisis. Primary care clinics continued to operate, providing remote services (usually by telephone), with special guidelines developed for providing teleconsultations during the pandemic. Specialist outpatient consultations were more difficult to conduct remotely, as these rely more on conducting a physical examination and/or diagnostic tests (the availability of which was also limited). Nevertheless, survey data show that 62% of the population used telehealth services in the first year of the pandemic, which was considerably higher than the EU average of 39% (Eurofound, 2021). This was enabled by pre-existing tools and platforms, such as the Patient’s Internet Account, and was further supported by countrywide implementation of e-health solutions and through various information technology initiatives implemented during the pandemic. Elective care was severely

constrained throughout the pandemic due to postponement of treatments and re-profiling of hospitals as COVID-19 hospitals.

Poland was very quick to react with protective measures once the first cases of COVID-19 were detected within its borders. Steps such as closures of schools, bans on mass gatherings and export bans for certain medicines were taken even before the state of epidemiological emergency was declared on 14 March 2020. The government introduced infection prevention measures, including closures of non-essential businesses, a ban on non-essential movement for the population and the closure of national borders.

For many years seen as a source of inefficiency, the relatively high number of hospital beds became an asset during the pandemic when infection rates soared. In 2019, Poland had 10.1 intensive care unit beds per 100 000 people, which was more than in many countries in the EU. Bed capacity for treating COVID-19 patients was initially secured by suspending all elective care and reserving beds for treating COVID-19 cases. A total of 22 hospitals – at least one in each voivodeship – were transformed into COVID-19 hospitals, designated for the sole use of COVID-19 patients. This secured a total of 10 000 beds. However, these decisions were sometimes controversial, as many of the reserved facilities remained severely underutilized before autumn 2020, and the number of COVID-19 beds was progressively reduced. The situation changed from October 2020, with both bed and respirator capacities coming under strain, despite the number of COVID-19 beds increasing to 45 000. Other measures to increase bed capacity included repurposing of existing facilities – for example, adapting hospital wards to treat COVID-19 cases and separating them from other wards with physical barriers to keep patients apart, and building field hospitals. Over the course of the pandemic, this hospital-centered model of COVID-19 response was replaced with one centered on primary health care: most patients with no or mild symptoms were looked after by primary care doctors rather than at infectious diseases hospitals, and most diagnostic tests were ordered at the primary health care level (Ministry of Health, 2020).

With the introduction of vaccinations, most of the temporary field hospitals that had been built were turned into vaccination sites. Vaccines were also administered in hospitals, clinics and other health facilities, with over 6 100 vaccination points nationwide.

Great effort has been made in recent years to implement an electronic health data platform and related e-health tools. From 2019, medical records have to be kept electronically by health care institutions and doctors. From January 2020, with a few exceptions, only e-prescriptions have been allowed. Implementation of e-referrals started in January 2021 in facilities that have the necessary information technology capacity, and from July 2021 all health care providers are expected to exchange medical health records electronically. The pandemic response has shown that successful implementation of these tools is closely connected to the level of digital skills of both health care providers and service users. Poland's efforts in the area of digital health will be supported through the European Health Data Space initiative, which aims to promote better exchange and access to different types of health data, including electronic health records,

genomics data and data from patient registries, and to support health care delivery, health research and policy making (European Commission, 2021).

Behavioral and environmental risk factors account for nearly half of all deaths in Poland. Although decreasing, smoking rates remain high and alcohol consumption is also higher than the EU average. Obesity is a growing health issue, and policy efforts to tackle it have increased, including the introduction of a “sugar tax” on beverages in 2021. Preventable mortality is far above the EU average, drawing attention not only to the relatively low spending on health promotion and disease prevention but also to the scope for strengthening tobacco and alcohol control measures (Sowada et al., 2022).

Low levels of financing are likely contributors to health workforce shortages, which are more severe than in most EU countries. These shortages contribute to access problems such as long waiting times, particularly in rural areas. In the EU, Poland has among the lowest number of doctors and nurses per capita. Further, many doctors and nurses are approaching retirement age, which exacerbates concerns about future supply. During the pandemic, regulations around the recruitment of international medical staff were relaxed, despite previous strong opposition.

Moving on with the considerations on the implementation of Sustainable Development Goal 3 in Poland (Good health and well-being) targets achievement indicators in 2019-2021 are as follow (Lafortune et al., 2022) and places Poland on 13 position:

- Life expectancy at birth (years) 75.6;
- Gap in life expectancy at birth among regions (years) 2.7;
- Population with good or very good perceived health (% of population aged 16 or over) 64.4;
- Gap in self-reported health, by income (p.p.) 25.3;
- Gap in self-reported unmet need for medical examination and care, by income (p.p.) 1.9;
- New reported cases of tuberculosis (per 100,000 population) 9.6;
- Standardized preventable and treatable mortality (per 100,000 persons aged less than 75) 352.2;
- Suicide rate (per 100,000 population) 12.0;
- Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population) 41;
- Mortality rate, under-5 (per 1,000 live births) 4.4;
- People killed in road accidents (per 100,000 population) 6.6;
- Surviving infants who received 2 WHO-recommended vaccines (%) 80;
- Population engaging in heavy, episodic drinking at least once a week (%) 1.1;
- Smoking prevalence (%) 26;
- People covered by health insurance for a core set of services (%) 94.0;

- Share of total health spending financed by out-of-pocket payments (%) 19.6;
- Subjective Wellbeing (average ladder score, worst 0-10 best) 6.0;
- Individuals that use the internet to make appointments with a practitioner (%) 11.

In recent years, value-based healthcare has become a subject of greater interest in Poland. For example, the Agency for Health Technology Assessment and Tariff System was working on a proposed reimbursement model based on payment for the outcome of treatment covering the entire healthcare continuum (prevention - diagnosis - treatment - rehabilitation). The COVID-19 pandemic has slowed this trend – around a quarter of Polish healthcare leaders indicate that the transition to a value-based healthcare model has become less of a priority for them due to the pandemic. This is a much higher percentage than the average in the 14 countries covered by the study (15%), which may reflect the profound impact of the pandemic on the situation in Poland. However, despite the obstacles caused by the current crisis, about a third of them are currently on a plan to move to value-based healthcare or have plans to do so in the future.

Three-quarters of Polish healthcare leaders, in terms of implementing digital medical technologies, currently invest the most in digital medical records. In addition, compared to the average of the 14 countries covered by the study, this technology is a higher priority for leaders in Poland. The percentage of healthcare entities with IT solutions that enable keeping medical records in electronic form has increased - from 56.6% in 2018 to 68.4% in 2021. These activities contribute to improving the quality of the healthcare system and patient safety, reducing inequalities in access to health care, increasing health awareness and detecting diseases in the early stages of development (Ministry of Economic Development and Technology, 2023). At present, the leaders of Polish health care are focused on creating the foundations of a digital medical record system, but going beyond the requirements caused by the current epidemic situation, they perceive artificial intelligence as one of their future investment priorities, with around a third currently investing in some form of AI, and 61% of them would like their hospital or medical facility to invest most in AI technology in the future.

Currently, only 2% of Polish healthcare leaders consider the implementation of sustainable development practices in their hospital or medical facility to be a priority. However, about half of them expect it to be one of their main goals in the future, more important than other needs, such as improving the technological infrastructure (30%) or facilitating the transition to remote or virtual care (27%) (Philips, 2021).

To sum up - health system resilience has been defined as the ability to prepare for, manage (absorb, adapt and transform) and learn from shocks.

4. Conclusions and Further Research

The pandemic has led healthcare leaders to act with agility, build resilience and adopt smarter ways of working to help future-proof care. It has also pushed them to rethink how care is delivered. In many cases, healthcare leaders have continued to use care practices that were adopted more widely during the pandemic, including virtual care. Managerial competencies seem to be crucial for recognizing the needs of the organization itself and its environment, as well as following new challenges and opportunities to deal with them (Krawczyk-Sołtys, 2018a, 2018b, 2019, 2021, 2022; Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2022, 2023).

The Future Health Index 2021 report found that just 4% of healthcare leaders saw implementing sustainability practices as a priority, although many (58%) agreed it would become a priority by 2024. Today, the picture is very different. This year's findings suggest that healthcare leaders have fast-tracked their sustainability plans. Almost one-quarter (24%) are prioritizing sustainability, and the same number plan to do so three years from now. Healthcare leaders in urban facilities are more likely than their peers in rural facilities to prioritize sustainability (26% vs 19%), demonstrating the role of patients and healthcare workers in driving sustainability. In urban areas where there is a wider choice of facilities, healthcare leaders are more likely to feel pressure to meet patient demands for sustainable practices in order to attract and keep patients. Equally, sustainability is increasingly playing a key part in recruiting talent in areas where there is significant competition. However, while leaders in rural facilities are currently behind those in urban facilities in prioritizing sustainability, they are set to surpass them in terms of the issue three years from now (29% vs 25%). There are also differences in attitudes towards sustainability between operational and clinical healthcare leaders. Clinical leaders are less likely to prioritize sustainability than their operational colleagues today and this difference is even greater in the future. However, they can also have an impact on emissions reductions, for example by prescribing medications that are manufactured with a lower carbon footprint or advocating for equipment that has zero landfill at the end of its life. For hospitals and healthcare facilities to achieve their sustainability goals, both clinical and operational leaders must play an equal part in carbon reduction (Philips, 2022).

The early COVID-19 response allowed Poland to contain the first wave of infections effectively. It also offered an opportunity to build contingencies, but the health system quickly came under strain when the infection rate surged during the second wave. Capacity issues affected the large inpatient sector, where shortages of health workers proved to be a major bottleneck to upscaling care, even when infrastructure such as additional intensive care unit beds was mobilized quickly. Over the course of the pandemic, primary health care increasingly became the first line of response to COVID-19. Thanks to the use of telemedicine solutions and supportive platforms and tools, it was largely possible to maintain primary care services during the pandemic. This was more difficult with specialist consultations, which tend to rely on

physical examinations and diagnostic tests. Provision of inpatient care for non-COVID-19 patients suffered the most, as health resources were reallocated to treatment of COVID-19 patients. Poland has bolstered access to the COVID-19 vaccine by assembling a range of vaccination sites to administer the inoculation. In the face of some vaccine hesitancy, it has also provided incentives to encourage the population to get vaccinated (Sowada et al., 2022).

It's supposed to be set out together on the path towards sustainable development, devoting ourselves collectively to the pursuit of global development and of "win-win" cooperation which can bring huge gains to all people.

The pandemic has exacerbated the difficulties faced by healthcare leaders before the crisis. Today, healthcare leaders face a human capital crisis: the 'great resignation' has serious consequences for the industry, leading to the closure of facilities, in some cases. This is an issue that must be addressed in order to fix other challenges. Yet (Breuer et al., 2020; Dahmen et al., 2021; Gibson et al., 2020), this area is not fully developed. Therefore, it seems necessary to conduct empirical and literature research in this area, which will enrich scientific knowledge, rationalize the research methodology, as well as allow to formulate recommendations for practice.

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PERSONAL COMPETENCIES AND EFFECTIVENESS OF HEALTH CARE UNITS – THEORETICAL APPROACH

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Purpose: The aim of the article is to present how constructed by Authors models of personal competencies connect to effectiveness of health care units. Important sets of personal competencies identified and rated as essential for effective health care units' practice reflects the scope of skills, knowledge and applications required to address the often complex problems encountered in these organizations.

Design/methodology/approach: The proposed lists of managerial and professional competencies (six domains each) were created and are based on the analysis of healthcare competencies models - the study of the literature - and one of the Authors' observations of the analyzed entities (as a consultant).

Findings: Evaluating the performance by personal competencies becomes essential for managers and training centers, since it contributes to the identification of gaps in knowledge, skills and attitudes of professionals, by promoting the elaboration and implementation of strategies for their development.

Originality/value (mandatory) An identification the personal competencies of health care units employees in connection to effectiveness of such entities.

Keywords: personal competencies, effectiveness, health care units.

Category of the paper: Conceptual paper.

1. Introduction

High-quality care is a priority in health care systems and is described as the provision of appropriate, efficient and effective services that result in optimal outcomes for patients.

Naturally patients are ultimately interested in improved health or health-related quality of life, but health services research continues to address whether health services financing and delivery are structured in ways to maximize production of intermediate goods, regardless of the link between these services and final outcomes (Fishman, Hornbrook, Goodman, 2004).

Therefore, the main mission of a health care system is to promote health and respond to the needs of people and society in the field of health and diseases. Needs change constantly under economic, social, political, and environmental conditions. So, the health care system must adapt to the needs arising from such a change (Tabrizi, Farahbakhsh, Sadeghi-Bazargani, Hassanzadeh, Zakeri, Abedi, 2016).

Health care units, like most organizations, function in a very unstable environment, and are formed by the determination of factors which refer to both distal and near surroundings (mostly because of underfunding, staff shortage, operating a social mission resulting from the nature of these units, etc.). Aspects like patient orientation and demands, high standards of medical services performed and the escalation of the performance of these organizations within the budget add to a growth of the conditions for medical units. Therefore the awareness and competences of the personnel engaged within these organizations are becoming more and more essential, because growing needs are characterized to help the change of research results to clinical and administration practice and the upgrading of policy and legal implications in this area, which should fundamentally alter to better achievements in the needs of patients, as well as expanding the competitiveness of these units (Krawczyk-Sołtys, 2018b).

According to Polish health policy the main objective of health care units is to ensure patients effective healthcare by providing medical services, considering patients' values and expectations. Such approach requires appropriate professional competencies of the employees, managerial competencies managing these organizations, as well as organizational competences.

As a supporter of resource based view (RBV) R.M. Grant claimed that the resources and capabilities can be tangible, intangible and human. All of them are important for ensuring the success of the organization activity but the largest attention, both in theory and practice, is assigned to human resources (Wright, Dunford, Snell, 2001; Pfeffer, 1994).

Drawing on the resource-based theory and dynamic capability view it should be pointed out that in healthcare units indirectly influence decision-making effectiveness through the mediating role of knowledge absorptive capacity (Wang, Byrd, 2017).

This article is focused on the issue how constructed models of personal competencies connect to effectiveness of health care units.

2. Personal competencies in health care units

Nowadays personal (managerial and professional) competencies are a subject of research throughout the world, a fact reflected by the huge number of publications on the topic. Along with that if we look at the health systems we can see that it's being confronted with rapidly increasing demand generated by the COVID-19 outbreak and more recently, the influx of refugees from war-torn Ukraine. A well-organized and prepared health system has the

capacity to maintain equitable access to essential service delivery throughout an emergency, limiting direct mortality and avoiding increased indirect mortality. As this situation creates the challenge, personal competences become even more important.

Presented model of managerial competencies in health care units (Fig. 1) was created as a result of studies of the literature of the subject conducted by the Authors and many years of direct observations of Agnieszka Krawczyk-Sołtys (as a consultant) in these entities (Krawczyk-Sołtys, 2018a, 2018b, 2019, 2021, 2022, Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2022, 2023). It contains six domains with 32 competencies. These domains capture the dynamics and complexity of health care unit's manager's role and reflect the dynamic realities in health leadership today.

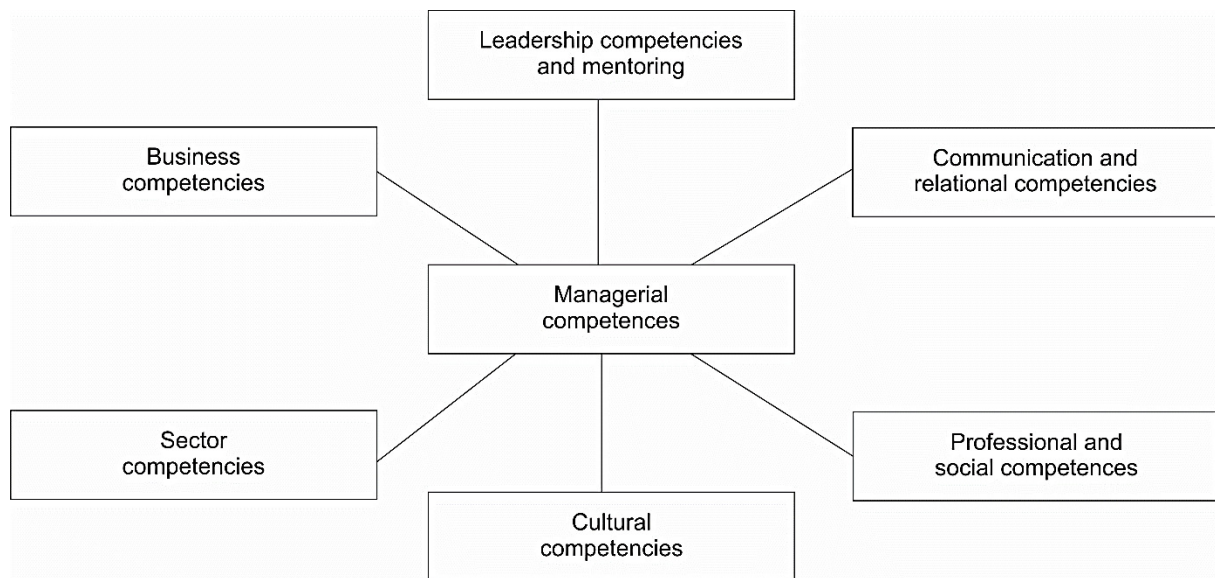


Figure 1. Model of managerial competences in health care units.

Source: own study.

First domain (Leadership Competencies) includes: leadership abilities and behaviors, leading change, encouraging employees to creativity, innovation and development, management skills and mentoring. Among the second domain – Communication and Relationship Competencies - were distinguished: relationship management, communication skills, and facilitation and negotiation. The third domain - Professional and Social Competencies – introduces: professionalism, professional development and lifelong learning, contributions to the development of management in health care, awareness of goals, values, strengths and weaknesses, ethical behavior and social awareness, ability to recognize common interests on organizational scale, empathy, ability to cooperate with people and have an effective influence on them, serving its interests and dignified representing the organization outside, ability to choose people for key positions in the organization. The fourth domain - Cultural Competencies in health care tends to be seen as a way to increase access to quality care for all patient populations and as a business imperative to respond to diverse patient populations and attract new patients and market share (Betancourt, Green, Carrillo, 2002) and can be

described as follows: creation of an organizational culture based on mutual trust, transparency and focusing on improving the quality of provided medical services, the ability to provide care to patients with diverse values, beliefs, and behaviors, meeting patients' social, cultural, and linguistic needs, delivering the highest quality of care to every patient, regardless of race, ethnicity, cultural background, removing barriers, such as different perspectives on health, medical care, and expectations about diagnosis and treatment, supplanting the current one-size-fits-all approach with a system more responsive to the needs of an increasingly diverse population. The fifth domain – Sectorial competencies (concerning the health care system and its environment) involved: knowledge of the functioning of the health care system and entities of this system, ability to optimize employment in the organization, personalizing health care, public health competences. Finally, in the sixth domain – Business Competencies – were described as: knowledge of basic business practices and the ability to manage projects, strict adherence to procedures, regulations and legal norms as well as the ability to create internal regulations on their basis, financial management, human resource management, strategic management, information and knowledge management, risk management, improving the quality of medical services, and systems thinking. Managerial competencies seem to be crucial for recognizing the needs of the organization itself and its environment, as well as following new challenges and opportunities to deal with them.

Next model which includes professional competencies in health care units (Fig. 2) was also created as a result of studies of the literature of the subject conducted by the Authors and many years of direct observations in these entities (Krawczyk-Sołtys, 2018a, 2018b, 2019, 2021, 2022, Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2022, 2023).

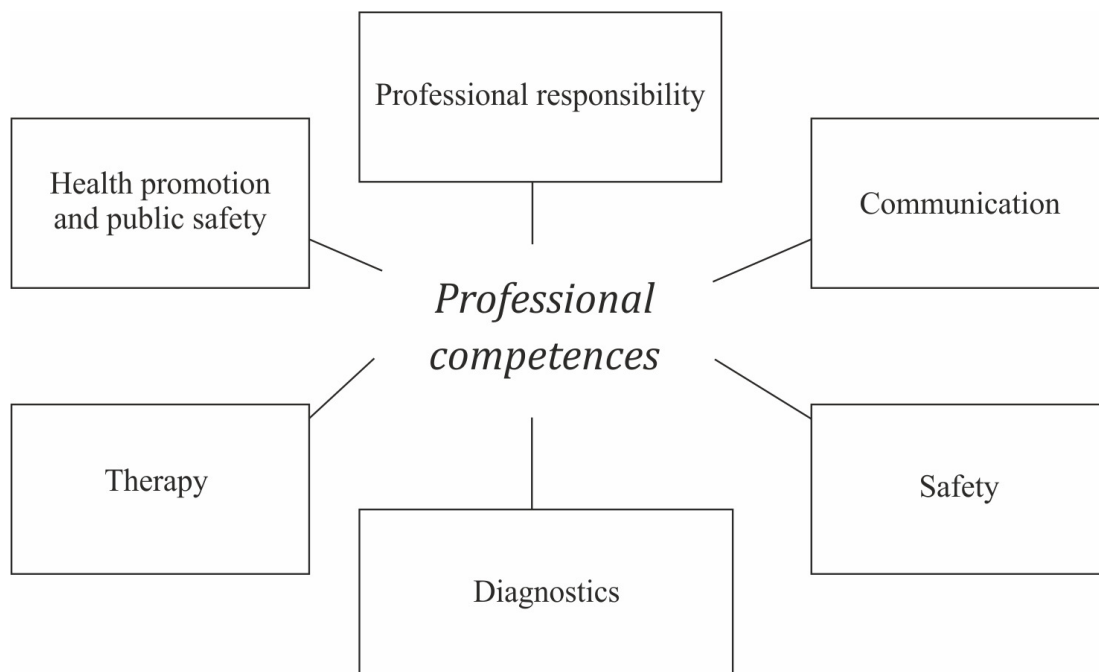


Figure 2. Model of professional competences in health care units.

Source: own study.

It contains six domains. Among Professional Responsibilities were distinguished such competencies as: functioning as a professional, participating in continuing education and professional development, possessing an understanding of the medicolegal aspects of the profession, recognizing and complying with relevant Polish legislation, functioning effectively in a team environment, making decisions effectively and managing scenes with actual or potential forensic implications. The second domain – Communication Competencies – refers to three competencies: practicing effective oral and written communication skills, practicing effective non-verbal communication skills and practicing effective interpersonal relations. In third domain – Health and Safety Competencies – were distinguished such competencies as: maintaining good physical and mental health, practicing safe lifting and moving techniques and creating and maintaining a safe work environment. The fourth domain of professional competencies is Assessment and Diagnostics Competencies and the fifth – Therapeutics Competencies. In case of these domains particular competencies are not being specified, because depending on the department, urgency of situation, etc. they are different. The last domain – Health Promotion and Public Safety Competencies – raised another qualities such as: integrating professional practice into community, contributing to public safety through collaboration with other emergency response agencies and participating in the management of a chemical, biological, radiological, nuclear and explosive incident.

It can be stated that over time not only has the overall level required increased but the factors important for success now include increased cognitive skills (use of influencing strategies and pattern recognition) as well as particular personal traits (self-confidence, initiative).

The Authors' study adopted a gap analytic approach to discover training needs through competency assessment. Results indicate incongruence in perceptions of current expertise and importance across four competencies: analytic skills, self-management, relationship management and goal and action management. Within these competencies, ability to analyze data quantitatively, display adaptability, positively influence and motivate co-workers, change management, planning and execution attract maximum importance. Multivariate analysis provides evidence of self-management, relationship management and analytic skills to be the strongest predictors of job performance. This implies that individual's ability to manage emotions, handle uncertainty, manage conflicts, influence co-workers, recognize pattern through data, technology usage, apply quantitative skills and solve problems, contributes considerably towards effective job performance. This necessitates an urgency on the part of organizations to focus on managerial competencies to derive maximum performance from its managers. On the other hand for the organizations, at an operational level, such findings can offer precise insights into the competency or training needs.

It should be also noted that mentors play an important role in the clinical setting, and an effective mentorship program is crucial in ensuring well preparation of future healthcare professionals (Karacay, Karadag, 2019). Mentor's role had to be found in mentoring practice in the workplace with assigned recourses and required education of nursing students' clinical

practice (Pramila-Savukoski et al., 2020). According to research (Mikkonen, Tomietto, Tuomikoski, Kaučič, Riklikiene, Vizcaya-Moreno, Pérez-Cañaveras, Filej, Baltinaite, Cicolini, Kääriäinen, 2021) age, work experience, frequency of mentoring and having completed mentoring training were associated with higher competence different areas of mentoring. Experienced and educated mentors need to be chosen to conduct the important task of mentoring.

Also, what's interesting the research results indicate that, in general, subordinates considered themselves more competent than their superiors. These findings suggest neither self-evaluation nor position-based evaluation is reliable in assessing personal competencies.

3. Effectiveness of health care units – literature review

The health care system is expected to work efficiently with respect to financial flows at the large scale, but to display the high complexity of individual patient care at the fine scale. The medical treatment of patients is an extremely high-complexity fine-scale task. One-size-fits-all does not work in this case. Applying such methods can only result in poor-quality care.

When a health care unit becomes less effective overall at many different tasks, it is not necessarily less effective at the particular tasks or measures that management or regulators are focusing on. It can be expected that for those tasks or measures, the organization will improve, while for others its effectiveness will decline. This explains why problems appear as indirect effects.

Also, the more problems arise with quality, the greater are the efforts to regulate the actions of health care units' staff. Imposing uniform care in some context may be constructive; however, in the context of complex organizations, uniformity is in itself a limitation. Exceptions do exist, but they must be understood within the framework of multiscale analysis rather than just assumed to exist. Since the resulting problems show up as indirect effects, it is difficult to discover their origins (Bar-Yam, 2006).

The high level of agreement on personal competencies considered essential for effective health care units performance provides a basis for the development of competency standards, as a distinct field of practice. Given some of the limitations of the competencies approach and the evolving nature of health care units, it is important to recognize that competencies need to be dynamic and change in response to changes in the field (Hughes, 2004).

Interprofessional healthcare team function is critical to the effective delivery of patient care. Team members must possess teamwork competencies, as team function impacts patient, staff, team, and healthcare organizational outcomes. There is evidence that team training is beneficial; however, consensus on the optimal training content, methods, and evaluation is lacking

(Greulich, Kilcullen, Paquette, Lazzara, Scielzo, Hernandez, Preble, Michael, Sadighi, Tannenbaum, Phelps, Krumwiede, Sendelbach, Rege, Salas, 2023).

There is a strong belief that effectiveness of health care teams can be improved by team interventions, as a wide range of studies have shown a positive effect of team interventions on performance outcomes (e.g. effectiveness, patient safety, efficiency) within diverse healthcare setting (e.g. operating theatre, intensive care unit, or nursing homes). Improving teamwork has therefore received top priority (Buljac-Samardzic, Doekhie, van Wijngaarden, 2020).

Performance of health care units can also be measured as its ability to restore and preserve health with acceptable costs for the society. Under the current prevalence of chronic disease, medical care (the major content of healthcare) underperforms in all key indicators: clinical effectiveness, benefit/risk ratio of interventions, cost/benefit ratio, and general population health.

Measures of performance are determined by the system's objectives, which are, in turn, set by the subject of management, or decision maker. There are several groups of stakeholders, potential subjects of management and decision makers in the health system: ordinary citizens (end users), health professionals and service providers, governmental and public bodies of different level (national, regional), manufacturers and distributors of medicines and health-related supplies, equipment, etc.

Distortions in organizational model of health care units has clearly manifested during the COVID-19 pandemic. The high risk groups of severe disease very closely coincide with modifiable risk factors of chronic non-infectious diseases. Hence, COVID-19 long-term prevention and treatment should be built around lifestyle correction and individual behavior. However, the public domain very rarely features a system of comprehensive advice for ordinary people (Martyushev-Poklad, Yankevich, Petrova, 2022).

4. Conclusions and Further Research

The importance of assessing competencies is undeniable. Competence recognition offers a way to develop workforce planning and career opportunities of practicing medical staff. Important sets of personal competencies identified and rated as essential for effective health care units' practice reflects the scope of skills, knowledge and applications required to address the often complex problems encountered in these organizations. This suggests that it cannot be expected an individual practitioner to have proficiency in all the competency units identified, emphasizing the need to develop work teams that ensure the competency mix required for effective work effort.

The literature review conducted clearly highlighted the need to create a valid, reliable and easy-to-use tool to identify the personal competencies of medical staff to support the knowledge transfer.

The article assumes that personal competencies are a combination of skills, knowledge, attitude, and behavior that a person requires to be effective in a wide range of jobs, and various types of organizations, in addition, may be a source of sustained organizational performance (Abd-Elmoghith, Abd-Elhady, 2021). These competencies are used and developed in the process of providing medical services in order to achieve results consistent with the strategic intentions of health care units (Krawczyk-Sołtys, 2018a).

Again, it is worth emphasizing that it is people and their knowledge, skills and competencies that are considered the key resource of the organization. Therefore is also a noticeable change in focus on the qualitative aspects of human resources as strategic element of the functioning of organizations that tend to develop the personal competencies of their employees.

The need for interventions like interprofessional education opportunities, staff induction programs and regular interprofessional meetings to foster acknowledgement of health care units, promoting the acceptance and growth of all the professions involved (Crafford, Kusrkar, Bronkhorst et al., 2023; Geese, Schmitt, 2023). Altogether, the employees themselves acquire and improve competencies, thus increasing their value and importance on the labor market. This trend is a result of the increasing requirements for both employees and organizations.

In regard to the health care units the competences of those organizations result from the people involved in the process, their skills and behaviors, in other words - their competencies. The achievements of such organizations, on top of the arrangements and actions that regulate them, come from the people and entities which are connected to the process, the competence they undependably and together have to possess, and the attitude they have to implement (individually and interactively) to employ the process – their competencies (Krawczyk-Sołtys, 2019; Parker et al., 2020). Their importance in the management of health care units is becoming more and more significant (Hein, Riegel, 2012) and is broadly highlighted in the literature on the subject (Liang et al., 2018; Leggat et al., 2011; Bartram et al., 2012; Clark, Armit, 2010; Richtie, Yen, 2013; Lewandowski, 2017).

The research results (Krawczyk-Sołtys, 2021, 2022) shows that extra operational resources provide important role during a pandemic in reference to an initial estimation and pilot function. This is possible to provide not only the emergency services but also the medical facilities in charge of providing further care (Breuer et al., 2020; Dahmen et al., 2021; Gibson et al., 2020).

The more specific abilities could be considered subdivisions of a ‘major competencies’ and are termed ‘supporting competencies’. Achievement of a major professional competencies requires the acquisition and demonstration of all supporting competencies related to that particular service or task. The presented models of personal competencies might be found useful to meet all actors’ needs such as: patients and their relatives, medical staff, health care units, and health care system.

As health care units function in constantly changing environment, some of the competencies are considered to be crucial in the terms of managing those changes. It can be stated that professional competencies as much as managerial ones can be key factor in managing change as well as in every day functioning of health care units. The medical staff practicing at competent level should be able to master tasks related to their specialty area and have the knowledge, skills and evidence-based knowledge to perform daily practices capably in changing clinical situations.

Health care practice on competent level should be theoretically well-grounded and autonomously well-planned and carried out. Competent medical staff is supposed to be encouraged to commit to the strategic goals and values of the health care organization. They should: share their professional expertise as part of a multi-professional team, committed to continuous reflection and improvement of their own professional competence, motivated to guide and to support co-workers and improve the processes of patient care (Meretoja, Lindfors, Kotila, 2019).

Set of personal competencies required in health care system should be patient-centered, focused on changes made simultaneously “top down” (through the regulatory context and infrastructure) and “bottom up” (through local pilot projects, like person-centered health management systems in large corporations, universities, and local communities).

Evaluating the performance by personal competencies becomes essential for managers and training centers, since it contributes to the identification of gaps in knowledge, skills and attitudes of professionals, by promoting the elaboration and implementation of strategies for their development (Soares, Leal, Rodrigues Resck, Pedreschi Chaves, Henriques, 2019).

There is a strong belief that effectiveness of health care units can be improved by team interventions, as a wide range of studies have shown a positive effect of team interventions on performance outcomes (e.g. communication, competence, skill, efficiency, effectiveness, innovation, satisfaction, well-being, knowledge, attitude and patient safety) within diverse healthcare setting (Buljac-Samardzic, Doekhie, van Wijngaarden, 2020).

Also supportive supervision is considered one of the best practices which includes collaborative reviews, observations, monitoring, constructive feedback, participation, problem-solving, and training and education (Brown, Kangovi, Wiggins, Alvarado, 2020).

The article highlights areas that need closer attention in the future therefore the further research will be conducted by the Authors. Therefore, it seems necessary to conduct empirical and literature research in this area, which will enrich scientific knowledge, rationalize the research methodology, as well as allow to formulate recommendations for practice.

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DETERMINANTS OF ENVIRONMENTAL TECHNOLOGY DEVELOPMENT IN TRANSITION REGIONS – CASE OF SILESIA REGION

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Purpose: The primary objective of this paper is to present the results of research conducted to identify factors influencing the development of environmental technologies in regions undergoing transformation.

Design/methodology/approach: To achieve the intended objectives, a study was designed which involved an initial identification of factors related to the development of environmental technologies. These factors were then structured and analyzed by a group of experts involved in the fair transformation process in the Silesian Voivodeship. The factors were categorized into four groups, which were evaluated by entities collaborating with the Specialized Observatory for Environmental Protection Technologies, followed by a ranking process. This resulted in the classification of factors into groups of significance, corresponding to their importance in the development of environmental technologies in transforming regions.

Findings: The main outcome of the analyses indicated that regional (specific) factors are significant for the development of environmental technologies but are not the key factors that would decisively influence this process. Instead, political-legal and economic factors were identified as key.

Research limitations/implications: The study's findings are primarily limited to one region - the Silesian Voivodeship. Therefore, it would be advisable to conduct comparative research in other mining regions, which would allow for the assessment of the same group of factors. Additionally, considering studies in regions where the transformation is not associated with mining but with other economic sectors would help to expand the list of specific factors and verify the other three groups.

Practical implications: The practical significance of the conducted research is linked to the design of legal and economic instruments for the development of environmental technologies. The study confirmed the crucial importance of these groups of factors. Furthermore, the results can be utilized by regional authorities in shaping development policies and fostering collaboration among local stakeholders.

Social implications: The research demonstrated that quality of life and social acceptance play a key role in the development of environmental technologies in transforming regions. This finding should serve as an impetus for planning informational and educational activities during the development and implementation of these solutions.

Originality/value: The article provides insights into factors crucial for planning the development of environmental technologies under the specific conditions created by the socio-economic transformation of a region.

Keywords: Environmental technologies, transforming region, development determinants.

Category of the paper: Research paper.

1. Introduction

Regions demonstrate diverse capabilities in terms of diversification and adaptation to change. This includes their proficiency in initiating new activities, particularly those pertaining to environmental protection and climate change adaptation. There exists significant variance among regions concerning their green specializations and the corresponding readiness to innovate and evolve new environmental technologies (Marra et al., 2017; Perruchas et al., 2019). Hence, comprehending the factors that promote green diversification and propel the development of environmental technologies, tailored to specific regional contexts, is of paramount importance. In light of the global challenges brought forth by climate change and environmental degradation, the concept of green growth has become a critical strategy for sustainable development, especially in regions experiencing transformation. The progression of environmental technologies is vital in these areas, forming the bedrock of socio-economic and environmental-spatial shifts. The Silesian Voivodeship, known as Europe's leading coal-producing region, is presently navigating the imperative of an energy transition, moving away from coal as its primary energy source. This shift is supported by current European policies (REPowerEU Plan, 2022; The European Green Deal, 2019), which intensify efforts towards green transformation (Morton, 2018).

The repercussions of mining and energy sectors on environmental degradation, combined with ongoing climatic changes, highlight the urgency for technological interventions to mitigate the adverse impacts of these activities. These interventions are designed not only for adaptation to changing environmental conditions but also for the revitalization of post-industrial zones for renewed socio-economic purposes. The deployment of environmental technologies is crucial in improving the life quality of the region's residents and in protecting the environment from further harm. However, the evolution of these technologies is intricate. While existing research primarily concentrates on the formal-legal and economic aspects (Hötte, 2020; Lv et al., 2021; Paramati et al., 2022; Söderholm, 2020; Vona, Patriarca, 2011; Zeng et al., 2020), additional studies emphasize the significance of social and environmental factors (Bilal et al., 2021; Feng et al., 2017; Knobloch, Mercure, 2016; Mäler, Vincent, 2003). Newly emerging determinants, especially in regions undergoing energy transformation, call for further investigation and analysis. This article aims to delineate the findings from the identification and assessment of key factors essential for the advancement of environmental technologies in a transforming region, as exemplified by the Silesian Voivodeship.

2. Development of environmental technologies in transition's regions

Green development has emerged as a pivotal force in the global economic restructuring and the enhancement of environmental governance. This phenomenon is extensively documented, as seen in the works of (Dutz, Sharma, 2012; Feng et al., 2017; Zhai et al., 2022), highlighting its growing influence. Governments worldwide are rigorously formulating and implementing astutely designed policy frameworks to shepherd the green economy.

In the context of the European Union, green growth is perceived as an economic progression that is either decoupled from resource utilisation or carbon-neutral in terms of CO₂ emissions. This concept, as elaborated by (Pichler et al., 2021; Vezzoni, 2023), presents a multitude of challenges to member states, spanning sectors such as energy, transport, construction, agriculture, and others. The crux of executing the objectives of the Green Deal lies in innovations, particularly eco-innovations and new technologies (Pichlak, 2017; Sarkar, 2013). These eco-innovations and technological advancements are poised to be sustainable solutions for maintaining competitive advantage and for the genesis of novel, innovative value chains (Szilagyí et al., 2018).

The planned and executed policy of green growth is set to transfigure the economies of numerous regions, especially those traditionally reliant on fossil fuels as their primary energy source. The scholarly literature is replete with instances demonstrating how environmental technologies can emerge in the wake of innovative activities and the amalgamation of environmentally friendly solutions with existing industrial technologies (Van Den Bergh, 2008; Zeppini, Van Den Bergh, 2011). This explains the higher degree of complexity and efficiency characterising technological solutions in regions dominated by traditional industry (Perruchas et al., 2019)). However, without governmental support and societal consensus, developing a green economy in these regions would be unattainable, as transformation is a challenging and often contested process. The economic profile shift, including the integration of ecological solutions in traditionally industrial regions, encounters significant barriers (Droste et al., 2016; Lindberg et al., 2019). However, without the support of authorities and social consensus, the development of a green economy in regions would not be feasible, as transformation is a challenging and frequently contested process. Economic profile alteration (Morton, 2018), including the integration of ecological solutions into the mainstream, encounters significant barriers in regions reliant on traditional industry.

Silesia, as Poland's coal mining hub, exemplifies a region where the transformative process is intensifying (TPSL WSL, 2022). The region's economy is undergoing a series of sanctioned changes as part of Silesia's development strategy. The focus on innovative development, including the selection of the green economy as one of the smart specialisations (Model RSI, 2018; RSI, 2013), has led to targeted and dynamic actions in the development of environmental technologies. The pivotal areas for the green economy in Silesia include renewable energy,

clean technologies, energy-efficient construction, public transport, waste management and recycling, sustainable land, water, and forest use, and (RSI, 2013, 2021). The green economy entails resource management, the utilization of economic instruments that favour environmental protection, support for innovative projects, more efficient water and waste management policies, and efforts towards sustainable consumption and production. Furthermore, given that energy (including renewable energy) is one of the smart specialisations, it has been decided that the green economy in Silesia will encompass green products and services, green investments, green economic sectors, green public procurement, green jobs, as well as the aforementioned technological areas (RSI, 2021).

The green economy in the Silesian Voivodeship comprises over 51,000 entities, according to REGON data (as of the end of June 2020), and more than half of them are thematically related, accredited, and active research laboratories (RSI, 2021). There is considerable potential in the Silesian Voivodeship for activities related to the green economy, including a significant potential for the location of photovoltaic farms, which can serve as a means of redeveloping parts of post-mining areas. Moreover, the region is also a leader in the production of components for PV modules in Poland (Zielone Śląskie, 2020). The robust industrial character of the economy in the Silesian Voivodeship means that the region is a place where new material solutions are developed and implemented, embodying the concept of a circular economy (Pichlak, Kruczek, 2017).

The development of technology, particularly environmental technology, regardless of the region, will be influenced by a variety of diverse factors, each with its unique characteristics and classifiable on multiple criteria. These factors can be external, arising from operating within a specific political, legal, economic, social, environmental, or technological environment, as well as internal (Bonds, Downey, 2012; Cao, Wang, 2017; Wasiq et al., 2023; Yue et al., 2021; Zeng et al., 2022), emanating from the specificities of the sector or region concerned, or even from individual enterprises (Ben Arfi et al., 2018; Chen, Liang, 2023). The development of environmental technologies in transitioning regions is an especially complex process, necessitating support at various levels: political, financial, technological, and social. In the case of transitioning regions, both external and internal factors need to be considered. The impact of these external and internal factors on the development of environmental technologies is variable, and the interdependencies between them may differ depending on the environmental dimension the technology addresses. With this in mind, an attempt was made to identify and then verify and evaluate the factors determining the development of environmental technologies in a transitioning region, formulating the hypothesis that: There are specific regional factors influencing the development of environmental technologies in regions undergoing transformation.

3. Methods

Research related to the identification and evaluation of the impact of various groups of factors on the development of environmental technologies in a region undergoing transformation was conducted in 2022. The study consisted of the following stages:

- A critical review of the literature, which resulted in the identification and systematization of factors conditioning the development of technologies. The outcome of this stage was a list of 61 factors divided into 5 groups (table 1);
- Verification of the developed list of factors through in-depth interviews;
- Development of an updated list of factors and its organization according to expert recommendations – the list after verification comprised 43 factors organized into four groups (political-legal, economic, social, regional) – table 2;
- Assessment of the significance of factors for the development of environmental technologies in the Silesian Voivodeship using the method of relative importance of objects;
- Identification of key factors for the development of environmental technologies.

Table 1.

Groups of factors identified from the literature review and their numbers

Group of factors	Number of factors in the group
environment	15
technical and technological	16
economic	11
legal	15
social	4

Source: own elaboration.

Table 2.

Factors breakdown after verification in the IDI

Group of factors	Number of factors in the group
politico-legal	11
economic	12
social	6
regional (specific)	14

Source: own elaboration.

For the study, two research tools were developed – an interview form used during conversations with experts and a survey questionnaire, employed to assess the significance of factors influencing the development of environmental technologies.

The verification of the preliminary list of factors, based on a critical literature review, was conducted through interviews with 7 experts engaged in the development of the Territorial Just Transition Plan for the Silesian Voivodeship up to 2030. The experts recommended changes in the grouping of factors, including the introduction of a group of regional factors reflecting the specifics of a region in transformation and the nomenclature of the factors.

The distinction of regional factors emphasizes the significant impact of the transformation process on mining regions and the possibility of phenomena that are not observed in other regions. The revised list of factors was finalized by the experts.

Subsequently, a survey questionnaire was prepared, asking respondents to assess the importance of individual factors for the development of environmental technologies in the region. This verified tool, in electronic form, was distributed to companies generating and implementing environmental technologies in the Silesian Voivodeship. The selection of companies was purposeful, based on the database of the existing regional Observatory for Environmental Technologies, listing 412 participants in the innovation ecosystem of the Silesian Voivodeship, engaged in activities related to the development of environmental technologies. Surveys were sent to all entities in the database, with responses received from 116 entities, of which 102 were complete. The rationale for such a selection of respondents was a critical analysis of the Silesian Voivodeship's development documents, where technological areas forming the basis of regional smart specialization and directions of just transition (TPSL WSL, 2022) were identified. Additionally, the resolutions adopted in the regional strategy (Zielone Śląskie, 2020) indicate that environmental technologies constitute a significant component of the development of a transforming region.

The collected results were subjected to scoring assessment with elements of statistical analysis. In this approach, based on the assessments of the importance of factors made by the respondents and the weights of criteria recommended by experts, it is possible to identify a set of factors with varying levels of significance¹.

4. Results and discussion

To conduct the hierarchization of factors influencing the development of environmental technologies in a region undergoing transformation, weights were assigned to the criteria for evaluating factors based on the extent to which they condition this development. Experts who conducted the verification of factors identified the following weights by consensus depending on the assessment of the factors:

- for a high level of significance - 60%,
- for a medium level of significance - 30%,
- for a low level of significance - 10%.

¹ Mathematical methods for assessing, ranking and selecting technologies.

The assessment of each factor was determined based on the collected data as follows:

$$S_i = 60\% \text{ Hr} + 30\% \text{ Mr} + 10\% \text{ Lr} \quad (1)$$

where:

S - score,

Hr - number of times the factor was identified as highly significant,

Mr - number of times the factor was identified as moderately significant,

Lr - number of times the factor was identified as not very significant.

The relevance of a factor in a given group of factors was then determined (i.e. one of political-legal, economic, social, regional):

$$\text{RSg} = \frac{S_i}{\sum_{i=1}^m S_i} \quad (2)$$

where:

RSg - relative score,

m - number of factors in the group.

and relevance of the factor considering all groups:

$$\text{RSt} = \frac{S_i}{\sum_{i=1}^n S_i} \quad (3)$$

where:

RSt - total relative score.

n - number of factors (n = 43).

In this way, the significance of the factors relative to the group and across the study was established. The results are summarised in table 3.

Table 3.

Assessment of the determinants of environmental technology development for a region in transition

Factor	Factor code	Hr	Mr	Lr	S	RSg	RSt
Political and legal factors							
Political situation	P1	84	12	6	54,6	0,1	0,026
Environmental and climate policy	P2	102	0	0	61,2	0,112	0,029
Supporting competitiveness and internationalization of enterprises	P3	60	30	12	46,2	0,085	0,022
Protection of industrial property and regulations related to commercialization	P4	15	57	30	29,1	0,053	0,014
Revitalization policy	P5	42	27	33	36,6	0,067	0,018
Efficiency of public administration operations	P6	69	9	24	46,5	0,085	0,022
Tax policy	P7	102	0	0	61,2	0,112	0,029
Environmental standards	P8	102	0	0	61,2	0,112	0,029
Regulations on conducting business activities	P9	12	57	33	27,6	0,051	0,013
Cooperation between R&D sector and enterprises	P10	96	6	0	59,4	0,109	0,029
Energy security	P11	102	0	0	61,2	0,112	0,029

Cont. table 3.

Economic factors							
Level of investment in new technologies	E1	102	0	0	61,2	0,103	0,029
Expenditure on R&D (Research and Development)	E2	102	0	0	61,2	0,103	0,029
Digital transformation	E3	45	33	24	39,3	0,066	0,019
Sectoral structure of the economy	E4	18	45	39	28,2	0,047	0,014
Availability of investment lands	E5	54	21	27	41,4	0,07	0,020
Credit and grant facilities	E6	90	0	12	55,2	0,093	0,027
Utilization of secondary raw materials	E7	90	3	9	55,8	0,094	0,027
Level of foreign investments	E8	63	0	39	41,7	0,07	0,020
Basic macroeconomic indicators (GDP, inflation, unemployment)	E9	93	0	9	56,7	0,095	0,027
Availability of grant funds (EU funds)	E10	81	0	21	50,7	0,085	0,024
Intensity of competitive struggle	E11	60	12	30	42,6	0,072	0,021
Prices of fuels and energy, raw materials, and land	E12	102	0	0	61,2	0,103	0,029
Social factors							
Ecological awareness	S1	60	3	39	40,8	0,139	0,02
Social acceptance in the context of implementing modern and innovative technologies	S2	96	0	6	58,2	0,199	0,028
Availability of human resources with desired qualifications	S3	81	0	21	50,7	0,173	0,024
Quality of life	S4	84	15	3	55,2	0,188	0,027
Development of staffing potential in entities within the higher education and science system in terms of creating innovative solutions	S5	87	3	12	54,3	0,185	0,026
Creation of new jobs places	S6	45	6	51	33,9	0,116	0,016
Regional (specific) factors							
Development strategies for mining municipalities	R1	93	0	9	56,7	0,088	0,027
The level of the region's dependence on the mining sector	R2	75	6	21	48,9	0,076	0,024
The amount of post-industrial land, including post-mining and degraded areas	R3	48	12	42	36,6	0,057	0,018
The level of reclamation and development of degraded and undeveloped post-industrial areas	R4	27	45	30	32,7	0,051	0,016
The demand for the use of waste materials from coal mining	R5	99	0	3	59,7	0,093	0,029
Educational profiles in mining regions	R6	63	15	24	44,7	0,07	0,022
Professional activity of workers in the mining and energy sectors	R7	69	6	27	45,9	0,072	0,022
Operation of companies associated with mining	R8	42	9	51	33	0,051	0,016
Investment attractiveness of post-mining regions	R9	81	0	21	50,7	0,079	0,024
Costs of developing land after the cessation of mining operations	R10	63	24	15	46,5	0,072	0,022
Seismic threats	R11	21	27	54	26,1	0,041	0,013
Scientific achievements and research and development potential of the region	R12	87	0	15	53,7	0,084	0,026
Influence of neighbour regions	R13	72	3	27	46,8	0,073	0,023
Investment activity in the region / investments in the region	R14	99	0	3	59,7	0,093	0,029

Source: own elaboration.

The process of identifying the determinants of environmental technology development in the transition region is finalized by ranking them according to their level of importance. To this end, a procedure was carried out to create a separable series, guided by the total relative scores (Rst) obtained. The following statistical guidelines were followed:

- the number of class intervals was calculated as the square root of the number of observations,
- the range of variation of the parameter under study was calculated from the formula:
 $\Delta x = x_{\max} - x_{\min}$,
- the optimal width of the class interval was calculated using the formula: $i = \Delta X / k$

The results obtained, together with the assignment of factors, are summarized in Table 4.

Table 4.

Importance of factors

Compartments	Numbers	Evaluation	Factors
<0.013-0.016>	7	redundant	P9; R11; P4; E4; S6; R4; R8
(0.016-0.018>	2	unimportant	P5; R3
(0.018-0.021>	5	relevant	E3; E5; E8; S1; E11
(0.021-0.024>	10	important	P3; P6; R6; R7; R10; R13 ; E10; S3; R2; R9
(0.024-0.027>	3	very important	P1; S5; R12
(0.027-0.029>	16	key	E6; E7; E9; S4; R1 ; S2; P2; P7; P8; P10; P11; E1; E2; E12; R5; R14

Source: own elaboration.

The analysis of factors within each group indicates that political and legal factors are key to the development of environmental technologies in transformation areas. This is primarily due to these factors being associated with national and international policies on environmental and climate protection, which have gained significance in recent years. These policies now form the basis of the transformation process, mandating regions and enterprises to take actions for environmental protection and climate change adaptation. Policies related to research and development, emphasizing collaboration between R&D sector and businesses, and the introduction of standards for sustainable investments support this process. Notably, the importance of energy security for the development of environmental technologies is highlighted, signalling that transformation processes, though critical, should not disrupt this vital aspect.

Among the economic factors influencing the development and implementation of environmental technologies in transforming regions, investment levels in new technologies, R&D expenditure, and the prices of fuels, raw materials, and land are deemed most significant. These factors are linked to political and legal factors, clearly indicating the investment needs of respondents in new environmental technologies, whose development is not feasible without increased expenditure on generation and implementation. Particularly for SMEs, financial resources for developing environmental technologies are often insufficient, and their actions are dictated by the need to comply with changing legal conditions. However, with the provision of economic financing instruments for investments in environmental technologies, including research, the expected outcome would be increased activities in this area.

Social factors critical for the development of environmental technologies include social acceptance and quality of life. Society expects new environmental technologies to primarily improve living conditions in health, wellbeing, and economic aspects. Unfortunately, these

technologies are often perceived as contributors to job reduction and the closure of production plants, especially in regions dominated by traditional industries. Therefore, building ecological awareness and ensuring conditions for new professions are key.

Regional factors, specific to the mining region of Silesia, are not considered key by respondents but are important forces influencing the development of environmental technologies. Noteworthy are factors related to investment activity in the region and the potential use of mining waste. Investment activity is one of the biggest challenges for transforming regions, as a change in economic profile, such as moving away from coal, may determine innovative activity. Particular attention should be paid to the challenges faced by the Silesian Voivodeship, which is undergoing a transformation process, intending to carry out a "green transformation" where environmental technologies will be one of the pillars of the region's modern economy. Environmental technologies not only enable the elimination or reduction of environmental damage but also the repair of existing damage and, in line with the circular economy, the use of what was previously seen as waste as a secondary raw material. This factor is a premise for finding new applications for mining waste. In the transformation process, a special role is assigned to mining municipalities, whose strategies should also support the development of environmental technologies. Usually, this support is indirect, linked to achieving goals related to reducing low emissions, improving waste and sewage sludge management, and preserving the environment and biodiversity.

The conducted research on the determinants of environmental technology development in regions undergoing transformation showed that mainly political-legal and economic factors are important for this process. Regional factors are significant for the development of environmental technologies but are not key, and therefore do not conclusively determine whether these technologies will be developed.

5. Summary

This study, investigates the factors influencing the growth of environmental technologies in areas undergoing socio-economic change, with a focus on the Silesian Voivodeship. Known for its heavy industrialization, especially in mining, this region is now transitioning towards sustainable practices. The research methodology involved identifying various factors potentially impacting environmental technology development, followed by expert analysis and categorization. These factors were then ranked for their influence on technology development.

Key findings indicate that while regional factors are significant, political-legal and economic factors play a more decisive role. Supportive policies, legal frameworks, and economic incentives are essential for fostering environmental technology development and adoption. The study highlights the need for comprehensive approaches that encompass political,

economic, and social dimensions for effective environmental technology development. It emphasizes the importance of designing legal and economic tools that facilitate this development and encourages regional authorities to use these findings for policy-making and fostering local stakeholder collaboration.

The research also acknowledges its geographical limitation to the Silesian Voivodeship and suggests expanding to other mining regions and sectors for broader insights. Additionally, it underscores the role of social factors such as quality of life and social acceptance in environmental technology implementation. The paper offers valuable insights into the factors crucial for planning the development of environmental technologies, particularly in regions experiencing socio-economic transformation. A multifaceted approach considering political, economic, and social dimensions is needed to effectively support the transition to environmentally sustainable technologies.

Acknowledgements

The study was carried out in the Department of Water Protection of the Central Mining Institute in Katowice, within the framework of the statutory work of the Ministry of Science and Higher Education (Statutory Activity of the Central Mining Institute in Katowice, Poland. Work no. 11133012-340).

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THE ROLE OF EMPLOYEE SKILLS AND THE APPLICATION OF ICT TOOLS IN THE CONTEXT OF DEVELOPING EMPLOYEE AGILITY

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Purpose: The article aims to investigate and understand the impact of key employee skills and ICT tools on the organizational agility of companies. It seeks to explore how individual characteristics and competencies of employees, combined with technology, shape an organization's ability to adapt in a dynamically changing environment.

Design/methodology/approach: The study employed a survey-based approach, collecting data from 930 respondents using the CAWI technique. It focused on analyzing the impact of employee skills and ICT tools on organizational agility.

Findings: The research revealed a strong correlation between employee skills in project management and organizational agility. It emphasized the significance of integrating technical skills with soft skills for enhancing agility.

Research limitations/implications: The study's limitations include its reliance on a survey method, potential non-representativeness of the sample across all sectors, and focus mainly on employee skills and ICT tools.

Practical implications: The findings suggest that organizations should invest in both ICT tools and employee skills development, particularly in areas of project management, to enhance organizational agility.

Social implications: The research highlights the importance of developing employee skills and using ICT tools in response to dynamic market changes, impacting the way organizations manage and adapt to change.

Originality/value: This study contributes new insights into the relationship between employee skills, ICT tools, and organizational agility, offering a comprehensive analysis of how these elements interact in a modern business context.

Keywords: employee agility, ICT tools, employee skills, organization, management.

Category of the paper: research paper.

1. Introduction

In today's complex and dynamic business environment, an organization's ability to quickly adapt to changing conditions is key. Organizational agility, as a response to these challenges, has become the foundation of modern management. This article examines the role of employee skills and ICT tools in the context of developing employee agility. By combining theory with practical observations, it is shown how organizations can effectively develop agility, becoming more competitive and innovative in current times.

The subject of the study is the analysis of organizational agility in the context of employee skills and the use of ICT tools. The study focuses on identifying key factors influencing an organization's ability to respond to changes, taking into account the role of technology and individual employee competencies.

The article aims to investigate and understand the impact of key employee skills and ICT tools on the organizational agility of companies. It seeks to explore how individual characteristics and competencies of employees, combined with technology, shape an organization's ability to adapt in a dynamically changing environment.

A hypothesis has been formulated that there is a strong correlation between key employee skills and the use of ICT tools and the organizational agility of companies. Organizations that invest in the development of their employees' competencies and effectively implement modern ICT tools have a greater ability to adapt in the face of environmental variability.

The article emphasizes the importance of organizational agility as a key element that allows organizations to effectively adapt to dynamically changing business conditions. It was observed that different technologies affect agility in different ways, although the overall trend points to the ever-increasing role of technology in shaping business practices. A key conclusion is also that optimal organizational agility is achieved by combining technical skills with employees' soft skills.

The article provides important guidelines for organizations aiming to increase their agility, highlighting the role of appropriate employee skills and the proper use of ICT technology. A new piece of knowledge is the revelation of a specific correlation between project management skills and agility, emphasizing the importance of these competencies in an organizational context. Moreover, the analysis points to the key role of personal traits in shaping agility, expanding the current understanding of this concept.

2. Literature Review

2.1. The essence and importance of organizational agility

Organizational agility refers to an organization's ability to quickly adapt to external and internal changing conditions while maintaining effectiveness and operational efficiency. This is a key element in today's dynamic business environment, where volatility, uncertainty, complexity, and ambiguity (known as VUCA) have become the norm. Agile organizations are better able to respond to changing customer needs, leverage new technologies, adapt to changing market regulations, and anticipate and respond to competitive threats. Agility allows organizations not only to survive but also to thrive in uncertain times, becoming more competitive and innovative (Skyrius, Valentukevič, 2020).

Organizational agility, being the key to success in today's complex business environment, is often seen as the most important pillar of modern management (Auerbach Publications, 2021; Varghese, Bini, 2019). Contemporary organizations face the challenge of not only quickly adapting to changes but also anticipating those changes and shaping the future. In this context, agility becomes not just a reactive response to change but also a proactive strategy that allows organizations to shape their environment (Akkaya, 2021; Sherehiy, Karwowski, 2017; Kt, Sivasubramanian, 2023).

Technology plays a crucial role in enhancing organizational agility. Information systems, cloud computing, and artificial intelligence enable organizations to respond faster to changes, automate processes, and tailor offerings to individual customer needs (Kumkale, 2022). However, agility is not just about processes or tools, but primarily about organizational culture. Agile organizations promote a culture of openness, collaboration, and continuous learning (Akkaya, 2021).

Despite many benefits, organizational agility is not without challenges. It requires continuous adaptation, investment in employee training, and changes in organizational culture (Sajdak, 2021). Moreover, an excessive focus on agility can lead to a lack of stability and certainty in organizational actions (Kumkale, 2022). It can be stated that organizational agility has a direct impact on improving organizational outcomes (Nafei, 2016). As market competition becomes increasingly fierce, companies must be able to quickly adapt to changing conditions to maintain their market position and achieve success. One of the key factors influencing organizational agility is the ability for business analysis and the use of information technology (Piecuch, 2021). In the era of digital transformation, the ability to collect, analyze, and interpret data has become a key element of organizational agility (Dudek, 2019). Organizations that invest in business analytics and business intelligence can better understand their business environment, predict market trends, and make informed strategic decisions (Chen, Siau, 2020).

Not only technology but also an organization's internal processes influence its agility. Process optimization, elimination of unnecessary stages, and increased efficiency can lead to a significant improvement in organizational outcomes. Modern approaches to process management focus not only on efficiency but also on flexibility and the ability to quickly adapt to changing conditions (Blickle, Heß, 2006).

In the context of globalization and increasing competition in international markets, organizational agility becomes the key to achieving a competitive advantage. Organizations that can quickly adapt to changing conditions are more likely to succeed in the long run.

2.2. Key employee skills and their impact on organizational agility

Organizational agility is the key to success in today's dynamic business environment (Dyba, 2020; Anthonius, 2021; Brown, Owens, Bradley, 2011). For organizations to achieve the desired agility, it is essential to have employees equipped with the right skills (Matuszczyk, Okólski, 2023). Studies indicate that certain key employee skills have a direct impact on an organization's ability to quickly adapt to changing conditions (Prieto, Talukder, 2023; Meera Jyothirmal et al., 2022).

Among these key skills are the abilities to manage a project, be a leader, achieve set goals within a designated time and budget, handle multiple projects simultaneously, and manage a project team (Maulana, 2021). These skills are essential for employees at various levels of the organization, from project managers to team leaders (Auerbach Publications, 2021; Davies, 2013; Stuart, Huzzard, 2017; OECD, 2021).

Project management and the ability to achieve set goals within a designated time and budget are crucial to ensure that projects are carried out efficiently and cost-effectively. Being a leader and managing a project team are essential for effectively directing teams and ensuring that all employees are working towards common goals (Kumkale, 2022). Handling multiple projects simultaneously requires multitasking and priority management skills, which are key in a rapidly changing business environment (Ramadhana, 2021; OECD & International Labour Organization, 2023; IEDP Ideas for Leaders, 2013). These skills, combined with other key competencies such as communication, problem-solving ability, and adaptability, are essential for achieving organizational agility.

2.3. The importance of personal traits of employees in the context of organizational agility

Employees' personal traits play a crucial role in shaping organizational agility. Individual characteristics, such as organizational intelligence, have a direct impact on an organization's ability to quickly adapt to changing conditions (Rahimi, Mansouri, 2019). In the context of a crisis, employees' perceptions of the organization's strategic agility can influence their work engagement and well-being. Organizations that promote and support the development of employees' personal traits, such as adaptability, creativity, and teamwork ability, can gain a competitive edge in a dynamic business environment (Ludviga, Kalvina, 2023). Additionally, empowering employees to act and make decisions can lead to increased organizational competitiveness and agility. Supporting employees in developing their individual competencies and skills can contribute to enhancing organizational intelligence, which in turn affects the organization's ability to rapidly respond to changing market conditions (Seifollahi, Shirazian, 2021).

Thus, employees' personal traits are an integral part of organizational agility, and investing in the development of these traits can benefit both the employees and the entire organization (Skyrius, Valentukevič, 2021). Employees' personal traits, such as values and attitudes, can influence their job satisfaction and sales performance, which consequently impacts the overall efficiency of the organization (İlhan, Erolu, Toygur Eroğlu, 2023). These values, combined with the right personal traits, can influence how employees perceive and respond to organizational policies, which can affect their overall work performance (Zagazig City Study, 2020).

In an international business context, organizational innovations play a key role in achieving success (Varghese, Bini, 2019). Employees' personal traits, such as their values and attitudes, can influence an organization's ability to innovate, which in turn affects its international performance (Prange, Pinho, 2017). Therefore, employees' personal traits have a significant impact on an organization's ability to adapt to changing conditions and achieve organizational agility.

2.4. The role of ICT tools in shaping organizational agility

Information and Communication Technology (ICT) tools play a crucial role in shaping organizational agility (Kt, Sivasubramanian, 2023). Modern organizations increasingly rely on ICT technologies to enhance their ability to quickly adapt to changing market conditions and customer needs (Collins, 2013).

Collaborative ICT tools, such as project management systems, communication platforms, and real-time collaboration tools, enable employees to communicate and coordinate actions effectively, leading to greater organizational agility (Collins, 2013). With these tools, teams can work together regardless of location, which is especially important in globally developed organizations (Stroiska, Trippner-Hrabi, 2016). Mobile ICT tools, like apps and mobile platforms, allow employees to access organizational information and resources anytime and anywhere, enhancing their ability to swiftly respond to changing market needs (Routledge, 2020). ICT tools enable greater agility in responding to customer needs and adapting to dynamic market conditions (Palgrave Macmillan, 2013).

Modern digital tools not only facilitate communication and coordination within organizations but also contribute to creating a culture of continuous learning and adaptation (Skrzypek, 2017). In this context, tools for gathering employee feedback during organizational changes become extremely important (Sherehiy, Karwowski, 2017). They allow organizations to collect real-time feedback, enabling faster adaptation to the needs and expectations of employees (Sedej, Justinek, 2021).

Digital libraries, being one of the key ICT tools, have undergone an evolution that has impacted how organizations gather, store, and share information. They support organizations in knowledge management and provide employees access to key resources, leading to a greater ability for innovation and adaptation (Candela, Castelli, Pagano, 2011).

New trends in Customer Relationship Management (CRM) also leverage digital tools to better understand customer needs and adapt to them (Nazempour, Yang, Waheed, 2019). Modern CRM tools enable organizations to collect real-time customer data, analyze this data, and tailor offerings to individual customer needs, leading to greater organizational agility (Lima, Pacheco, 2021).

3. Empirical Study Results

3.1. Research Methodology

The subject of the study is the analysis of organizational agility in the context of employee skills and the use of ICT tools. The study focuses on identifying key factors influencing an organization's ability to respond to changes, taking into account the role of technology and individual employee competencies.

The article aims to investigate and understand the impact of key employee skills and ICT tools on the organizational agility of companies. It seeks to explore how individual characteristics and competencies of employees, combined with technology, shape an organization's ability to adapt in a dynamically changing environment.

A hypothesis was formulated that there is a strong correlation between key employee skills and the use of ICT tools and the organizational agility of companies. Organizations that invest in the development of their employees' competencies and effectively implement modern ICT tools have a greater ability to adapt in the face of environmental variability.

The research methodology was based on a survey approach. To accurately verify the presented issues, empirical studies were conducted at the turn of February and March 2022. A survey questionnaire was used for the research, which was completed by 930 respondents, following the CAWI technique standards. The choice of the survey method allowed for the collection of detailed data from a large group of participants in a relatively short time. The results obtained from the survey questionnaire provided valuable information on the perceptions and assessments of respondents in the scope of the discussed issues. The survey was designed to thoroughly investigate key areas related to organizational agility, employee competencies, and the application of ICT technology in the context of the researched issue.

Table 1 presents the sociodemographic data of respondents who participated in the survey. The data analysis covered four main categories: gender, age, position held, and company size. In the gender category, the majority of respondents were women, representing 61.7% of the sample, while men constituted 38.3%. In terms of age, the largest group was respondents under 25 years old, accounting for 66.1% of the sample. People aged 26-35 years constituted 18.1%, in the age range 36-45 years - 11.2%, and those over 45 years - 4.6%.

Regarding the position held, the majority of respondents were employees, accounting for 69.2% of those surveyed. Lower-level management constituted 14.1%, middle-level management 10.9%, and top management 5.8%. In relation to the size of the company in which the respondents work, the largest group were people working in large enterprises (over 250 employees), accounting for 39.0% of the sample. Micro-enterprises (less than 10 employees) and small enterprises (10-50 employees) were represented by 21.3% and 21.6% of respondents, respectively. Medium-sized enterprises (50-250 employees) accounted for 18.1% of those surveyed.

In terms of the sector of operation, the largest group (33.66%) comes from the transport, communication, utilities, housing, and trade sector. The finance, insurance, marketing, advertising, and real estate sector constitutes 31.94%, while the health, social care, education, scientific research, tourism and recreation, state administration, judiciary, police, and military sector represents 23.23%. Regarding the company's operational duration, the vast majority (68.06%) represents companies that have been in operation for over 8 years. Companies with experience ranging from 4 to 7 years account for 18.17%, and from 1 to 3 years - 10.75%. In relation to the type of business conducted, service-providing companies dominate (53.52%). Trade represents 29.55%, and production 16.92%. The survey allowed for multiple answers in this category. In terms of the geographical scope of company operations, international activity prevails (44.8%). National-scale activity represents 30.4% of companies, local activity 15.8%, and regional activity 8.9%.

Table 1.
Sociodemographic data of the respondents

1. Gender	N	%
Woman	574	61.7%
Man	356	38.3%
Total	930	100.0%
2. Age	n	%
Below 25 years	615	66.1%
26-35 years	168	18.1%
36-45 years	104	11.2%
Above 45 years	43	4.6%
Total	930	100.0%
3. Position held	n	%
Top management	54	5.8%
Middle-level management	101	10.9%
Low-level management	131	14.1%
Employee	644	69.2%
Total	930	100.0%
4. Company size	n	%
Micro-enterprise (less than 10 employees)	198	21.3%
Small enterprise (10-50 employees)	201	21.6%
Medium enterprise (50-250 employees)	168	18.1%
Large enterprise (more than 250 employees)	363	39.0%
Total	930	100.0%
5. Sector of operation		
Sector 1 – agriculture, forestry, fisheries	32	3.44%
Sector 2 – mining, manufacturing, and construction	72	7.74%
Sector 3 – transport, communication, municipal and housing services, and trade	313	33.66%
Sector 4 – finance, insurance, marketing and advertising, and real estate transactions	297	31.94%
Sector 5 – healthcare, social care, education, scientific research, tourism and recreation, public administration, judiciary, police, and military	216	23.23%
Total	930	100.00%
6. Duration of company's operation:		
Below 1 year	28	3.01%
From 1 to 3 years	100	10.75%
From 4 to 7 years	169	18.17%
More than 8 years	633	68.06%
Total	930	100.00%
7. Type of business conducted		
Production	197	16.92%
Trade	344	29.55%
Services	623	53.52%
Total	1164*	100.00%
8. Geographical scope of the company's operation		
Local	147	15.8%
Regional	83	8.9%
National	283	30.4%
International	417	44.8%
Total	930	100.0%

* - possibility to provide more than 1 answer.

Source: own elaboration based on conducted research.

3.2. Presentation of Research Findings

During the study, an effort was made to assess the competencies of the surveyed employees in using ICT tools. Table 2 presents the assessment of respondents' competencies in using information and communication technologies (ICT) on a scale from 1 to 5, where 1 indicates the lowest level of competency, and 5 the highest.

The majority of respondents (405) rated their competencies at level 4. Another significant group (275) admitted to having skills at level 3. 182 respondents assessed their competencies at the highest, fifth level. Meanwhile, 56 respondents admitted to having skills at level 2, and the smallest group, consisting of 12 people, rated their competencies at the lowest, first level.

Table 2.

Employees' competencies in using information and communication technologies (ICT)

Scale 1-5	Number of respondents
1	12
2	56
3	275
4	405
5	182

Source: own elaboration based on conducted research.

Further verification focused on the ability to adapt to rapidly occurring changes, on a scale of 1 to 5. Table 3 presents the assessment of respondents' skills in adapting to rapidly occurring changes. The ratings were presented on a scale from 1 to 5, where 1 indicates a lack of ability to adapt to changes, and 5 indicates a high level of adaptation to dynamic changes.

The majority of respondents (461) rated their adaptive skills at level 4. Another large group (294) believed they possess a high ability to adapt to rapid changes, rating themselves at level 5. 160 respondents assessed their skills at the average level of 3. A smaller number of respondents admitted to a lower level of adaptive skills, with 13 rating themselves at level 2 and only 2 individuals admitting to the lowest level of adaptation, rating themselves at level 1.

Table 3.

Skills to adapt to rapidly occurring changes

Scale 1-5	Number of respondents
1	2
2	13
3	160
4	461
5	294

Source: own elaboration based on conducted research.

An important feature of the study was the distinction of skills, attributes, and personality traits, which are also indicators of agility. Table 4 presents the assessment of agile employees' skills in various aspects of project management. Respondents evaluated their skills in the scope of individual competencies, choosing one of the five available answers: "Definitely NO", "Rather NO", "No opinion", "Rather YES", and "Definitely YES".

In the "Manage a project" category, the largest group of respondents (549) answered "Rather YES", while 163 people rated themselves as "Definitely YES". Meanwhile, 135 respondents had no opinion on the matter, 69 answered "Rather NO", and 14 "Definitely NO".

In the aspect of being a leader, 480 respondents answered "Rather YES", and 217 "Definitely YES". 124 people had no opinion, 91 answered "Rather NO", and 18 "Definitely NO".

Regarding achieving set goals within the stipulated time, 528 respondents answered "Rather YES", and 310 "Definitely YES". 66 people had no opinion, 20 answered "Rather NO", and 6 "Definitely NO".

In the category of achieving goals within the set budget, 531 respondents rated themselves as "Rather YES", and 218 as "Definitely YES". 144 people had no opinion, 32 answered "Rather NO", and 5 "Definitely NO".

In relation to managing multiple projects simultaneously, 442 respondents rated themselves as "Rather YES", and 187 as "Definitely YES". 176 people had no opinion, 96 answered "Rather NO", and 29 "Definitely NO".

In the category of managing a project team, 441 respondents answered "Rather YES", and 176 "Definitely YES". 200 people had no opinion, 87 answered "Rather NO", and 26 "Definitely NO".

Table 4.

Agile skills of employees

	Definitely NO	Rather NOT	No opinion	Rather YES	Definitely YES
Manage the project	14	69	135	549	163
Be a leader	18	91	124	480	217
Achieve set goals within the designated time	6	20	66	528	310
Achieve set goals within the allocated budget	5	32	144	531	218
Execute multiple projects simultaneously	29	96	176	442	187
Manage the project team	26	87	200	441	176

Source: own elaboration based on conducted research.

Subsequently, areas were identified in which applied ICT technologies support and develop organizational agility. Table 5 presents the areas of application of information and telecommunication technology (ICT) that support organizational agility. For each area, the number of respondents who considered the given area significant in the context of supporting agility, as well as the percentage share of these answers in relation to all responses, was provided.

The majority of respondents (614, accounting for 12.1% of all responses) identified "Communication" as a key area of ICT application supporting organizational agility. Other large groups of respondents indicated "Group work" (602 responses, 11.8%) and "Remote work" (530 responses, 10.4%) as significant application areas.

Other areas highlighted by respondents include "Decision-making" (496 responses, 9.7%), "Project management" (459 responses, 9.0%), "EDI – electronic document flow" (381 responses, 7.5%), "CRM – customer relationship management" (357 responses, 7.0%), "E-commerce" and "E-business" (respectively 333 and 330 responses, both at 6.5%).

Fewer respondents pointed to areas such as "Business process virtualization" (260 responses, 5.1%), "SCM – supply chain management" (244 responses, 4.8%), "Networking" (238 responses, 4.7%), "B2B or B2C" (198 responses, 3.9%), and "Other" (50 responses, 1.0%).

Table 5.

Areas of application of information and communication technology (ICT) supporting organizational agility

Areas of application of ITC	N*	%
Teamwork	602	11.8%
Decision-making	496	9.7%
Project management	459	9.0%
EDI – electronic document flow	381	7.5%
B2B or B2C	198	3.9%
SCM – supply chain management	244	4.8%
CRM – customer relationship management	357	7.0%
Communication	614	12.1%
Networking	238	4.7%
Virtualization of business processes	260	5.1%
E-commerce	333	6.5%
E-business	330	6.5%
Remote work	530	10.4%
Other	50	1.0%
Total	5092	100.0%

Source: own elaboration based on conducted research.

The analysis of the conducted research allows for the formulation of several important conclusions regarding the competencies and characteristics of employees, as well as the role of ICT technology in the context of organizational agility. The majority of respondents rate their skills in using information and telecommunication technologies as good or very good, indicating a high level of proficiency in ICT technology within the surveyed group. A significant number of employees believe they are capable of adapting to rapid changes, which is crucial for organizational agility.

In terms of agile skills, most respondents believe they are capable of managing projects, being leaders, and achieving set goals within a specified time and budget. This ability to manage projects and be a leader is essential in a dynamically changing business environment.

Regarding personality traits, most respondents consider themselves to be flexible, assertive, and capable of remote work. The high rating of these traits indicates an ability to adapt to new working conditions, which is essential for maintaining organizational agility.

Finally, ICT technologies play a key role in supporting organizational agility. Communication, group work, and remote work are the main areas where ICT technologies are considered most valuable. This points to the need for investment in tools and technologies that support these areas of activity in order to increase organizational agility and respond to dynamically changing business requirements.

3.3. Structural model and its assumptions

The research aimed to understand how various ICT tools influence and develop the organizational agility of companies, understood as the ability to respond to changes and unforeseen situations. A key objective of the analysis was also to understand how individual characteristics and skills of employees, related to project management and their personality, impact business efficiency and how they are perceived in the context of organizational agility.

The structural model, estimated using the maximum likelihood method, takes into account observable endogenous variables, such as employee skills in executed projects, their personality traits, and the ICT tools used. The model also includes unobservable endogenous variables that refer to employee skills, their competency assessment by the employer, and areas of ICT tool utilization. Additionally, the model contains exogenous variables that may account for measurement errors or other undetected factors influencing the analysis.

For this purpose, a structural model was estimated using the maximum likelihood method (see Fig. 1). There was no basis for rejecting the null hypothesis that the residual values of the empirical and theoretical matrices are equal to zero ($\chi^2 = 1058.27$; $p = 0.001$). The root mean square error of approximation (RMSEA) value of 0.095 indicates that the model fits the data well.

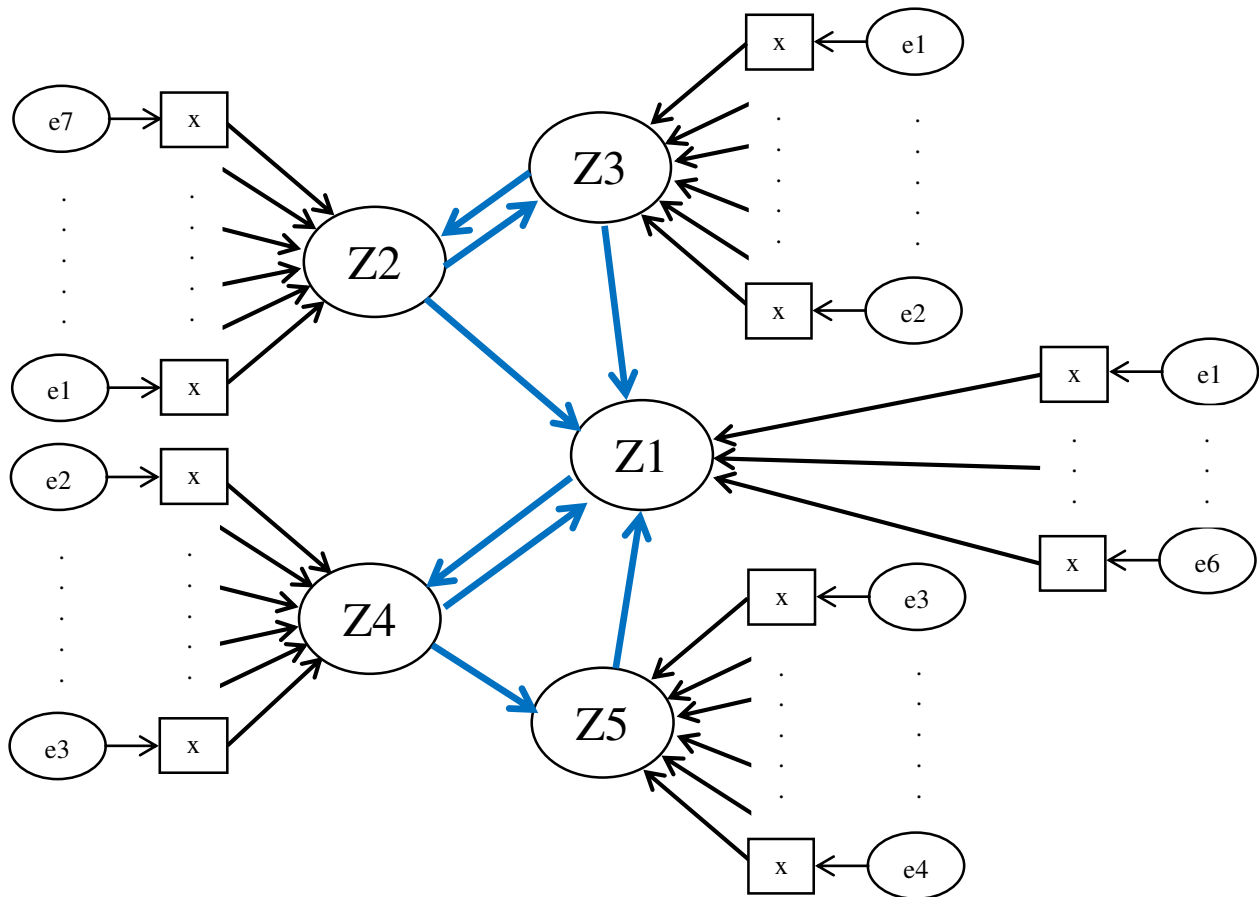


Figure 1. Estimated structural model.

Source: own elaboration based on conducted research.

3.4. Discussion

The structural model estimated using the maximum likelihood method includes observable endogenous variables:

- X1 - In the projects you carry out, can you: [Manage the project],
- X2 - In the projects you carry out, can you: [Be a leader],
- X3 - In the projects you carry out, can you: [Achieve set goals within a specified time],
- X4 - In the projects you carry out, can you: [Achieve set goals within the budget],
- X5 - In the projects you carry out, can you: [Execute multiple projects simultaneously],
- X6 - In the projects you carry out, can you: [Manage a project team],
- X7 - At your workplace, is your: [Competence] taken into account,
- X8 - At your workplace, is your: [Innovativeness] taken into account,
- X9 - At your workplace, is your: [Creativity] taken into account,
- X10 - At your workplace, is your: [Open-mindedness] taken into account,
- X11 - At your workplace, is your: [Engagement] taken into account,
- X12 - At your workplace, is your: [Dedication] taken into account,

- X13 - At your workplace, is your: [Risk management ability] taken into account,
- X14 - At your workplace, is your: [Reliability] taken into account,
- X15 - At your workplace, is your: [Ingenuity] taken into account,
- X16 - Your personality traits include: [Flexibility],
- X17 - Your personality traits include: [Assertiveness],
- X18 - Your personality traits include: [Mobility and remote work],
- X19 - Your personality traits include: [Problem-solving ability],
- X20 - Your personality traits include: [Adaptability to new working conditions],
- X21 - Your personality traits include: [Ability to implement innovative ideas],
- X22 - Your personality traits include: [Acceptance of new duties],
- X23 - Your personality traits include: [Ability to work in an age-diverse team],
- X24 - Your personality traits include: [Ability to work in a multicultural environment],
- X25 - Group work,
- X26 - Decision-making,
- X27 - Project management,
- X28 - EDI – electronic document flow,
- X29 - B2B or B2C,
- X30 - SCM – supply chain management,
- X31 - CRM – customer relationship management,
- X32 - Communication,
- X33 - Networking,
- X34 - Business process virtualization,
- X35 - E-commerce,
- X36 - E-business,
- X37 - Remote work,
- X38 - Others,
- X39 - Spreadsheets,
- X40 - Databases,
- X41 - Data visualization tools,
- X42 - Corporate portals,
- X43 - Social media portals,
- X44 - Data warehouses,
- X45 - Business intelligence and Big data,
- X46 - Cloud computing,

- X47 - Internet of Things,
- X48 - Mobile technologies,
- X49 - Artificial intelligence,
- X50 - Others.

The structural model estimated using the maximum likelihood method includes observable endogenous variables:

- Z1 - In the projects you carry out, can you,
- Z2 - At your workplace, is your contribution taken into account,
- Z3 - Your personality traits are,
- Z4 - Indicate the areas where applied ICT supports/enhances organizational agility (ability to respond to changes and unforeseen situations),
- Z5 - Indicate which ICT tools are most commonly used in your company.

Unobservable exogenous variables:

e1, e2, e3, e4, e5, e6, e7, e8, e9, e10, e11, e12, e13, e14, e15, e16, e17, e18, e19, e20, e21, e22, e23, e24, e25, e26, e27, e28, e29, e30, e32, e33, e34, e35, e36, e37, e38, e39, e40, e41, e42, e43, e44, e45, e46, e47, e48, e49, e50.

Non-standardized and standardized model coefficients are presented in Tables 6 and 7. Table 7 provides detailed estimates for 50 variables, labeled from X1 to X50. For each of these variables, four values are presented. The first column, "Variables", serves as an identifier for a specific variable. The second column, "Estimated Parameter Value", displays the estimated value for each variable. The next column, "Estimation Error", shows the estimation error associated with the parameter estimate for each variable. The fourth column, "Critical Value", provides the critical value for the estimate of each variable. The last column, "p Value", indicates the significance level for the estimate; interestingly, all values in this column are marked with ***, suggesting that all estimates are statistically significant. Table 8 provides detailed information about parameter estimates for each of the analyzed variables and their statistical significance level.

Based on table 6, the following conclusions can be drawn:

All estimates are statistically significant: All values in the "p Value" column are marked with ***, indicating a high level of statistical significance for all estimates. This suggests that each variable significantly influences the research model.

Diversity of estimated values: The estimated values for individual variables differ, indicating the diversity of these variables' influence on the phenomenon under study.

Estimation Errors: Although the estimated parameter values vary, the estimation errors for most variables are quite similar. This means that the accuracy of the estimation is consistent among different variables.

Critical Values: Critical values for most variables are also similar, which may indicate consistency in assessing the significance of estimates.

In summary, Table 6 indicates that all analyzed variables have a significant impact on the research model, with varying degrees of estimated parameter value. Estimation errors and critical values for these variables are quite similar, indicating consistency in assessing significance and accuracy of estimates.

Table 6.
Unstandardized model coefficients

Variables	Estimated parameter value	Estimation error	Critical value	p-value
X1	1.75864	0.085	18.587	***
X2	1.6465	0.084	14.326	***
X3	1.7177	0.057	15.587	***
X4	1.74262	0.068	15.987	***
X5	1.57886	0.085	18.861	***
X6	1.57352	0.086	18.874	***
X7	1.44714	0.075	16.874	***
X8	1.1214	0.098	16.587	***
X9	1.20684	0.087	15.985	***
X10	1.28516	0.082	16.521	***
X11	1.51122	0.541	15.388	***
X12	1.3083	0.548	15.457	***
X13	0.95942	0.598	15.872	***
X14	1.35102	0.084	13.524	***
X15	1.24066	0.305	12.894	***
X16	1.43646	0.088	14.784	***
X17	1.05198	0.064	14.856	***
X18	1.31898	0.071	14.876	***
X19	1.48274	0.088	14.784	***
X20	1.45782	0.078	14.796	***
X21	1.08402	0.068	14.854	***
X22	1.37416	0.098	14.784	***
X23	1.424	0.087	14.856	***
X24	1.23176	0.085	18.587	***
X25	1.07156	0.084	14.326	***
X26	0.88288	0.057	15.587	***
X27	0.81702	0.068	15.987	***
X28	0.67818	0.085	18.861	***
X29	0.35244	0.086	18.874	***
X30	0.43432	0.075	16.874	***
X31	0.63546	0.098	16.587	***
X32	1.09292	0.087	15.985	***
X33	0.42364	0.082	16.521	***
X34	0.4628	0.544	15.488	***
X35	0.59274	0.548	15.457	***
X36	0.5874	0.597	15.852	***
X37	0.9434	0.084	13.524	***
X38	0.089	0.301	12.864	***
X39	1.05554	0.088	14.684	***
X40	1.157	0.064	14.856	***
X41	0.47348	0.071	14.876	***
X42	0.52866	0.088	14.754	***
X43	0.64436	0.078	14.796	***
X44	0.37024	0.068	14.854	***
X45	0.36312	0.098	14.784	***
X46	0.30438	0.087	14.556	***
X47	0.22784	0.076	14.657	***
X48	0.72624	0.095	14.554	***
X49	0.20648	0.067	14.351	***
X50	0.17266	0.076	14.257	***

Note: *** indicates $p < 0.001$.

Source: own elaboration based on conducted research.

Table 7.
Standardized model coefficients

Variables	Estimated parameter value
X1	0.988
X2	0.925
X3	0.965
X4	0.979
X5	0.887
X6	0.884
X7	0.813
X8	0.630
X9	0.678
X10	0.722
X11	0.849
X12	0.735
X13	0.539
X14	0.759
X15	0.697
X16	0.807
X17	0.591
X18	0.741
X19	0.833
X20	0.819
X21	0.609
X22	0.772
X23	0.800
X24	0.692
X25	0.602
X26	0.496
X27	0.459
X28	0.381
X29	0.198
X30	0.244
X31	0.357
X32	0.614
X33	0.238
X34	0.26
X35	0.333
X36	0.33
X37	0.53
X38	0.05
X39	0.593
X40	0.65
X41	0.266
X42	0.297
X43	0.362
X44	0.208
X45	0.204
X46	0.171
X47	0.128
X48	0.408
X49	0.116
X50	0.097

Based on the analysis of values in the "Estimated Parameter Value" column in Table 6, the variables that have the greatest impact on organizational agility are:

X1 - In the projects you carry out, can you: [Manage the project] with an estimated value of 1.75864.

X4 - In the projects you carry out, can you: [Achieve the set goals within the budget] with an estimated value of 1.74262.

X3 - In the projects you carry out, can you: [Achieve the set goals within the set time] with an estimated value of 1.7177.

X2 - In the projects you carry out, can you: [Be a leader] with an estimated value of 1.6465.

X5 - In the projects you carry out, can you: [Execute multiple projects simultaneously] with an estimated value of 1.57886.

These variables indicate the key skills and characteristics that are important for organizational agility, such as the ability to manage projects, achieve goals within set timeframes and budgets, and be a leader.

The key skills and characteristics that have the greatest impact on organizational agility include:

Project Management: The ability to effectively manage projects is paramount for organizational agility.

Goal Achievement: Achieving set goals within a designated time and budget is crucial for maintaining agility in an organization.

Leadership: Being a leader and the ability to lead a team is essential for organizational agility.

Multitasking: The ability to execute multiple projects simultaneously is important for maintaining agility and flexibility in a dynamically changing environment.

In general, organizational agility is strongly associated with management skills, goal achievement, and leadership in the context of projects.

Table 7 presents the standardized coefficients of the model for 50 variables, from X1 to X50, indicating the strength and direction of the relationship of each variable with the dependent variable in the model. The highest coefficient values, close to 1, such as for variables X1 (0.988), X3 (0.965), and X4 (0.979), indicate the greatest influence of these variables in the model. Coefficients in the range of 0.5-0.9 suggest a medium influence, while values below 0.5, like for X28 (0.381) or X50 (0.097), indicate a low influence on the dependent variable. An additional note regarding the $p < 0.001$ value emphasizes that all presented estimates are highly statistically significant. In short, the analysis of this table helps understand which variables have the greatest influence on the phenomenon studied in the conducted research.

Table 4 emphasizes the importance of specific skills and ICT tools in the context of their impact on organizational agility. The most significant turned out to be project management skills, achieving set goals within a designated time, and budget. This indicates that effective project management and the ability to achieve set goals are key to organizational agility.

The coefficients for variables representing employees' personal traits also indicate their importance. Leadership, flexibility, and the ability to adapt in changing conditions are key to maintaining agility in a dynamically changing business environment. Overall, the results from Table 9 confirm that both technical skills related to ICT and employees' soft skills are essential for companies' organizational agility.

The above interpretations are valid only when the values of other variables remain unchanged. The coefficient values thus describe the direction (positive/negative) and the strength of the influence of the explanatory variable on the explained variable. The strength of influence on the explained variable can be compared between explanatory variables using standardized coefficients. The values of non-standardized coefficients depend on the units in which the variables are measured.

4. Conclusions

Based on the analysis of the data contained in Tables 6 and 7, clear relationships were observed between specific employee skills and organizational agility. Skills in project management, achieving set goals within a specified time and budget, and being a leader proved to be particularly important. The significance of these skills is highlighted by their high value in the structural model, suggesting their pivotal role in shaping organizational agility.

Additionally, the analysis points to the importance of personal traits of employees in the context of organizational agility. Flexibility, adaptability, and leadership are not only important for individual effectiveness but also for the overall ability of the organization to respond to changes.

In the context of ICT tools, a varied impact of different technologies on organizational agility was observed. While some tools seem to be more influential than others, the overall trend points to the increasing role of technology in shaping agile business practices.

In conclusion, the research indicates that both technical skills related to ICT and soft skills of employees are essential for organizational agility. In the age of rapid technological and business changes, such a combination becomes key to organizational success. Based on the conducted analyses and interpretations of the results, several key elements of new knowledge in the field of organizational agility were identified. Firstly, there is a strong correlation between employees' project management skills and organizational agility. Specifically, the ability to achieve set goals within a specified time and budget, as well as being a leader, are key indicators of agility in an organizational context.

Secondly, the personal traits of employees, such as flexibility, adaptability, and leadership, play a significant role in shaping organizational agility. These traits not only influence individual employee effectiveness but also the ability of the entire organization to respond to changes.

Thirdly, the diversity of ICT tools used in the organization has a varied impact on organizational agility. While all ICT tools contribute to agility, some of them clearly have a more significant impact compared to others.

Fourthly, the integration of technical skills related to ICT with the soft skills of employees is key to achieving optimal organizational agility. Combining these two areas allows organizations to effectively respond to dynamically changing business conditions. Thus, organizational agility is a complex construct that is shaped both by technical skills and the personal traits of employees.

It's also worth mentioning the limitations of the conducted research. The limitations of this study primarily arise from the nature of the sample. The study was based on the analysis of responses from 930 respondents, which, although a significant number, may not be representative of all sectors or organizational cultures. Additionally, the study mainly focused on employee skills and the use of ICT tools, which might overlook other key factors influencing organizational agility, such as organizational culture or management structure. The survey method, although widely used, also carries limitations, such as potential errors arising from respondent answers or their interpretation. Lastly, the dynamically changing technological environment means that conclusions drawn from current data might not be relevant in the future as new technologies and tools emerge.

Comparing this research with the findings of other researchers would be valuable. For instance, Prieto and Talukder (2023) focused on the concept of "resilient agility" as a key condition for the sustainable development of employees and organizations. Another interesting reference is the work of Grugulis and Vincent (2011), who discuss the impact of changing boundaries on shaping employee skills in the context of fragmented organizational forms. Comparing these studies with the results of this analysis reveals the diversity of approaches to the issue of organizational agility and employee skills in academic literature.

In light of the research results and current trends in the literature on organizational agility, several directions deserve further exploration. Firstly, a deeper analysis of personal traits of employees, such as flexibility or adaptability, could provide more detailed information about their specific role in shaping organizational agility. In this context, it would be worth investigating which personal traits are most valuable for different types of organizations or in different industry sectors.

Secondly, although ICT tools play a key role in enhancing agility, there's a need for a more detailed analysis of how specific technologies and their applications influence agility in different organizational contexts. Research could focus on identifying technologies with the most potential in the context of agility and developing best practices for their implementation.

Another direction could be to investigate how organizations can effectively combine technical skills related to ICT with the soft competencies of employees to achieve optimal agility. Such research could provide practical guidelines for managers and team leaders regarding training, development, and team management in a dynamically changing environment.

Lastly, considering that organizational agility is key to success in today's complex business environment, it's worth reflecting on the future of this concept. What are the future challenges related to agility? What new technologies or strategies might emerge in the coming years? Answers to these questions can provide valuable insights for future research in this field.

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BUILDING A MORE COMPETITIVE AND SMARTER EUROPE AS A GOAL OF THE COHESION POLICY OF THE EUROPEAN UNION – THE PERSPECTIVE OF THE POLISH ECONOMY

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Purpose: The primary objective of this article is to illustrate the strategic goals outlined in the European Union's cohesion policy PO1, "A more competitive and smarter Europe" in the context of Poland for the period 2021-2027, and provide an overview of the initial experiences of Poland in implementing these goals. A secondary objective is to present the features and evaluate the European Union's cohesion policy concerning support for research and innovation (R&I), particularly within the programming period of 2021-2027.

Design/methodology/approach: The research employed various methods, including a literature analysis focusing on EU funds, cohesion policy and innovation, an analysis of EU strategic and programming documents for the period 2021-2027, as well as analysis of the financial data contained therein, mainly relating to the area of "A more competitive and smarter Europe". This specific area, constituting a key aspect of the EU cohesion policy, serves as the primary focus of the study, with particular attention given to its application in Poland. The deductive method was employed for reasoning, and the research findings were presented using graphical methods.

Findings: The funding allocated to R&I in the EU has been progressively increasing. In the period from 2000 to 2006, the allocation was approximately EUR 26 billion, and for the years 2021-2027, there is a planned investment of EUR 137.5 billion in this area. These funds are designated to be utilized under one of the five objectives of the EU cohesion policy for 2021-2027, specifically PO1, known as "A more competitive and smarter Europe". The implementation of the PO1 objective aims to bridge the innovation and digital divide across the EU. In Poland, a substantial investment of EUR 16,046 billion is earmarked to achieve this goal. The initial competition organized in Poland under the SMART path has demonstrated significant interest in these funds, presenting an opportunity to enhance the country's innovativeness.

Research limitations/implications: The research faced limitations, particularly in maintaining the consistency of homogeneous financial data. The primary source utilized was the Cohesion Data Platform, chosen for its up-to-date information. Another constraint was the nascent stage

of competitions for EU funding under SMART paths, which significantly restricted the availability of research material.

Practical implications: The research can be used by potential beneficiaries of EU funds to create innovative projects that can be submitted to subsequent SMART competitions in the future.

Originality/value: Considering that the topic revolves around a relatively recent subject, namely Smarter Europe in the 2021-2027 perspective, and is grounded in the most current data available as of the end of 2023, the article contributes to both domestic and foreign literature on the subject of subsidy support instruments directed towards enterprises through state institutions.

Keywords: a more competitive and smarter Europe, Cohesion Policy, EU funds, competition SMART in Poland.

Category of the paper: research paper.

1. Introduction

The trend accompanying shifts in European Commission policies in recent years clearly reflects a strong commitment to enhancing support for EU Member States in developing sustainable and competitive economies. International competitiveness for the European economy is defined by its capacity to leverage participation in the global division of labor, foster wealth and prosperity, and increase productivity.

Research on the competitiveness of the European economy, conducted over several years, indicates that Europe is facing challenges in the competition for global markets, not only against the United States and Japan. Over the last two decades, East Asian countries, including China and India, have emerged as some of the most competitive economies globally (Dicken, 2012).

Enhancing the competitiveness of the European economy has been a key objective of successive strategies implemented within the EU, including the Lisbon Strategy and Europe 2020. These strategies have been accompanied by adjustments in cohesion policy, which, through its initiatives, aimed to foster the development of a dynamic and competitive economy.

The new financial perspective for 2021-2027 encompasses a range of programs implemented with funds from the European Union (EU). It primarily centers on economic, social, and territorial cohesion, as well as natural resources and the environment. The key elements are:

- greater European cohesion with a larger budget,
- synergy and unification of programs under uniform regulations,
- efficiency and more targeted use of EU funds,
- strong emphasis on the topics of sustainable development, environment and climate, and digitalization.

In Poland, EU programs encompass the European Funds for the Modern Economy, Infrastructure, Climate and Environment, Digital Development, Eastern Poland, Social Development, as well as Technical Assistance and the Just Transition Fund (Małek et al., 2021, pp. 29-30; Sapala, 2021, pp. 27-35). The budget allocated for Poland in the 2021-2027 programming period is approximately EUR 76 billion. Notably, a significant portion of this budget is designated for the development of the Modern Economy (FENG, 2022). This priority involves earmarking PLN 36 billion for research and development, innovative projects, and initiatives aimed at enhancing the competitiveness of the Polish economy. The FENG program is anticipated to benefit around 17.6 thousand enterprises, potentially leading to the creation of over 14.5 thousand new jobs.

The primary objective of this article is to illustrate the strategic goals outlined in the European Union's cohesion policy PO1, "A more competitive and smarter Europe" in the context of Poland for the period 2021-2027, and provide an overview of the initial experiences of Poland in implementing these goals. The first competition in the new perspective was the SMART competition, hence the article presents the first Polish statistics and experiences. Additionally, the article aims to outline and assess the characteristics of the European Union's cohesion policy, with a specific emphasis on its role in supporting research and innovation, particularly pertinent within the context of the 2021-2027 programming period. The topics addressed pertain to a relatively novel subject, denoted as "Smarter Europe" within the 2021-2027 timeframe, and draw upon the latest data available as of the conclusion of 2023. Consequently, this article serves as a supplementary contribution to the existing literature concerning subsidy support mechanisms aimed at businesses through governmental entities.

2. Literature review

The European Union stands out as the most significant and influential among all international economic integration schemes (El-Agraa, 2015). This prominence is attributed to several distinctive features of the group. Facilitated by the Single European Market (SEM), the EU enables the unrestricted movement of people, goods, services, and capital (both monetary and establishment rights) across its member states. Moreover, the European Union allocates funds and resources through a variety of channels, including funds, programs, and financial instruments.

EU funds play a pivotal role in bolstering development in Member States, exerting direct and indirect influence on various facets of society. Their impact on development is substantial, encompassing diverse aspects of social, economic, and environmental well-being. Moreover, these funds play a crucial role in supporting the endeavors of Member States towards attaining a more sustainable and prosperous future (Šostar et al., 2023).

It is indicated that co-financing projects supported by EU funds significantly influences the ongoing development of specific regions, facilitating the realization of numerous development initiatives (Florkowski, Rakowska, 2022). European Union funds serve as an accessible financing source for a range of project ideas, playing a role in fostering sustainable socio-economic development at the local, regional, and national levels. The literature provides evidence suggesting that financial disbursements from EU funds correlate with reduced Eurosceptic sentiments (Crescenzi et al., 2020).

The heightened focus on innovation development within the EU in recent years stems not only from a shared understanding of the pivotal role innovation plays in economic advancement but is also substantiated by macroeconomic data indicating that Europe lags behind its principal global competitors in research and development expenditure. An additional rationale is grounded in the knowledge that innovations can contribute up to 80% of economic growth in developed countries, with investments in innovation in less developed countries seen as enhancing export outcomes in sectors crucial for bolstering enterprise competitiveness and domestic demand (Mendez et al., 2013). It was evident that the future of the EU was intricately linked to the support and cultivation of innovation. Thus, the amount of financial resources allocated to research and innovation in the European Union is gradually increasing. Since 2000, the investments in research and innovation (R&I) under Cohesion Policy have grown exponentially: from €26 billion in the 2000-2006 period to over €86 billion (about 25 percent of the ESIF) in 2007-2013, to €121 billion in the 2014-2020 period (about 30 percent of the ESIF) (Polverari, Dozhdeva, 2018). In turn, in the EU Multiannual Financial Framework for 2021-2027, EUR 137.5 billion was planned for the priority of innovation and digital economy alone (Council of the European Union, 2021).

Despite changes in Poland's approach to EU funds over the years, the combination of institutional potential and efficient management has been crucial in achieving a high level of utilization of funds from EU sources (Bachtler, McMaster, 2008). Research indicates that all regions in Poland have prioritized the development of human capital and innovation, resulting in a substantial increase in the effectiveness of EU funds (Jagódka, Snarska, 2021). Additionally, Murzyn (Murzyn, 2020) demonstrated that the intelligent development of regions in Poland experienced a substantial boost through the utilization of EU funds.

The predominant share of EU funds is allocated in the form of non-repayable support, i.e. subsidies. The amount of these subsidies is primarily contingent on various factors: the type of beneficiary, the nature of the project, and, for entrepreneurs, the size of the entity and the region where the project is executed, along with the specific support instrument employed. A beneficiary whose project has received a positive assessment of the application and who is granted funds may, by implementing the project, count on co-financing of part of the costs considered eligible for a given support instrument. Consequently, subsidies are regarded as a viable option for companies to finance investments characterized by a specific cost structure.

It is important to note that only costs meeting specific criteria and features are eligible for co-financing (Ministerstwo Funduszy i Polityki Regionalnej, 2022).

The primary motivation behind providing subsidies is to alleviate the financial constraints faced by enterprises, particularly small and medium-sized enterprises, and assist them in making impactful investments that enhance their technologies (Muraközy, Telegdy, 2023), thereby supporting and promoting economic growth.

3. Materials and Methods

The article delves into the topic of European Union funds, with a particular emphasis on EU cohesion policy. It provides an overview of the essence and general characteristics of the cohesion policy, considering both strategic and specific goals within the 2021-2027 timeframe. The first strategic objective, PO1 "A more competitive and smarter Europe", undergoes a detailed analysis. Subsequently, the article illustrates the assumptions of the PO1 strategic goal for Poland, offering the initial Polish statistics and experiences related to the implementation of this goal, with a specific focus on R&I.

The research aligns with the programming period of EU funds for 2021-2027, with the initial statistics from the SMART competition for Poland available for the year 2023. The territorial scope of the research encompasses the entire European Union, with a more in-depth description of the PO1 goal specifically provided for Poland.

The research material primarily relied on factual data sourced from the EU Cohesion Open Data Platform database and information extracted from EU strategic and program documents. Additionally, public statistics from Eurostat and Statistics Poland were incorporated. The research employed various methods, including a literature analysis focused on EU funds, cohesion policy, and innovation, an analysis of EU strategic and programming documents for the period 2021-2027, involving an examination of the data included in them, particularly financial information, predominantly related to the domain of "A more competitive and smarter Europe". This specific area, integral to the EU cohesion policy, served as the primary focus of the study, with a distinct emphasis on Poland. The deduction method was additionally employed for reasoning, and the research findings were communicated through graphical methods.

The research encountered limitations, primarily stemming from challenges in ensuring the consistency of homogeneous financial data. The primary reliance on the Cohesion Data Platform was due to its regular updates. The data in this database is frequently updated, and thus may not always align with previously published program documents. Another limitation was the fact that competitions for EU funding under SMART paths started in 2023, which significantly limited the research material. Therefore, this is an argument for continuing research in the future.

4. Results

4.1. Goals and essence of the European Union's Cohesion Policy for the period 2021-2027

In the new perspective, the European Union's cohesion policy outlines five overarching goals: (1) A more competitive and smarter Europe; (2) A greener and lower-carbon transition to a net-zero carbon economy; (3) A more connected Europe through increased mobility; (4) A more social and inclusive Europe; (5) Europe closer to citizens by supporting the sustainable and integrated development of all types of territories (European Parliamentary, 2023, p. 7). These goals are formulated in a concise, contemporary, and broad manner, emphasizing support for growth and addressing the developmental needs of Member States and their regions, irrespective of their socio-economic status. The first four goals are sectoral in nature, while the last goal is territorial (see table 1).

Table 1.

The objectives of the EU cohesion policy in the period 2021-2027

No.	Strategic objectives	Specific objectives	Nature of the objectives
PO1	A more competitive and smarter Europe	1.1. developing and enhancing research and innovation capacities and the uptake of advanced technologies; 1.2. reaping the benefits of digitisation for citizens, companies, research organisations and public authorities; 1.3. enhancing sustainable growth and competitiveness of SMEs and job creation in SMEs, including by productive investments; 1.4. developing skills for smart specialisation, industrial transition and entrepreneurship; 1.5. enhancing digital connectivity;	sectoral
PO2	A Greener, carbon free Europe	2.1. promoting energy efficiency and reducing greenhouse gas emissions; 2.2. promoting renewable energy (...); 2.3. developing smart energy systems, grids and storage outside the Trans-European Energy Network (TEN-E); 2.4. promoting climate change adaptation and disaster risk prevention and resilience, taking into account eco-system based approaches; 2.5. promoting access to water and sustainable water management; 2.6. promoting the transition to a circular and resource efficient economy; 2.7. enhancing protection and preservation of nature, biodiversity and green infrastructure, including in urban areas, and reducing all forms of pollution; 2.8. promoting sustainable multimodal urban mobility, as part of transition to a net zero carbon economy;	sectoral
PO3	A more Connected Europe	3.1. developing a climate resilient, intelligent, secure, sustainable and intermodal TEN-T; 3.2. developing and enhancing sustainable, climate resilient, intelligent and intermodal national, regional and local mobility, including improved access to TEN-T and cross-border mobility;	sectoral

Cont. table 1.

PO4	A more Social Europe	<p>4.1. enhancing the effectiveness and inclusiveness of labour markets and access to quality employment through developing social infrastructure and promoting social economy;</p> <p>4.2. improving equal access to inclusive and quality services in education, training and lifelong learning through developing accessible infrastructure, including by fostering resilience for distance and on-line education and training;</p> <p>4.3. promoting the socioeconomic inclusion of marginalised communities, low income households and disadvantaged groups, including people with special needs, through integrated actions, including housing and social services;</p> <p>4.4. promoting the socio-economic integration of third country nationals, including migrants through integrated actions, including housing and social services;</p> <p>4.5. ensuring equal access to health care and fostering resilience of health systems, including primary care, and promoting the transition from institutional to family-based and community-based care;</p> <p>4.6. enhancing the role of culture and sustainable tourism in economic development, social inclusion and social innovation;</p>	sectoral
PO5.	A Europe closer to citizens	<p>5.1. fostering the integrated and inclusive social, economic and environmental development, culture, natural heritage, sustainable tourism and security in urban areas;</p> <p>5.2. fostering the integrated and inclusive social, economic and environmental local development, culture, natural heritage, sustainable tourism and security in areas other than urban areas.</p>	territorial

Source: own work based on: Regulation (EU) 2021/1060 of the European Parliament and of the Council, of 24 June 2021 (art.5); Regulation (EU) 2021/1058 of the European Parliament and of the Council, also of 24 June 2021 (art. 3).

In the 2021-2027 perspective, the European Union has earmarked EUR 378 billion for cohesion policy. When combined with national co-financing from both public and private sources, the total budget reaches EUR 545 billion (European Commission, 2023a).

During the reviewed period, expenditure on cohesion policy averages around 0.2% of the EU GDP per year, exhibiting notable national variations. The average annual aid intensity for the discussed financial perspective is estimated to range from EUR 10 per person in Luxembourg to EUR 366 per person in Estonia. The EU-27 average stands at EUR 118 per person, while for Poland, this indicator is EUR 280 per person. Once again, the funding from cohesion policy is notably concentrated on less developed regions and EU Member States. In less developed regions (where GDP per capita is less than 75% of the EU average), the average support intensity per capita is approximately EUR 207 per year. In more developed regions (where GDP per capita is above 100% of the EU average), this amount is EUR 21 per person. This substantial difference serves to mitigate disparities in the development of EU regions (Christou et al., 2023).

In the period 2021-2027, the allocated funds are designed to contribute to: making Europe more competitive and smarter through innovation and support for small and medium-sized enterprises, as well as digitization and digital connectivity, developing and improving research and innovation, capabilities and the use of advanced technologies, seeking to leverage digitalization for the benefit of citizens, businesses, research organizations and public authorities, strengthening the sustainable growth and competitiveness of SMEs and creating

jobs in SMEs, including through productive investment, developing skills for smart specialization, industrial transformation and entrepreneurship, and improving digital connectivity (CESIE, 2021).

The simulations conducted suggest that the invested funds under the EU cohesion policy for the period 2021-2027 are anticipated to yield the following effects in the future (Christou et al., 2023):

- Cohesion policy interventions would increase the EU's GDP by 0.5% by the end of the implementation period in 2029 (versus a no-cohesion policy scenario);
- Their structural effect on the target economies means that their impact will continue long after the programmes have been terminated, with GDP remaining at 0.3% above its initial level in 2050;
- 25 years after the beginning of the programming period, each euro spent on the policy will have generated EUR 2.8 of additional GDP in the EU, which corresponds to an annual rate of return of around 3.4%;
- The policy will also boost the labour market, with an increase in employment of 0.64% in 2027, which corresponds to about 1.3 million additional jobs.

4.2. A more competitive and smarter Europe

As part of the implementation of the P01 goal "A more competitive and smarter Europe", support will be provided for scientific research and innovation aimed at eliminating the innovation and digital divide throughout the EU. A total of over EUR 117.2 billion has been allocated for this purpose, with EU funding amounting to over EUR 75.7 billion. The co-financing structure for individual specific objectives under P01 is as follows: Enhancing research and innovation – 48.1%; Growth and competitiveness of SMEs – 32.1%; Reaping the benefits of digitisation – 14.5%; Digital connectivity – 3.0% and Skills for smart specialisation and transition – 2.3% (see fig. 1).

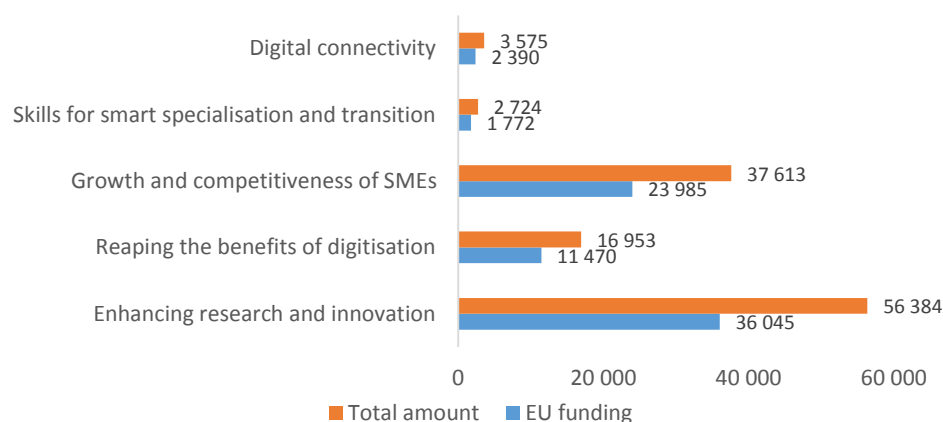


Figure 1. The budget P01 A more competitive and smarter Europe divided into specific objectives, including EU funding (in euro).

Source: own study based on: Cohesion Policy 2021-2027 outcome of programming.

It is estimated that under the Smart Europe strategic goal, financial support will be extended to approximately 725,000 enterprises engaged in activities aimed at fostering smart growth. The program beneficiaries will also include researchers who will gain access to enhanced facilities and new equipment for research and innovation. The direct advantages of the P01 implementation will also extend to the residents of the European Union, who will benefit from a fast mobile network and fixed digital infrastructure. Furthermore, selected public administration entities will undergo digitization (see Fig. 2).

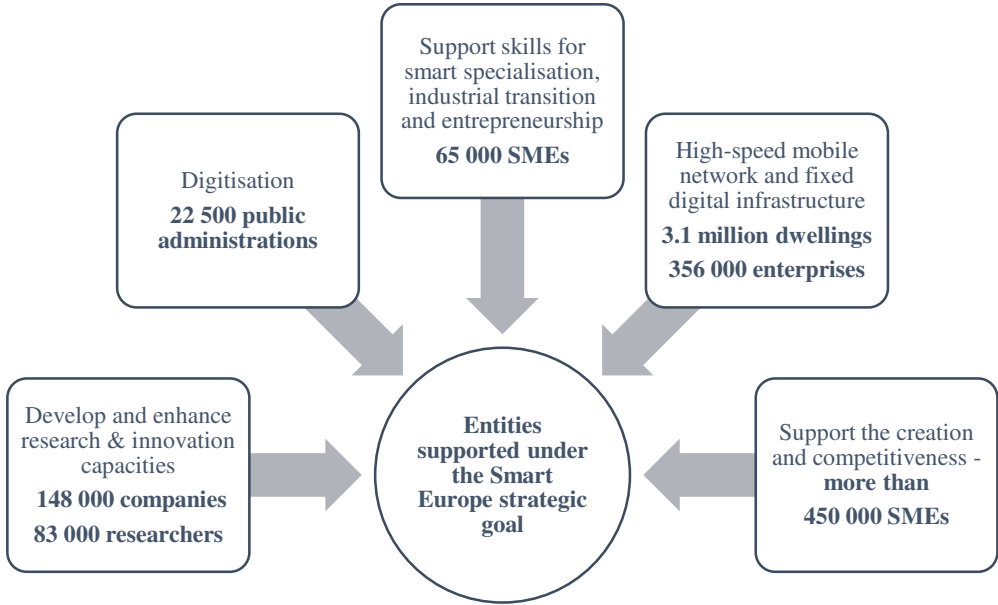


Figure 2. Entities supported under the Smart Europe strategic goal

Source: own study based on: Cohesion Policy 2021-2027 outcome of programming.

The budget value of PO1 Smarter Europe ranks third, following PO4 Social Europe (EUR 167.1 billion) and PO2 Greener Europe (EUR 128.9 billion), underscoring the significance of this area for the future of the EU.

4.3. Smart Poland

Poland is set to receive the largest budget for the implementation of cohesion policy in the period 2021-2027 among all EU member states, with a total amount exceeding EUR 92 billion. For comparison, Italy follows with €74.1 billion, and Spain with €52.6 billion (European Commission, 2023b).

To achieve the goals under P01 Smart Europe, Poland will receive EU funding of EUR 16,046 billion in the 2021-2027 perspective. Only Spain will receive more in this area, i.e., EUR 16,689 billion. Financial resources under the PO1 objective will be invested in Poland across four specific objectives, with as much as 55.1% allocated to Enhancing research and innovation (see Fig. 3).

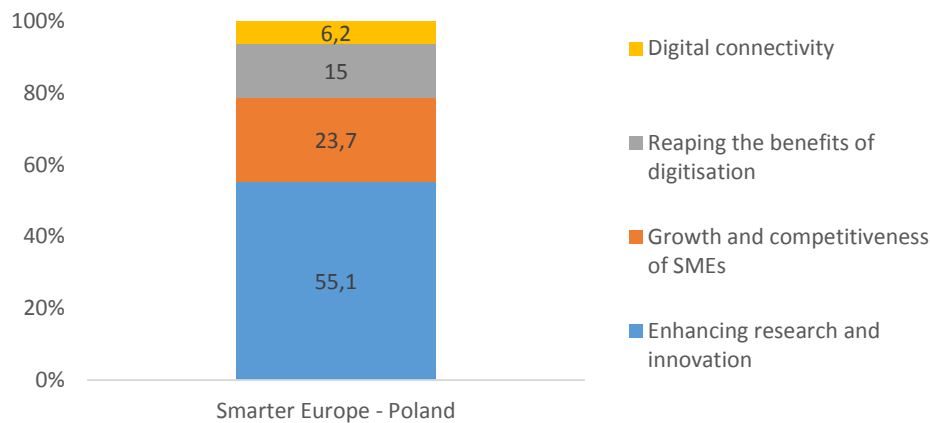


Figure 3. The structure of the Smart Europe budget in Poland (%).

Source: own study based on: Cohesion Open Data Platform (2023).

The primary program for Poland implementing the PO1 "More Competitive and Smarter Europe" goal is the European Funds for Smart Economy 2021-2027 (FENG, 2022). These initiatives will facilitate the execution of innovative research and development projects aimed at enhancing the competitiveness of the Polish economy. The program primarily targets entrepreneurs, the science sector, consortia of entrepreneurs, and consortia of entrepreneurs collaborating with research organizations and business environment institutions (such as entrepreneurship centers, innovation centers, and financial institutions). FENG's total budget is PLN 37.1 billion (EUR 7.9 billion).

The inaugural competition announced under the Smarter Europe Priority was the SMART competition, jointly organized by the Polish Agency for Enterprise Development (PARP) and the National Center for Research and Development (NCBiR). The SMART's objective is to develop and reinforce the research and innovation capabilities of enterprises, aimed at implementing product or process innovations, fostering the digitization and transformation of enterprises toward sustainable development, promoting the internationalization of enterprises, and enhancing the competences of staff (Ścieżka SMART, 2023). With a multi-modular approach, the competition aims to provide support to enterprises across various areas of activity. Assistance under the SMART Path may be granted for the implementation of projects such as conducting research and development work, implementing the results of R&D work, expanding research infrastructure, facilitating the digital or green transformation of enterprises, supporting internationalization efforts, and improving staff competences.

In 2023, PARP announced the first competitive call for applications for funding from the SMART Path under the European Funds for a Modern Economy Program (FENG), ending the recruitment of applications in May 2023. The competition enjoyed considerable interest among entrepreneurs, as shown by its statistics. Entrepreneurs submitted 1,540 applications for a total amount of PLN 15,189,712,000.43. Moreover, when the SMART Path was announced, by the end of the recruitment process, hotline consultants and PARP experts served almost 11,000 consultations regarding the competition. Subsequently, the projects were subjected to a multi-

faceted assessment by expert teams. The projects submitted in the call for proposals were assessed substantively in accordance with the project selection criteria. 198 projects received a positive assessment.

5. Discussion

The productivity and innovativeness of the Polish economy are crucial factors in narrowing the gap in GDP per capita compared to the EU-28 countries. In 2018, labor productivity reached 63% of the EU average, a notable improvement from the 50% recorded in 2010. However, despite significant growth over the past decade, it still falls below the EU average (*Założenia Do Umowy Partnerstwa Na Lata 2021 -2027*, 2019, p. 4). Strengthening support in this priority is essential for the continued development of the Polish economy.

According to the latest (Eurostat, 2023) research and development expenditure in 2021 for EU Member States increased by 6% compared to 2020, reaching a total of EUR 328 billion. Poland is among the five countries that have experienced a notable rise in the intensity of research and development expenditure over the last decade. However, in Poland, these expenditures remain below the EU average.

Research serves as a pivotal catalyst for innovation, and the monitoring of research and development spending, along with its intensity (R&D expenditure as a percentage of GDP), serves as two essential indicators for comparing countries based on their commitment to development. In 2021, Poland witnessed an increase in expenditure on research and development (GERD) in relation to GDP, reaching 1.44% of GDP, and enterprise expenditure (BERD) rose to 0.91% of GDP. In terms of R&D expenditure intensity, Poland is approaching levels comparable to Spain – 1.43% of GDP, Italy – 1.49% of GDP, and Greece – 1.44% of GDP. However, these figures still lag behind the most innovative EU countries, such as Sweden – 3.35% of GDP, Austria – 3.32% of GDP, Belgium – 3.19% of GDP, and Germany – 3.13% of GDP (Eurostat, 2023).

In recent years, the number of individuals engaged in R&D activities in Poland has experienced significant growth. In 2021, compared to the previous year, it rose by 7.8% to reach 305.6 thousand people, marking a nearly 28% increase over the past five years. Notably, in 2021, for the first time, over half of the R&D staff were employed in enterprises (GUS, 2022). This shift signifies that enterprises will become the primary source of innovation in the Polish economy in the coming years. Given the strong correlation between innovation and competitiveness, the ability to generate competitive products and services is directly linked to an innovative advantage.

The Global Innovation Index (GII), which categorizes world economies based on their innovation capabilities, positioned Poland at the 41st place among the 132 economies included in the Global Innovation Index 2023 ranking. Additionally, Poland holds the 36th position among the 50 economies in the high-income group. Within the European context, Poland is ranked 26th among the 39 European economies (Dutta et al., 2023).

Table 2.
Poland GII Ranking (2020-2023)

Year	GII Position	Innovation Inputs	Innovation Outputs
2020	38th	38th	40th
2021	40th	37th	42nd
2022	38th	41st	36th
2023	41st	50th	36th

Source: Global Innovation Index 2023.

The statistical confidence interval for Poland's ranking in GII 2023 falls within the range of 39-42. In 2023, Poland exhibits stronger performance in terms of innovation outcomes compared to innovation expenditures. Specifically, Poland is ranked 50th in terms of expenditure on innovation, a position lower than the previous year. However, in terms of innovative results, Poland maintains its 36th position, consistent with the previous year (Dutta et al., 2023). This state of affairs certainly justifies allocating significant financial resources to the goal of supporting innovation in the Polish economy. Therefore, if Poland hopes to continue to grow or even accelerate its pace of development, it should now strive to improve its levels of productivity and innovation. Poland's potential for further growth is significant (Waląg, 2023). However, it depends on many factors, including: the level of investment, innovation, human capital and the country's resilience to external factors. The incoming funds from the European Union provide an opportunity for dynamic development, provided they are properly used.

6. Conclusions

The limited innovativeness of the Polish economy compared to other developed nations underscores the pressing need for immediate action to rectify this unfavorable situation. For years, the insufficient allocation of funds from the national budget to R&D development has hindered efforts to enhance the competitiveness of the Polish economy. The increase in production costs, including primarily wages and energy costs, means that the offer of Polish producers and service providers is no longer as price competitive as in previous years. Competitiveness predicated on low prices is now the purview of developing countries, posing a challenge for Polish entrepreneurs attempting to stay competitive. Consequently, it is imperative to explore alternative strategies to foster the long-term competitiveness of the

Polish economy. Similar challenges confront the entire European economy, which is gradually losing competitiveness in comparison to the economies of the USA, Japan, China, and India.

This challenge is to be addressed by promoting innovation in the European economy using cohesion funds in the 2021-2027 perspective. The advancement of a smart economy is also viewed as a means to equalize the level of socio-economic development among regions in the EU. It aims to leverage endogenous potentials, supported by the outcomes of R&D efforts, to expedite the development of regions with significantly lower GDP per capita than the EU average.

In 2023, political issues constrained Polish entrepreneurs from fully capitalizing on support for projects enhancing their innovation and competitiveness. Towards the end of 2023, Poland was on the verge of initiating the utilization of EU funds under the 2021-2027 financial perspective, marking the commencement of various competitions for project co-financing, calls for applications, expert evaluations, and subsequent project implementations co-financed from EU funds. The substantial interest in the competition organized by PARP suggests a high level of interest from the enterprise sector in securing funds for the commercialization of R&D initiatives.

The anticipation is that in the upcoming years, the funds allocated to Poland under SMART will be invested in employment, economic growth, and European territorial cooperation, aligning with the five primary objectives of cohesion policy. These objectives aspire to foster a more competitive, smarter, greener, better-connected, and socially inclusive Europe. Continuous monitoring of the progress toward achieving these goals is of utmost importance.

Hence, it is imperative to persist in future research efforts. Subsequent research endeavors should encompass a comprehensive examination of implemented EU projects, an assessment of the efficacy and efficiency of both EU and national funds (both public and private) expended, and an evaluation of the extent to which the designated objectives of EU cohesion policy, particularly the strategic goal "A more competitive and smarter Europe", have been achieved. Prioritizing research and innovation across EU member states remains pivotal in the pursuit of constructing a smart and competitive economy.

Acknowledgements

The publication was partially funded by the Faculty of Economics, Finance and Management, University of Szczecin and Faculty of Economics, West Pomeranian University of Technology in Szczecin: "Green Lab. Research and Innovations".

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ACTIVITY OF POLISH ORGANISATIONS PARTICIPATING IN THE EMAS SCHEME TO REDUCE THE EMISSION OF AIR CONTAMINANTS

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Purpose: The purpose of this paper was to present the undertakings of Polish enterprises participating in the EMAS scheme, dealing with waste and sewage management, water supply and land reclamation, implemented in order to reduce air contaminants emissions.

Design/methodology/approach: The assumed research method was based on the analysis of secondary sources in form of environmental statements. The selection of sample was targeted and the research involved a complete analysis among 19 companies participating in the EMAS scheme, selected based on their business profile and dealing with waste and sewage management, water supply and land reclamation. The analysis described herein allowed to identify most common initiatives aimed at reduction of emissions and indicate specific solutions applied in that area.

Findings: Most frequent solutions include: vehicle replacement, use of renewable sources of energy, use of low-emission technologies, devices or systems, failure prevention systems, monitoring, analysis and measurement of emissions. Possibilities to apply specific solutions have been indicated considering different profiles of activity.

Research limitations/implications: The fact that data in environmental reports are not uniform, which makes them difficult to analyse, is the limitation of the described research. Exemplary solutions are not provided in all environmental reports. Further research might focus on the analysis of initiatives taken by Polish manufacturing or power engineering companies in the area of waste management.

Practical implications: The key input of the described research is the list of specific solutions that could be implemented in organisations with different profiles of activity in order to reduce emissions of air contaminants.

Social implications: Exemplary solutions beneficial in terms of air quality improvement, and also general life quality improvement, have been presented.

Originality/value: The outcome of this study may supplement previous research concerning the EMAS scheme, providing specific examples of solutions that could be implemented in organisations to reduce emissions of air contaminants.

Keywords: EMAS scheme, environmental policy, greenhouse gas, reduced emissions.

Category of the paper: Research paper.

1. Introduction

One of the major challenges within the European Union is tackling climate changes. Its importance has been highlighted, among others, in the European Green Deal, a new growth strategy which sets the goal to reach net zero emission of greenhouse gases in the European Union until 2050 (COM (2019) 640 final). The proposed climate neutrality measures include greater reduction of emissions, reaching at least 55% as compared with the values set in 1990 (Regulation (EU) 2021/1119, 2021). Seeking effective solutions to reduce emission of air contaminants is a long lasting process that requires involvement, not only at the EU level, but also in individual member states. Additionally, this initiative should have the form of a top-down framework and directions of activities set at the international or national level, and voluntary resolutions adopted by different organisations. One of the instruments that can be used in order to reduce emission of air contaminants is the eco-management and audit scheme (EMAS) introduced by the European Union. Currently, it is considered the most credible and clear environmental management system, with the primary aim of supporting different organisations in continuous improvement of environmental performance (which includes the area of emissions).

This paper is an attempt to extend the knowledge concerning particular activities undertaken by Polish organisations participating in the EMAS scheme to reduce the negative impact or increase the positive impact on environment. Filling this gap is particularly important considering the fulfilment of the EU climatic goals, taking initiatives to ensure the "healthy planet for all" (COM(2021) 400 final) and presenting out of the box solutions adopted in the analysed organisations to reduce emissions of greenhouse gases, that could inspire or be readily implemented by other organisations. Presenting exemplary activities might supplement the measures planned and implemented in individual countries to improve air quality, which is also a key element of life quality improvement.

2. Importance of EMAS scheme for climate neutrality

As it has already been mentioned, the EU has set an ambitious goal to reach climate neutrality until 2050. Its fulfilment strongly depends on multilevel cooperation (international, European, national, regional, local) between organisations in different sectors. The schedule and types of major initiatives leading to the reduction of air, water and soil contamination have been formulated in the zero waste hierarchy. According to this hierarchy, the basis for the EU policy should be preventive activities related to all stages of contaminants emissions, from the extraction of natural resources, through production, services and supply,

to consumption. In this context, this policy particularly encourages implementing zero-emission production processes, design of safe and sustainable products or services, using innovative tools and technologies, and changing consumption habits. When it is impossible to eliminate the source of contamination, further activities, according to the zero-emission hierarchy, should focus on reduction. Modern and smart solutions within production processes, using safe and sustainable products, services and business models, as well as digital solutions for tracking and reducing contamination should be particularly promoted in this area. Another type of activities, mentioned as the last resort in the zero-emission hierarchy, is repair and compensation for damage caused as a result of the release of contaminants (COM(2021) 400 final).

Fulfilment of the EU climatic goals will also depend on setting top-bottom framework of action and taking voluntary initiatives by organisations and bodies whose activity is more or less related to producing air contaminants. The EMAS scheme is one of the tools that could be used in different economic sectors. Its basic goal is to support organisations in continuous improvement of their environmental performance, which somehow forces them to seek new (innovative) or better solutions. As regards the hierarchy of contamination management activities, the EMAS scheme can support businesses in the fulfilment of two prioritized types of activities, related to preventing or reducing emissions. Organisations participating in the EMAS scheme are additionally obliged to present regular reports on their improvement in six environmental areas: energy efficiency, efficient usage of materials, water, waste, biodiversity and emissions. As regards the last of the listed areas, the evaluation encompasses total yearly emission of greenhouse gas (at least emissions of CO₂, CH₄, N₂O, HFC, PFC and SF₆), in tonnes of carbon dioxide equivalent, and total yearly emissions to air (at least SO₂, NO_x and PM), in kilograms or tonnes (Regulation (EC) No. 1221/2009, 2009). The organisations participating the EMAS scheme present their performance as part of a public environmental report which must be delivered and updated as the requirement of the participation. When it comes to preventing or reducing emission of air contaminants, it should be mentioned that organisations participating in the EMAS scheme are obliged to maintain conformity with relevant laws. Enterprises participating in the EMAS scheme must monitor any changes in these laws and adjust their activity accordingly. Considering the principles of climate policy, it means conformity with the following acts: The Act on the System to Manage the Emissions of Greenhouse Gases and Other Substances; Law on ozone-depleting substances and certain fluorinated greenhouse gases; Regulation of the Minister of Environment concerning the types of installation which may cause substantial pollution to particular natural elements or to the environment as a whole; Regulation of the Minister of Environment on types of installations requiring notification; Regulation of the Minister of Environment establishing cases when emission of gases or dust into the air does not require notification (Dz.U. 2009, nr 130, poz. 1070; Dz.U. 2015, poz. 881; Dz.U. 2014, poz. 1169; Dz.U. 2019, poz. 1510; Dz.U. 2010, nr 130, poz. 881).

The significance of the EMAS scheme can also be perceived with respect to the last method of contamination management listed in the hierarchy mentioned above. This is because the primary goal of the EMAS scheme is supporting organisation in continuous improvement of environmental performance. Consequently, preventive actions and reducing emission of contaminants are prioritized, which can help companies avoid exceeding acceptable level of contamination.

3. Review of previous research concerning the EMAS scheme

The previous research concerning the EMAS scheme focused mainly on explaining the reasons, barriers and benefits related to the implementation of the system. As regards the outcomes, the analysed organisations were asked about the general benefits (if any) resulting from the implementation of the EMAS scheme. Available sources indicate that environmental benefits were most common. These were mainly related to systematisation and optimising previous environmental activities (Freimann, Schwaderlapp, 1996; Hillary, 1998; Bohne, 2000; Steger, 2000; Umweltbundesamt, 2000; Kossler et al., 2002; Morrow, Rondinelli, 2002; Hyršlova, Hajek, 2005, 2006; Abeliotis, 2006; Ministerio De Medio Ambiente, 2006; Nycz-Wróbel, 2016a); limiting the negative environmental effect, mainly through the reduction of produced waste and consumption of resources and energy (Bültmann, Wätzold, 2000; Schucht, 2000; Umweltbundesamt, 2000; Braun, Grotz, 2002; Wenk, 2004; Hyršlova, Hajek, 2006; Vernon et al., 2009; Nycz-Wróbel, 2016a) and also improvement of environmental performance (Hillary, 1998; Morrow, Rondinelli, 2002; Hillary, 2004; Daddi et al., 2011; Merli et al., 2014; Nycz-Wróbel, 2016a). However, in certain studies organisations reported particular improvement in emission of air contaminants. It concerned French (Schucht, 2000) and German (Bültmann, Wätzold, 2000) companies, but in both cases, the reported level of improvement was medium. In another study conducted among German enterprises, savings were indicated as the result of the improvement in environmental performance, however, the largest savings were connected with the improvement in areas of energy and emissions (Steyrer, Simon, 2013). The positive effects of the EMAS scheme implementation also include lower percentage of failures and environmental incidents, which can be particularly important for companies whose emissions increase as a result of a failure (e.g. ignition of waste at the landfill of a waste disposal company). Benefits in this area have been reported by companies from the EU countries (Vernon et al., 2009); Czechia (Hyršlová, Hájek, 2006); Austria (Kossler et al., 2002) and Germany (Umweltbundesamt, 2000). In this case, improvement shall be the effect of conformity with the EMAS requirement for drafting special emergency readiness and responding procedures, which ensures that organisations are better prepared for hazards. Consequently, this can contribute to a reduction in frequency of incidents.

Only a few studies included questions regarding specific solutions adopted to achieve environmental performance. The study among Polish power engineering enterprises listed specific undertakings leading to reduce emissions of air contaminants. These included: using modern low-emission technologies (with renewable sources of energy), upgrade of technologies, installations and facilities, use of flue gas purification systems, measurement of emissions and process sealing (Nycz-Wróbel, 2021a). In Polish manufacturing enterprises, emissions were mainly reduced through the implementation of new technologies or upgrading already used technologies (with the use of renewable energy sources), monitoring and measurement of emissions and also modification of transport operations (Nycz-Wróbel, 2021). The research among French and German organisations only presented activities leading to the improvement of environmental performance (without indication of specific areas where improvement should be achieved). These included: optimising or introduction of new processes, technical improvement of existing facilities or installations, optimising transport operations, improvement of environmental impact of products or replacement of problematic materials (Bültmann, Wätzold 2000; Schucht, 2000). As presented in certain studies, solutions adopted in organisations can be perceived as technology (Braun, Grotz, 2002; Rennings et al., 2006; Nycz-Wróbel, 2016) or product environmental innovations (Hoffmann et al., 2003; Salomone, 2008; Nycz-Wróbel, 2016).

The studies described above enabled to identify certain environmental benefits achieved as a result of participation in the EMAS scheme. Only a few studies listed specific activities conducted to improve environmental performance in different areas related to environment. This study is an attempt to fill this gap. Presenting the results of these studies can be particularly important for managers of organisations seeking specific solutions that could be implemented in order to achieve improvement of environmental performance, including the area of emission of air contaminants.

4. Aim and method

The purpose of the paper was to present the undertakings of Polish enterprises participating in the EMAS scheme, dealing with waste and sewage management, water supply and land reclamation, implemented in order to reduce air contaminants emissions.

The theoretical part presents the assumptions of the EU hierarchy of air, water and soil contaminants management, and describes the relevant EMAS scheme requirements. Additionally, the results of previous desk-research from Poland and other countries, regarding the EMAS system have been presented, indicating a gap in the knowledge concerning particular solutions implemented by the analysed organisations in order to improve their environmental performance.

The empirical part contains the results of individual research conducted in Polish enterprises participating in the EMAS scheme, dealing with waste and sewage management, water supply and land reclamation.

The assumed research method was based on the analysis of secondary sources in form of environmental statements. These are reports obligatory for organisations participating in the EMAS scheme, that must be drawn up, published and updated on a regular basis. Information that can be found in environmental statements include exemplary activities planned or implemented to improve environmental performance in particular areas, among others, related to emissions. It is noteworthy that environmental statements are credible sources of data, as their content is regularly assessed in terms of correctness, reliability, credibility and conformity with the EMAS Regulation by a third party environmental verifier (Regulation (EC) No. 1221/2009, 2009). The analysis of environmental statements had been used as the grounds for the research in previous studies concerning the EMAS scheme, among others, describing the effects of EMAS implementation on the improvement of environmental performance (Daddi et al., 2011; Matuszak-Flejszman, 2019; Heras-Saizarbitoria, 2020; Nycz-Wróbel, 2020). Certain available studies emphasise the importance of environmental statements in searching information on technical innovations that organisations could apply in their facilities, previously implemented by other companies (Rennings et al., 2006).

Environmental statements were downloaded from the Polish EMAS website. The grounds for the study was the register dated 28 September 2023. The selection of sample was targeted and the research involved a complete analysis among 19 companies participating in the EMAS scheme, selected based on their business profile and dealing with waste and sewage management, water supply and land reclamation. Companies representing this particular sector have been chosen due to the fact that they constitute one of the three largest groups in the EMAS register, based on the division with reference to the structure of business activity. Additionally, this study will supplement the previous research concerning activities implemented to reduce emissions of air contaminants, conducted in the other two largest groups of Polish companies participating in the EMAS scheme (power engineering and manufacturing sector). For one of the companies listed in the EMAS register, environmental statement could not be retrieved, as a result of which, indicating any activities presented in their report was not possible.

Table 1 presents the characteristics of the analysed population, considering the type of activity and size of enterprise.

Table 1.*The characteristics of analysed enterprises considering the size and type of business activity*

No.	Designation for study purposes*	Size of organizations	NACE code
1.	A	Large	36.00.Z; 37.00.Z
2.	B	Medium	35.1; 35.2; 38.1; 38.2; 39.0; 81
3.	C	Medium	37.00.Z; 35.11.Z
4.	D	Large	36; 37
5.	E	Small	38.1; 38.3; 39; 81; 71; 68
6.	F	Micro	38.32; 70
7.	G	Micro	38.32; 70
8.	H	Medium	38.1; 38.2; 38.3; 81
9.	I	Small	38.1; 38.2; 39.0
10.	J	Medium	Report could not be retrieved
11.	K	Medium	38.1; 81.2; 81.3
12.	L	Micro	38.32; 70
13.	M	Large	38.1; 38.3; 39.0
14.	N	Large	38.1; 38.3; 81.2
15.	O	Small	38.22
16.	P	Small	37; 38.2; 46.9; 47.9
17.	R	Medium	38.1; 38.3
18.	S	Small	38.1; 81
19.	T	Small	38.22.Z

* In order to present the results of the study, companies participating in the study have been coded with letters A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, R, S, T.

Source: individual research based on the analysis of environmental statements.

Considering the size of organisations, the analysed population consisted of four large, six medium, six small and three micro enterprises. The type of activity has been presented based on the NACE classification, which is the reference for the profile of activity considered by a third party environmental verifier in the assessment of the implemented EMAS system. The detailed characteristics of NACE codes, indicating the number of organisations dealing with particular activities, is presented in Table 2.

Table 2.*Detailed characteristics of activity performed by the analysed enterprises*

NACE code	Characteristics	Number of enterprises
38.1	Waste collection	9
38.3	Materials recovery	5
38.2	Waste treatment and disposal	4
37/37.00.Z*	Sewerage	4
39/39.0	Remediation activities and other waste management services	4
81	Services related to buildings and landscape activities	4
38.32	Recovery of sorted materials	3
70	Activities of head offices; management consultancy activities	3
36/36.00.Z*	Water collection, treatment and supply	2
38.22/38.22.Z*	Treatment and disposal of hazardous waste	2
81.2	Cleaning activities	2
35.1	Electric power generation, transmission and distribution	1
35.11.Z*	Production of electricity	1
35.2	Manufacture of gas; distribution of gaseous fuels through mains	1
46.9	Non-specialised wholesale trade	1
47.9	Retail trade not in stores, stalls or markets	1

cont. Table 2.

68	Real estate activities	1
71	Architectural and engineering activities; technical testing and analysis	1
81.3	Landscape service activities	1

* Subclasses listed according to the Polish Classification of Activities (PKD).

Source: individual research based on the analysis of environmental statements.

Among the analysed enterprises, the largest groups deal with waste collection (9) and recovery of materials (5). Another significant groups of companies are those dealing with waste processing and neutralisation (4), sewage disposal and water treatment (4), land reclamation and other services related to waste management (4), building cleaning services, green area management and recovery of materials from sorted waste (3).

The study was conducted from 8 September 2023 until 31 October 2023. A preliminary in-depth analysis of entire environmental statements of individual companies participating in the study has been performed. Based on the conducted analysis, all types of activities aimed reducing emissions of air contaminants, implemented in Polish organisations, have been listed. Next, the identified activities were listed and grouped. The outcome has been presented in form of a chart. Table 3 presents the most frequently performed activities. Tables 4 to 8 present specific solutions applied as part of particular undertakings listed in Table 3.

5. Research outcomes

Table 3 presents the most common initiatives taken to reduce emissions of air contaminants among Polish enterprises dealing with waste and sewage management, water supply and land reclamation.

Table 3.

Most common activities performed among Polish organisations to reduce emissions

Activities	Number of enterprises
Upgrading vehicle fleet	9
Using renewable sources of energy	6
Using low emission equipment and installations or upgrade of systems	5
Use of technologies allowing to reduce emissions	4
Other	7

Source: individual research based on the analysis of environmental statements

The most common solutions adopted to reduce emissions of air contaminants include upgrading vehicle fleet (9), use of renewable sources of energy (6), use of low emission equipment and installation or upgrade of systems (5), and use of low emission technologies (4). A group of other activities has also been identified, including different solutions adopted in the analysed organisations to control emissions (7).

Table 4 presents specific solutions used in relation to the operated vehicle fleet.

Table 4.*Solutions applied in Polish enterprises to reduce emissions related with vehicle operation*

Upgrading vehicle fleet	Enterprise	Number of enterprises
Replacement or extending vehicle fleet	D, E, H, K, M, N, R	7
Introducing additional indicator for vehicle fleet upgrade	E, M, R	3
Planned purchase of new vehicles	H, K, N	3
Use of low-emission vehicles	B, N	2
Decommissioning of vehicles	K	1
Optimum management of vehicles and fuel-consuming machines	O	1

Source: individual research based on the analysis of environmental statements.

The research indicates that the most commonly adopted solution in vehicle fleet modernisation was replacement of old vehicles. Seven companies decided to do that (D, E, H, K, M, N, R). When replacing vehicles, choosing those conforming to higher emission standards (e.g. Euro 6), or using a different drive (electric, CNG or diesel), was a priority. Two of the analysed companies (B, N) reported in their environmental statements that they had already used low-emission vehicles, while three enterprises (H, K and N, already using low-emission vehicles in their fleet) intended to buy new vehicles. When planning a purchase, as in the case of vehicle replacement, choosing zero or low-emission cars, conforming to higher emission standards (Euro 6), or using a different drive (CNG), was a priority. Three enterprises participating in the study used an additional indicator for fleet modernisation, to assess their performance in that area (E, M, R). Other activities consisted in decommissioning outdated vehicles (Euro 2 standard) and optimum vehicle fleet management. These solutions were adopted in individual enterprises.

Table 5 presents specific solutions adopted to switch to renewable energy sources.

Table 5.*Usage of renewable energy sources in Polish enterprises*

Use of renewable sources of energy	Enterprise	Number of enterprises
Producing electric energy and heat using renewable energy sources	B, C, D, I	4
Photovoltaic installations or microinstallations	A, B, D, P	4
Modernisation of energy management facilities at a sewage treatment plant to use biogas for electric energy and heat production	D	1
Construction of a biogas plant	P	1

Source: individual research based on the analysis of environmental statements.

In most cases, the usage of renewable energy sources involved production of electric energy and heat, and also using photovoltaic installations or microinstallations. Each of these solutions was adopted in four enterprises. Two companies (B, D) produced electric energy and heat for own purposes and for clients, company I recovered landfill gas, and company C used biogas in that process. Beside that, other undertakings involving the use of biogas can be identified among these companies. One of them consisted in plant modernisation to allow the use of biogas in the production of electric energy and heat (D), while the other was construction of a biogas plant (P).

Polish enterprises also used low-emission equipment or installations (Table 6).

Table 6.

Equipment and installations used by Polish enterprises

Usage/modernisation of equipment or installations	Enterprise	Number of enterprises
Use of air conditioning devices containing less than 3 kg of coolant and releasing less than 5 tonnes of CO ₂ equivalent F-gases	H, K, N	3
Use of air conditioning devices containing less than 3 kg of R410A or R404A and R410A or R32 coolant		
Modernising local boiler plants used for heating of company buildings (replacement of coal fired boilers with oil or gas fired boilers). Yearly technical inspection of air conditioning units. Refilling coolant in air conditioning units	D	1
Upgrade of existing emissions capture and reduction systems. Purchase and installation of new equipment	O	1

Source: individual research based on the analysis of environmental statements.

Most of activities reported by the analysed organisations concerned air conditioning systems. Keeping a proper level of cooling medium (e.g. by refilling) and CO₂ equivalent of fluorinated greenhouse gases was very important.

Another group of solutions included low-emission technologies (Table 7).

Table 7.

Low-emission technologies used in Polish enterprises

Use of technologies allowing to reduce emissions	Enterprise	Number of enterprises
Trenchless repair of sewage systems	A	1
Using a new insert at a sulphur-recovery plant	C	1
Use of modern solutions to reduce emissions from mechanical and biological treatment of municipal waste	E	1
Considering current weather conditions and weather forecasts when conducting significant processing activities in open space	H	1
Proper processing, recovery, recycling and neutralisation of waste (according to BAT). Performing all waste processing operations indoors. Organised release of exhaust air from the production hall using fan discharge units	O	1

Source: individual research based on the analysis of environmental statements.

Five organisations provided specific examples of technologies in their environmental statements. These included rather expensive solutions, e.g. trenchless repair of sewage system to avoid closing roads and redirecting traffic, which allows to reduce emissions from fuel combustion (A). Another significant solution was replacing bog iron ore with a new insert in a sulphur-recovery installation at a sewage treatment plant, to remove hydrogen sulphide from biogas (C). Desulphurisation is a result of chemical reactions in which bonds between hydrogen sulphide and trivalent iron are formed. If the concentration of hydrogen sulphide in biogas rises during the desulphurisation process, insert must be replaced. This solution allowed complete desulphurisation of fuel (biogas) and reaching zero emission of SO₂. Other solutions reported by the waste management company consisted in planning processes to be performed in open

spaces based on current weather conditions (H). Consequently, pile forming and displacement, sieving and grinding operations were restricted in unfavourable weather conditions, and piles were formed so that the smallest area of compost was exposed to wind. Another waste management company (O) reported proper performance of all waste treatment operations, considering the possibilities to reduce emissions in each particular process.

The analysis of environmental statements also allowed to identify other activities performed in Polish enterprises to reduce emission of air contaminants (Table 8).

Table 8.

Other activities implemented in Polish organisations to reduce emissions

Other activities	Enterprise	Number of enterprises
Purchase of cameras to ensure CCTV system coverage of the entire waste processing site	H, P, T	3
Construction of a fire-fighting water tank with the minimum capacity of 432 m ³		
Training for employees in OHS rules and safety procedures.		
Constant supervision of conformity with relevant procedures.		
Regular inspection of equipment and buildings.		
Maintenance of fire-fighting installations and equipment.	A, H, O	3
Specifying requirements for transport of waste (vehicle class, ADR certificate of the carrier) and procedures defining the scope and methods of verification		
In-depth analysis of sources and scale of emissions related to processing operations.		
Outsourcing and conducting measurements of dust emissions in individual processing operations and consulting results with the integrated environmental permit.		
Hiring a third party specialist in industrial dedusting systems to perform analysis and propose technical solutions for further reduction of dust emissions	A	1
Monitoring and monthly measurement of landfill gas emissions (methane, carbon dioxide and oxygen) at each landfill gas extraction well		
Documenting all data related to environmental performance to control levels of emissions		
Social campaigns	C	1
Implementing a project aimed at effective reduction of emissions from a sewage treatment plant	E	1
Notification on the use of a system not requiring permission to release gases and dust into the air	O	1
Drafting an investment and organisational framework based on the measurement of total emissions.	P	1
Maintaining proper efficiency of machines and equipment		
Training employees in reducing low emissions of air contaminants.		
Encouraging employees to use low-emission transport.		
Introducing a programme to reduce commuter emissions.	H	1
Promotion of cycling within the organisation.		
Introducing an indicator to monitor the number of employees using low-emission transport		
Planting trees at the area of 450 m ² .		
Closure and reclamation of landfill.		
Appointment of environmental protection teams		

Source: individual research based on the analysis of environmental statements.

The group of other activities mostly involved monitoring, analysis or measurement of emissions (A, H, O) and preventing environmental incidents (H, P, T). The latter type of activities was reported by enterprises dealing with waste management, because ignition of

waste is particularly dangerous, considering emission of air contaminants. The analysed enterprises performed activities aimed at preventing incidents within their own plants, and also beyond their premises (specifying waste handling requirements). The research participants were also involved in raising awareness among their employees through training, special actions (e.g. commuter's emission reduction programme promoting low-emission transport and annual cycling events) and appointment of workgroups (to raise awareness and promote environmental activity among employees, suppliers and subcontractors, and introduce environmental initiatives). Worth mentioning in this group is a special social campaign held by a water supply and sewage company titled "Drink tap water" (A). Its goal was to promote drinking tap water instead of buying bottled water, drawing attention to the benefits of reducing the carbon footprint (which is much lower when water is supplied through the network rather than delivered in bottles).

6. Discussion

The described research allowed to identify activities most commonly adopted in Polish enterprises dealing with waste and sewage management, water supply and land reclamation to reduce their emissions. These included: replacement of vehicle fleet, use of renewable sources of energy, considering emissions when applying new technologies, devices and installations, adopting appropriate solutions to prevent environmental incidents and also monitoring, analysis and measurement of emissions. Comparing these outcomes with the previous research, we can conclude that the types of activities performed to improve organisations' environmental performance are not much different. Most of them concern the use of technology, devices and installations, irrespective of the environmental area in which improvement is expected. As far as reduction of air contaminants is concerned, we can also notice that the type of undertakings is quite similar, regardless of the profile of activity. Comparing the results obtained among the Polish enterprises dealing with waste and sewage management, water supply and land reclamation, and Polish power engineering and manufacturing companies participating in the previous research, we can identify most common solutions aimed at reducing emissions in each individual group. These included use of low-emission technologies, equipment or installations, use of renewable sources of energy and also emission monitoring and measurement systems. Considering the profile of activity, we can also indicate process sealing solutions (adopted in companies from the power engineering and waste management sectors), and also fleet upgrade with vehicles conforming to higher emission standards or using a different type of drive (manufacturing and waste handling companies).

Considering the presented hierarchy of contaminants management, the importance of the EMAS scheme should be emphasised for two recommended types of activities, namely preventing and reducing contamination. As the described research shows, most initiatives taken among the analysed enterprises consisted in preventing or reducing emissions (this study was focused on emissions of air contaminants, but EMAS scheme can be equally important for the two other types of contaminants mentioned in the hierarchy). The EMAS scheme, with its restrictive requirements (e.g. continuous improvement of environmental performance, maintaining legal conformity and preventing environmental incidents), helps organisations avoid excessive environmental impact (e.g. increased emission). That is why its significance must be considered with reference to the last type of activities mentioned in the hierarchy, that should be used only as a last resort, namely the repair and compensation of damage occurring as a result of contamination.

Based on the described research, we can formulate recommendations for managers of organisations who seek inspirations or out of the box solutions that could be adopted in their companies to prevent or reduce emissions of air contaminants:

- The first area where improvement possibilities should be sought is the technology, equipment or installations – as the study suggests, in these particular areas most of the analysed companies took action to improve their environmental performance, irrespective of the profile of their activity. Despite the fact that these solutions are related with the highest cost, and in many cases return on investment can be a long perspective, we could identify one less expensive activity, namely considering weather conditions when performing operations in which higher dust emissions occur.
- Companies whose major sources of emissions include transport and handling operations, should consider purchase of vehicles conforming to higher emission standards or using a more environmentally friendly drive (e.g. CNG or electric).
- In organisations where increased emission can occur as a result of a failure, taking preventive actions is very important. And again, the study shows that less expensive solutions can also be adopted in this area (e.g. introducing and controlling conformity with safety procedures for internal and external operations). These solutions could be adopted in different organisations relying on relatively limited resources.
- Another undertaking that can, depending on the adopted solutions, entail more or less significant cost, is the emissions monitoring, analysis and measurement system. It can be applied in any organisations, regardless of their profile. Here, they can seek assistance of third party experts (e.g. laboratories certified by the Polish Centre for Accreditation) or conduct monitoring and measurements on their own (e.g. using indicators specified in the EMAS Regulations or developed individually).
- In organisations whose operations cause increased emission of dust, tightening of industrial processes is recommended.

- Using renewable sources of energy is also worth considering, which can not only reduce CO₂ emission but can also help improve environmental performance of an organisation.
- Organisations with smaller financial potential or conducting activity not related with high emission of air contaminants, intending to improve their environmental performance in this and other fields, could introduce training and awareness-raising courses for employees or other stakeholders cooperating with the organisation, appoint environmental teams whose duties could be adjusted to individual needs, conduct interesting environmental campaigns for employees or external stakeholders, and develop an own set of indicators to assess improvement in a selected environmental area.
- The hierarchy of contamination management activities, recommended by the EU, should be also considered, with the emphasis on preventing and reducing emissions.

As it has already been mentioned, the outcomes of this study can supplement previous research concerning the EMAS scheme, providing specific examples of solutions that could be adopted in organisations to improve their environmental performance. The fact that data in environmental reports are not uniform, which makes them difficult to analyse, is the limitation of the described research. Some organisations did not present examples of specific activities in their environmental statements. However, the analysis indicated activities that could inspire or be readily implemented to reduce emissions of air contaminants in different organisations.

7. Conclusions

The purpose of the paper was to present the undertakings of Polish enterprises participating in the EMAS scheme, dealing with waste and sewage management, water supply and land reclamation, implemented in order to reduce air contaminants emissions. The research allowed to identify examples of specific solutions commonly adopted in this area. These included: vehicle replacement, use of renewable sources of energy, use of low-emission technologies, devices or systems, failure prevention systems, monitoring, analysis and measurement of emissions. The key input of the described research are examples of specific activities that could inspire or be readily implemented in different organisations. It is particularly important considering the principles of the EU climate policy, but also the quality of life of the society. This paper supplements the previous research concerning the EMAS scheme.

The described research does not provide sufficient information to fill the gap in the knowledge concerning the activities performed by organisations participating in the EMAS scheme to improve their environmental performance. Therefore, areas of further study in this field should be indicated, e.g. undertakings of Polish manufacturing or power engineering enterprises related to waste management.

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THE ROLE OF 5G IN PROMOTING PATIENT-CENTRIC CARE IN SMART HEALTHCARE SYSTEMS

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Purpose: This publication seeks to present the potential benefits of fifth generation (5G) wireless technology in smart healthcare systems, especially in enhancing patient-centric care.

Design/methodology/approach: Analysis of international and local literature.

Findings: The healthcare sector is transforming and changing from a dispersed disease-centric to a more personalized patient-centric model. This has been accelerated by the integration of wireless communication technologies used in administrative functions and smart healthcare applications. 5G technology is a game-changer in smart healthcare systems and promotes patient-centered service delivery. The growing use of wearable technology has had a massive impact on personalized and round-the-clock health monitoring, especially in remote settings and this requires a stable and reliable network. The high-speed wireless technology has advanced emergency response, making it quicker and more effective, allowing healthcare providers to make timely life-saving decisions. Its high performance and reliability have led to an increase in patient experience and performance, physically and virtually. This has led to better healthcare service delivery that is more personalized and efficient as medical professionals use personalized approaches that suit the specific health needs and preferences of patients.

Originality/value: Originality/value: This article offers an analysis of the role 5G plays in supporting a patient-centered care in smart healthcare systems. The value of this research is based on outlining the interdisciplinary nature of 5G and how it can promote care services and technological advancements in healthcare.

Keywords: 5G, healthcare, patient-centric.

Category of the paper: literature review.

1. Introduction

Smart healthcare systems are increasingly becoming necessities in the delivery of medical services. However, current systems are facing immense efficiency strains due to the rise in viral infections, chronic illnesses, and a growing elderly population (Ahad, Tahir, Yau, 2019). To reduce the burden on healthcare systems and improve the quality of care, organizations are

turning to modern technological solutions. Even though the integration of smart technology into the healthcare system has been gradual and started to pick up in the early 2000s, the onset of commercial deployments of 5G technology only started in around 2019.

Healthcare facilities are turning to focus on providing individuals with patient-centered medical services rather than disease-focused (Bojhour et al., 2018). This approach puts the patient in the “driver’s seat” as clinicians have found that when patients take an active role in their care, then the results are better. A customized patient-centered approach improves patient outcomes, leads to better engagement and decision-making, and consequentially a higher satisfaction. Furthermore, a modern patient-centric approach focuses on preventive care, especially after the Covid-19 pandemic which highlighted the vulnerability of disease-focused healthcare systems.

Technology advancements have played an important role in promoting the patient-centric approach, with mobile health applications, telemedicine, and electronic health recordings catalyzing the development of highly advanced, reliable, and well-coordinated patient care. 5G wireless network has become one of the important technologies in unifying smart healthcare systems and patient-centric medical approaches. With it, patients, clinicians, and other administrators can coordinate and provide the necessary medical care. This network makes accessing patient data, collaborating amongst medical personnel, training new professionals, handling emergencies, and monitoring the patient’s progress more efficient. This research introduces 5G technology and the potential outcomes of using it in healthcare, especially in an era where patients are centered.

2. 5G wireless technology

The fifth-generation wireless technology is powering the current fourth industrial revolution. Unlike its predecessors, its connectivity is faster, more stable, and more secure. This makes the wireless network. It’s driven by the following specification requirements and advantages such as: (Ansari et al., 2022; Attar et al., 2022; Martinez-Alpiste et al., 2020):

- 100% coverage.
- 99.999% availability.
- 1-millisecond latency.
- Up to 10 Gbps data rate.
- 1000x bandwidth per unit area.
- 90% reduction in the network energy use.
- Up to 10-year battery life for low-powered IoT devices.
- Up to 100x more connected devices per unit area compared to 4G LTE.

- Fixed wireless access: a better alternative to wired broadband and suitable for markets without fiber optics.
- Mission-critical control: higher resiliency and lower latency suitable for high demand and emergency healthcare situations that require absolute reliability.
- Superior mobile broadband enables clinicians and medical trainees to access ultra-high-definition videos and use virtual reality.
- Internet of Things (IoT): enabling exponentially high connections while using lower power.

3. eHealth monitoring of chronically ill patients

Chronically ill patients need centered care due to the complex nature of their complications and their progressive changes. The multifaceted characteristic of chronic conditions requires personalized patient-centered care as they are difficult to address. They need individualized treatment plans, constant monitoring, routine checkups, adjustments in the administration of treatment, and long-term management.

Medical personnel have to continuously change how they handle such cases as they progress or regress and look for the emergence of new complications hence it is important to know how to track them. This basic nature of chronic illness requires the involvement of different participants including the patient, clinicians, and caregivers. The use of 5G technology comes in handy in this case, helping in communication, constant monitoring, and administration of care.

It allows high data transmission from monitoring devices which healthcare providers can use to make important and timely decisions e.g. changing therapy. Smart medication dispensers can integrate this technology and be used in secure monitoring and adherence tracking (Liang et al., 2021). This makes it possible to manage the timely dispensation of prescriptions in the right doses and refilling of medicine and nutritional supplements which most of these patients need. It ensures that patients can take their treatment when required and eliminates the likelihood of negative drug interactions (Choi, 2019) and if there is a lack of adherence or depletion in the prescription, then caregivers can get notified on time (Kumar et al., 2023). Movement for most chronically ill patients can be challenging so 5G eliminates the need for physical hospital visits by promoting telemedicine and encouraging virtual consultations. The high resolution offers high visual clarity for better assessment, improving the telemedicine experience. This means clinicians can attend to patients in rural and remote areas, ensuring even those in marginalized communities receive quality healthcare (Saeki et al., 2022; Mwangama et al., 2020).

This wireless communication network offers faster data transmission with low latency, leading to a more engaging telehealth experience. As a result, it fosters a healthcare environment that is more engaging, immersive, and patient-centered. 5G's ability to quickly, securely, and reliably transmit data makes it suitable for emergency responses and managing fall detection. With a wearable device connected to 5G, a sudden change in patient activity means that caregivers can quickly get an emergency alert and respond. The network in addition to wearables can be fine-tuned to offer advanced location-based services, including real-time locations, and in the event of a fall or slip, the device can transmit the emergency alert alongside the precise location (Bartoletti et al., 2021; Ersoy, Alemdar, 2010; Usman, Philip, Politis, 2019).

4. Data-driven insights for predictive analytics

One of the main objectives of using 5G in healthcare is for it to be integrated with wearable health monitors and used to perform local data analysis i.e. without the need to connect to the cloud. For instance, a heart rate monitor can be used as a stand-alone data analysis device to monitor heart health data and provide immediate response by alerting caregivers if there are alarming changes (Devi et al., 2023).

Its ultra-low latency makes it ideal for intensive care unit monitoring with real-time analysis of the continuous stream of data from connected devices. This way, healthcare professionals can monitor the patient's vitals and respond quickly in case of anomaly. The high-speed data transmission capabilities can empower the healthcare sector to harness big data for disease monitoring, design personalized treatment plans, and conduct predictive analytics (Prakash et al., 2022). Big data, in this case, refers to the information collected from various medical devices i.e. clinical, and wearables found in the form of data reports and biometric text (Jain et al., 2021). This data can be swiftly processed in near real-time to extract information for doctors and clinicians. AI can be used to power biometric patterns and provide accurate diagnoses or predict the best possible treatment in care areas related to medical imaging and precision medicine.

5. Data privacy and security

Data is a crucial component of patient-centered care as it is used in tailoring services based on specific individual needs. This includes diagnosis and personalized treatment plans based on symptoms, gender, age, medical history, lifestyle, and genetics. Traditional security

mechanisms used in legacy systems such as data encryption and isolation cannot effectively provide sufficient data protection in a distributed healthcare system (Chen et al., 2020).

The successful use and storage of digital data in patient-centered care requires investing in cybersecurity. As the healthcare system becomes more digitized, it raises questions regarding data privacy and security, thus, safeguarding patient information becomes important. 5G is an important tool that can accelerate the rate at which cyber threats can be established and handled. It allows faster and more timely data analysis, download of data, and communication across different parts of organizations (Mohanta, Das, Patnaik, 2019).

Advancements in 5G's network slicing will support enhanced patient privacy through multiple dedicated networks within a common shared physical infrastructure. This means that organizations can apply different instances of cybersecurity measures across various inner networks as patient data is not shared across isolated slices, minimizing the risk of data violations and unauthorized access (Sylla et al., 2022).

The technology allows the implementation of Zero Trust Security Architecture (ZT) (Ramezanpou, Jagannath, 2022) which, unlike the traditional security models, assumes that security and privacy threats are found inside and outside the network. When used with 5G, the identity-centric ZT promotes comprehensive monitoring and authentication to verify user identity, give access controls to users, and continuously assess the security of users, devices, and applications within the network.

The technology's ability to allow real-time monitoring and evaluation of network traffic can also be ideal for mitigating threats. Through continuous monitoring, organizations can quickly identify abnormal patterns and act on them promptly. 5G uses edge computing for data processing which means that data is processed closer to the source i.e. at the edge of the network, and as a result, it helps to reduce the risk of transmitting sensitive health data over long distances for processing. Furthermore, edge computing in 5G enables the use of "virtual" hardware which means data can be sent through virtual hubs and switches and be modified/relocated quickly instead of specialized hardware that can easily get compromised. overall, this localized data processing technique improves the healthcare system's overall security (Chan, Jain, Gupta, 2016).

6. 5G in emerging healthcare technologies

In emerging healthcare, 5G has been crucial in supporting the use of Virtual Reality (VR) and Augmented Reality (AR). The high-speed network offers a seamless integration between virtual and real elements by delivering large data sets at ultra-fast speeds and providing real-time responsiveness (Rahmati, Hazarika, 2023).

VR can allow medical students to simulate surgical procedures (Reid et al., 2017), dissect the human anatomy, or diagnose and monitor patients in a risk-free virtual setting without loss of human life. 5G mobile network presents an opportunity to accelerate the adoption of VR/AR in healthcare as it guarantees better visualization and increases medical precision. BioFlightVR startup, for instance, offers VR/AR training that medical professionals and new joiners can use to refine their skills using realistic simulations (Virtual reality medical training, 2022). A high-speed and reliable mobile network such as 5G can enhance the use of this technology, allowing more users to utilize it.

Using a 5G-powered AR can facilitate better communication and engagement between doctors and patients, leading to better visualization of symptoms. For instance, AccuVein AR startup has handheld scanners that medical staff can use to easily locate veins. 5G technology blends with the growing adoption of VR and AR in healthcare, allowing real-time interpretation leading to enhanced diagnosis, decision-making, and more patient-centric service delivery. The combination of AR/VR and a low latency network that allows seamless multiple-device connection offers an opportunity for implementing remote and active training where both the trainee and trainer can engage without limitations of physical barriers or scheduling limitations for high-demand experts (Vega et al., 2020).

7. The future of 5G in healthcare

5G technology is expected to promote better accessibility to healthcare services, especially concerning remote support. Thus, in-person hospital visits are bound to reduce, with more focus shifting to telemedicine. As a result, it is bound to enhance care delivery to confined and chronically ill patients (Javaid et al., 2023). The use of robots to deliver assistance and conduct remote surgeries with high precision will reduce the understaffed surgical sector and overworked personnel. For instance, the 5G network by Huawei and the Kangduo robot surgery system used a porcine model to perform remote hepatectomy (Tewari et al., 2022) so more refined human applications are on the way. In patient-centric healthcare systems, the 5G network will facilitate the development of collaborative environments. This is through the use of interlinked care providers and devices that allow the sharing of patient data with ease and the delivery of well-coordinated, holistic care with universal quality (Georgio, Georgiou, Satava, 2021) in different locations and areas of specialties.

5G's future in patient-focused healthcare is closely linked to the advancement of IoT and AI. Its high-latency feature makes it suitable for driving the growth of AI-based diagnostics and the use of IoT in patient care, resulting in better predictive and personalized healthcare. Home healthcare is becoming popular as the population continues to age. Most people are choosing to stay at home as it is cheaper and more convenient. 5Gs technological elements such

as real-time patient monitoring (Peralta-Ochoa et al., 2023), real time updates of vital signs, and smart dispensation of medicine means that homecare, especially for the elderly and those chronically ill will continue to grow in the future as patients choose to manage or recover chronic conditions from the comfort of their homes. This communication network will lay the groundwork for other industry players in the healthcare sector such as pharmaceutical brands. They can keep track of disease and patient behavior, improve their research efficiency, and provide better products and services via the seamless connection of devices and better accessibility. Consequentially, this can be used in predictive analytics, resulting in better research outcomes and decision-making for a more sustainable future.

8. Conclusion

The use of 5G network technology in the era of smart healthcare is bound to transform the patient-centered medical approach by changing how care services are delivered and how patients experience them. 5G enhances seamless and reliable connectivity, allowing professionals to interact with patients and collaborate with their colleagues regardless of location barriers. Thus, it opens new opportunities for medical dispensation and training by promoting virtual access. The technology provides ultra-fast data transfer speeds with low latency making it possible to manage and attend to chronically ill patients who require continuous and remote monitoring. It's real-time data analytics and swift data transmission provide clinicians with an opportunity to access critical information and promptly make life-changing decisions. Furthermore, it makes it possible for clinicians to attend to individuals in remote and underserved communities through telemedicine. The future of 5G is expected to enhance how surgical procedures are done, especially in medical traineeship through virtual reality simulation and high-clarity images without the use of human subjects (Pérez-Martínez, Yanez, 2023). Overall, 5G wireless technology will propel healthcare in a new dimension and it is expected to enhance the growth of homecare health services, telemedicine and robotic surgery support, remote patient monitoring, and an overall improvement in the smart city infrastructure.

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PROACTIVITY, ORGANIZATIONAL TRUST AND MOTIVATION IN DEVELOPMENT POTENTIAL OF FRANCHISING COMPANIES

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Purpose: Franchising activities are highly specific, and research on improving the organization and management of human resources in such companies is rarely conducted due to the overestimation of the rigidity of the franchisee-franchisor agreement in terms of implementing appropriate attitudes and behaviors of organization members, including stimulating proactivity, building organizational support or motivating employees. Hence, the main aim of the study is to determine how motivation, organizational trust and proactivity affect a franchise company's development potential.

Design/methodology/approach: The study had a form of questionnaire survey realized among 150 franchise businesses in 2022. The opinions of the respondents were gathered using a 5-point Likert scale. The study's respondents were chosen by purposeful random selection. Once the reliability indicator values had been accepted, a statistical study utilizing descriptive statistics, correlation indicators, and a multiple regression model had been completed.

Findings: The research confirmed positive correlations between employee proactivity, organizational trust and internal motivation system and the development potential of franchising companies. The built multiple regression model indicated that these variables significantly influence the development potential of franchisees' companies - the whole model explained 42.8% of variation in the response.

Research limitations: The main limitations of the study was not fully representative research sample, thus the study requires further confirmation. The quantitative nature of the study should be extended to include qualitative research explaining the examined relationships.

Practical implications: For management practitioners, the development of management tools is recommended to improve internal organization and HR management, which should be created as a complementary element to principles of the franchising system rather than as competing one.

Originality/value: The paper's contribution is visible by highlighting the significance of creating an organizational culture based on motivation, internal trust and proactivity in development of organization within the franchising network.

Keywords: motivation system, organizational trust, proactivity, development potential, franchising.

Category of the paper: Research paper.

1. Introduction

Franchising is one of the most popular forms of doing business nowadays. It is a stable system that unites a franchisor and a franchisee under a single brand. For a charge, the franchisor passes the brand and business model to the franchisee, along with all related trademarks, products, or systems. A franchise agreement, which establishes the franchisor's relations with its franchisees, is intended to ensure consistency, quality, and a certain degree of confidence in the goods and services the franchisees offer. The promotion of principles like dependability, honesty, credibility, and mutual understanding inside enterprises shows the significance of leadership in the establishment of trust and loyalty in franchise relationships. Communication, a factor fostering franchising system trust, is also crucial (Ghani et al., 2022).

The success of a franchise depends on the relationship between the franchisor and the franchisee. Consistent business strategy, capable management, and excellent communication ensure that all parties are involved. There needs to be an open and trustworthy relationship between the franchisor and the franchisee. While there is only one final decision-maker in a franchise system, decisions are frequently reached by consensus in a fast-growing, well-managed franchise system (Hizam-Hanafiah et al., 2023). To ensure the development and success of the entire system, franchisees and franchisors work together and actively take part in the innovation process (Karmeni, de la Villarmois, Beldi, 2018). Being competitive involves ongoing development of the offer to satisfy client needs. All ecosystem players must cooperate with the franchisor in order to accomplish this.

The research presented in this paper is interesting in that it examines how organizational factors built the development potential of franchising businesses, which are known for their high management specificity as a result of the tight franchisor-franchisee relationship. The primary goal of the study is to determine how motivation, organizational trust and proactivity affect a franchise company's development potential. Therefore, the paper's contribution is to supplement theoretical knowledge by highlighting the significance of creating an organizational culture based on motivation, internal trust and proactivity in development of organization within the franchising network. Based on this knowledge, the paper then identifies the practical implications for both franchisors and franchisees.

2. Literature review

2.1. Motivation system

Motivation is known as a force that directs, stimulates and perpetuates behavior or an individual's willingness to carry out a task (Bos-Nehles et al., 2023). As Fırat, Kılınç and Yüzer (2018) point out, motivation is the energy that drives a person towards a certain goal. The term "motivation" refers to the forces that start work-related behavior and control its form, progress, intensity, and length (Løvaas et al., 2020).

Examining how people are motivated by several interconnected elements is important aspect of human resources management. People who have chosen to meaningfully attempt to accomplish something they value are motivated. What is more valuable to each person varies. People can be motivated in a variety of ways, including by financial incentives, goals to reach, the fear of losing their jobs, and the objectives of the company or certain groups within the business. It is stated that in order for each employee to successfully do their assigned tasks inside the organization, they would need a unique set of skills and goals, and that the process of motivating starts with understanding the needs of a particular individual (Ismajli et al., 2015).

One of the basic tasks in the field of human resources management is to provide the organization with motivated employees. To achieve this, appropriate and consistent motivational activities should be undertaken at all levels of management, starting from managers who should have knowledge about the needs and expectations of their subordinates and the ability to influence their attitudes and behaviors, to human resources specialists who have the ability to shape employee motivation by designing effective motivational systems. The company should develop an appropriate employee motivation system, in accordance with its specificity. An efficient motivation system should take into account incentives, measures, rules and conditions appropriately matched to the needs of employees, which will have a significant impact on the employee's behavior in such a way that both the employee and the organization achieve the intended outcomes. It consists of motivation tools that can be divided into three groups: constraint, encouragement, and persuasion (Knap-Stefaniuk, Karna, Ambrozová, 2018).

2.2. Organizational trust

Trust inside an organization is seen as the cornerstone of enduring relationships between employees and employers. It can be characterized as a readiness to be exposed to the other party's actions based on the expectation that the other party will carry out a certain action that is crucial to the party relying on it, regardless of the ability to observe or manage the other party. Since it has so many positive effects on a company, such as lowering transaction costs or fostering employee cooperation, organizational trust is viewed as a type of social capital. Furthermore, trust lowers monitoring expenses, reduces opportunistic behavior, encourages

organizational innovation, and gives the company a distinct competitive edge. It has been shown that trust impacts relationship processes, such as the quality of interactions, as well as business outcomes (Silva, Carrizo, Mota, 2023).

Organizational trust is related to a person's conviction that their membership in the organization would be advantageous in every way. Organizational trust can be understood in two different ways: first, as trust within a specific organization, and second, as trust in the company's leaders. Organizational trust is a quality that enhances task implementation in organizations by having a favorable social connotation. In addition, the importance of leaders in fostering organizational trust is highlighted, as this is where the process of enhancing trust within organizational structures starts (Ilyas, Abid, Ashfaq, 2020).

At the individual level, trust is described as a state in which a person has confidence in a particular individual or group of individuals who possess a particular set of traits in respect to a particular object. In this instance, we're referring to the more specific idea of "relational trust", which is different from "generalized trust" in others. However, it should be recognized that there is a causal link between relational and generalized trust. Generally speaking, we understand that when people can be trusted, transaction costs are lower and collaboration in various fields increases. There is proof that relational trust and cooperation play an important part in how businesses developed, and there is also evidence that there is a strong link between generalized trust and innovation at the firm level (Bischoff, Hipp, Runst, 2023). So, because it enables businesses to exchange information and work together to solve challenges as part of good management of the innovation process, trust is crucial to the process of innovation (Shazi, Gillespie, Steen, 2015), which ensure the development of the organization.

2.3. Organizational proactivity

The ability of a business to seize commercial opportunities by making an effort in a highly competitive environment is referred to as proactivity. Being proactive means being able anticipate new goods and services rather than just reacting to events as they happen now. Major firms consistently enter new markets early because they can confidently foresee the demands of a competitive marketplace. They also frequently receive the label of "quick movers", despite the fact that they initiate and sustain these efforts, such as the first moving firms. Proactivity is the ability to create an insight centered on gaps that are discovered through in-depth investigation or market research analysis. So, businesses may stay competitive by being proactive (Al-Mamary, Alshallaqi, 2022).

According to Lumpkin and Dess (1996), being proactive refers to the alignment of predictions and actions with market expectations and needs going forward. According to this viewpoint, proactive organizations are defined by a desire to lead the way and take advantage of new opportunities in their surroundings. By focusing on premium market sectors, charging high prices, and displacing rivals, proactive businesses can get a first-mover advantage. Concepts relating to the first-mover advantage and the disclosure of unmet consumer

requirements are included in the proactivity (Liu, Lee, 2015). Proactive economic organizations can foresee future consumer demands and market shifts when searching for market opportunities (Fadda, Sørensen, 2017).

Providing suggestions for improvement, getting feedback, and selling issues to management are all examples of proactive behavior in the workplace (Parker, Wang, Liao, 2019). Self-initiation is essential for foreseeing and controlling situations. By clearly defining their jobs, proactive employees may efficiently manage new tasks and goals, according to prior study. Proactive individuals are better able to establish and sustain working relationships with their superiors and coworkers, which might have an impact on social interactions in the workplace (Luqman, Zhang, Hina, 2023).

2.4. Hypotheses development

In the literature, it is frequently noted that proactivity and corporate performance are related. Proactive businesses are the first that recognize early signs of changes in their environment, are able to detect the opportunities that these changes present for gaining a competitive edge, and are able to take advantage of those possibilities. A proactive strategic mindset encourages internal dialogue and knowledge exchange, which aids in achieving desired business outcomes, and built development potential of company (Sancho-Zamora et al., 2021). An enterprise can anticipate the needs of emerging markets and combine resources to better address them than rivals if it maintains a very proactive approach. Being proactive enables businesses to take advantage of the first-mover advantage and gain rewards that latecomers won't, such as expanding their customer base and improving their reputation with consumers. This fact provides strong evidence that firms' business performance and proactivity are positively correlated, which contributes to their success (Loan et al., 2023). In relation to the franchising industry, the relationship between proactivity and business performance has also been noted, albeit to a lesser level (Zahoor, 2021). Based on these arguments, we propose the following hypothesis:

H1: Proactivity has a positive impact on development potential of franchising companies.

According to George, Aboobaker and Edward (2020), organizational trust is seen as a key component of satisfying and lasting employee-employer interactions. Enhancing organizational trust within a company has a number of benefits. The benefits of trust for an organization include lower supervision costs, a decline in opportunistic behavior, support for organizational innovation, and unmatched competitiveness. It affects the effectiveness of interactions as well as the economic outcomes (Silva, Carrizo, Mota, 2023). The topic of trust was also discussed in relation to the efficiency of franchising companies, but the main focus is on trust within the franchising system, and especially towards the franchisor (Herz et al., 2016). Meanwhile, the aspect of organizational trust in the franchisee's company, which affects the efficiency of work and the entire organization, is omitted. As such, we can define the hypothesis as follows:

H2: Organizational trust has a positive impact on development potential of franchising companies.

The motivation system is an important element of modern human resources management. It is a tool for influencing the organization's managers on employees, influencing the increase in work efficiency and the results of the entire company. The motivation system is intended to encourage employees to work more effectively, thus contributing to better achievement of the organization's goals and improving the efficiency of its functioning (Knap-Stefaniuk, Karna, Ambrozová, 2018). Human resources have the ability to create competitive advantage for their organizations. Employee performance depends on many factors, including motivation, which significantly affects organizational performance. A motivated employee has individual goals that are consistent with the organization's goals and directs his or her efforts in this direction. Additionally, these organizations are more successful because their employees are constantly looking for ways to improve their work (Dobre, 2013). It is pointed out that it is necessary to build and strengthen employee motivation, both internal and external, which directly improves work efficiency, which contributes to the improvement of the economic condition of the enterprise and its development (Meirinhos et al., 2023). Considering the above, the following hypothesis was developed:

H3: Motivation has a positive impact on development potential of franchising companies.

3. Methods

In 2022, the study was carried out as a survey among 150 franchise businesses. Initial (pilot) research on a group of 10 persons was conducted prior to the survey to ensure that it was accurate and transparent in its content. The collected findings were organized, examined, and interpreted before being combined into a research report.

As independent variables, proactivity (PR), organizational trust (OT), and motivation system (MS) were selected. Every independent variable in the study was constructed using four survey responses that related to individual, group, organizational, and inter-organizational actions or activities. The opinions of the respondents were gathered in the form of arbitrary evaluations using a 5-point Likert scale.

The development potential (DP) was a dependent variable in the research. The development potential as a dependent variable was presented as a sum of five survey responses, and takes into account changes in the level of employment, the number of the company's clients, the quality of services provided, efficient internal organization of the company, and the efficiency (effectiveness) of company management over the last two years. The study's respondents were chosen by purposeful random selection.

While most research in the field of organizational variables employs a managerial perspective, the study's use of an employee method was novel. In actuality, employee research will provide you access to information that supervisors do not have.

In our study, the first stage of analysis was to assess the validity and reliability of the data (Tab. 1) in order to assess the caliber of the research.

Table 1.

Cronbach's alpha reliability test

PR	OT	MS	DP
0.833	0.847	0.891	0.876

Source: own research.

A Cronbach's alpha coefficient was used to evaluate the internal consistency of a group of objects. Given that 0.7 is the generally accepted value for Cronbach's alpha, it should be noted that the level of Cronbach's alpha is high (above 0.8) for all variables.

4. Results

It should be noticed that the respondents' responses for the proactivity and motivation system assessments are relatively comparable when assessing descriptive statistics for independent variables (Fig. 1), each of which consists of 4 component variables rated on a 5-point Likert scale. On a scale of up to 20, respondents gave the proactivity variable an average rating of 14.24 and the internal collaboration variable an average rating of 14.16. The organizational trust variable's mean responses, however, were higher and reached a level of 15.55. The least amount of standard deviation (3.80) was observed for this variable, indicating the least amount of response dispersion.

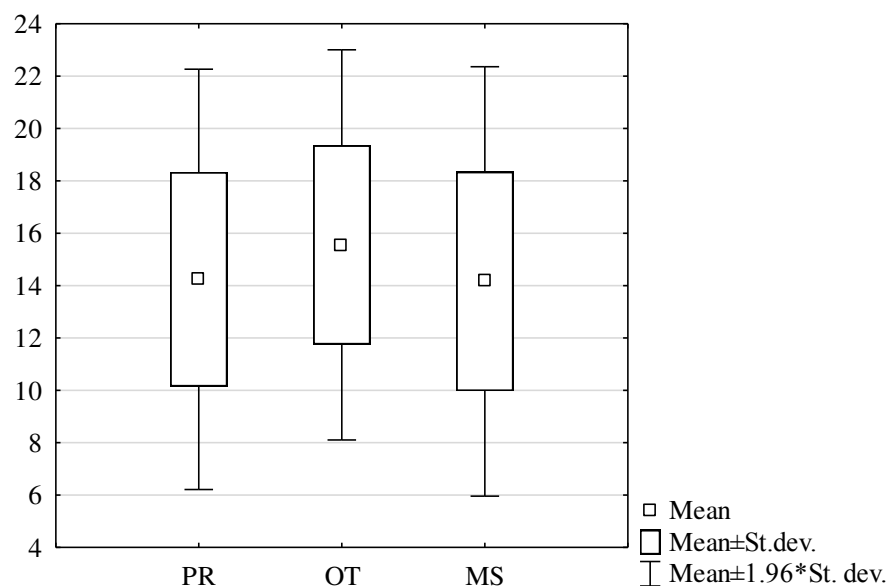


Figure 1. Descriptive statistics for proactivity (PR), organizational trust (OT), and motivation system (MS).

Source: own research.

The development potential of franchisees' businesses served as the study's dependent variable (Fig. 2). According to an analysis of descriptive statistics, this variable's average response on a scale of up to 25 was 18.71, and the standard deviation was 4.59. As a result, the respondents gave their franchising businesses positive ratings for their development potential.

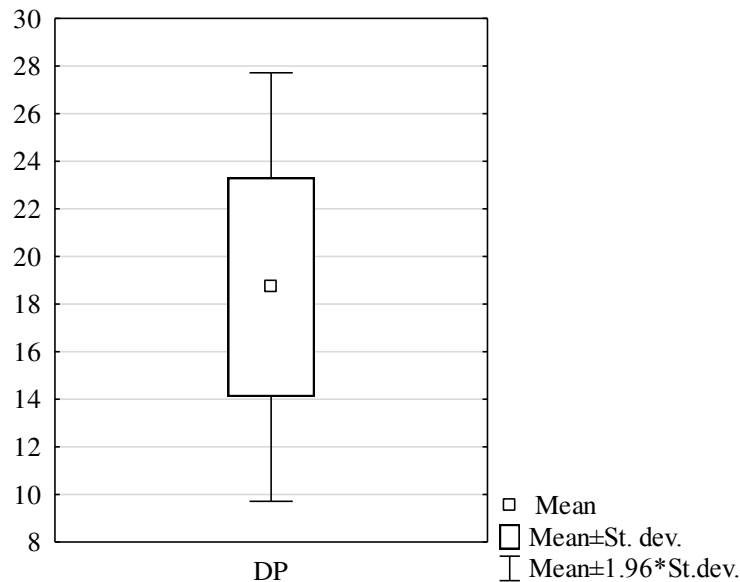


Figure 2. Descriptive statistics for development potential (DP).

Source: own research.

The correlation between the variables was looked at as the following phase in the research. The Kendall Tau correlation indicator was used to determine the correlations between the predictors. For all of the tested aspects, the study of Kendall's tau correlation revealed statistically significant dependencies trending in a positive direction (Table 2). The strength of the correlation between the variables ranged from weak to moderate, which allows for multiple regression analysis to be performed.

Table 2.

Descriptive statistics and correlation analysis (n = 150; p < 0.05)

	Mean	S.D.	MS	OT	PR	DP
PR	14.240	4.094	1.000	0.312	1.000	0.409
OT	15.553	3.801	0.312	1.000	0.380	0.320
MS	14.160	4.184	0.413	0.380	1.000	0.425
DP	18.713	4.593	0.409	0.320	0.425	1.000

Source: own research.

Multiple regression analyses were used to evaluate trends in the influence of independent factors on the development potential in franchised businesses (Tab. 3). The development potential level was included as dependent variables in the regression model. It was verified by Table 3's summary of the multiple regression model that the entire model was statistically significant ($p < 0.05$). Additionally, the complete model was able to account for 42.8% of the response variability, which is a promising outcome.

Table 3.
Multiple regression model summary

R Square	Adjusted R Square	Sum of Squares SS	df	Mean Square MS	Change Statistics			F	p
					SS	df	MS		
0.440	0.428	1381.465	3.000	460.488	1761.209	146.000	12.063	38.173	0.000

n = 150	Parameters estimates Sigma-restricted parameterization			
	DP Param.	DP Std. Err.	t	p
Intercept	5.351	1.343	3.986	0.000
PR	0.262	0.082	3.177	0.002
OT	0.260	0.090	2.897	0.004
MS	0.395	0.087	4.516	0.000

Source: own research.

All predictors within the model seem to have a statistically significant beneficial impact on GP. A 26.0% to 39.5% increase in the level of the development potential variable in the franchising company follows a 100% increase in each predictor.

5. Conclusion

The development of an enterprise depends on a significant number of factors, so it is complex, variable, and difficult to predict. However, it should be noted the growing importance of organizational factors in building the development potential of the organization. This may be particularly important in the case of companies that cannot base their development on the introduction of new products or services, remaining dependent companies within the network, as is the case with franchising systems. Franchisee companies are characterized by a high specificity of activity, but it seems that the quality of franchisor-franchisee cooperation and effective human resources management can be a significant stimulator of the growth of these organizations.

The survey conducted allowed for confirmation of all three research hypotheses. It can be concluded that proactivity, organizational trust and the motivational system have a significant positive impact on the development potential of franchising companies.

The research method has a number of limitations that can be discovered. First off, because only franchisee businesses are included in the research sample, the research group is not entirely representative. In order to assure the entire representativeness of the study, including in connection to specific enterprise features, such as the size of the enterprise or the length of operation on the market, an option would be to expand the research in the future. The flexibility of this research is somewhat constrained by the fact that only quantitative research is being

done utilizing a questionnaire with closed-ended questions. The answer would be to add qualitative research that explains the factors that led to the associations that were discovered.

Numerous contributions are made to the body of literature by this research. The state of the art was initially reviewed to emphasize the significance of specific organizational characteristics on the development of franchising firms and to close any gaps in the literature. This is a unique study in this group of enterprises, which highlights its contribution to science. Examining the impact of organizational proactivity, organizational trust and the impact of the motivation system built in the company on the development potential of franchisees highlights the importance and need for further research on the impact of organizational variables on specific groups of economic entities.

This study also has implications for management practitioners, highlighting the importance of organizing and managing human resources and the development of franchising systems, as well as the need for continuous improvement in these areas. Therefore, business professionals can employ research findings to enhance operational and strategic business operations. The development of management tools that support the use of powerful organizational solutions concurrently with the operating principles of the franchising system is highly advised, with the idea that both components should be viewed as complimentary rather than as competing with one another.

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PLANNING AND OPPORTUNITIES FOR DEVELOPMENT OF STUDENTS' PROFESSIONAL CAREER IN POLAND AND ITALY – A COMPARATIVE STUDY

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Purpose: The aim of the article was identification and analysis of factors influencing students' career planning and development in Poland and Italy.

Design/methodology/approach: The first stage of the research involved an analysis of the source literature and a review of the activities undertaken by universities in order to support students in career planning. This was followed by an analysis of reports on the situation of young people on the labour market in Poland and Italy. The final research method was a diagnostic survey with the use of a questionnaire, which was addressed to students of selected universities in both countries.

Findings: Polish and Italian students are aware of their needs regarding their future careers, they are able to formulate career goals and to select a strategy needed to achieve them. However, there are noticeable differences in the implementation of their career plans. These discrepancies may be due to the socio-economic situation of students' countries of origin.

Practical implications: The article is a source of information for both students embarking on their professional careers and employers who will be able to meet the expectations of young employees, as well as universities seeking to create competitive activities in order to support professional development of their students and graduates.

Originality/value: The article presents an interesting, comprehensive and comparative study of students in two EU countries, taking into account not only labour market data, but also direct opinions of students and an analysis of the career support activities offered by universities.

Keywords: professional career, career counselling, student needs, labour market, higher education.

Category of the paper: Research paper.

1. Introduction

Changes that have taken place in society and economy as well as in an individual's identity have shaped the current approach to career management. In the past, a professional work system was in place and the learned occupation was most often a lifelong profession that defined a person's identity. One of the signs of the transformation of the contemporary approach to careers is the deviation from linear, predictable and long-term careers to the development of flexible, variable, mosaic careers implemented in many organisations where responsibility for their development has been transferred to employees (Smolbik-Jęczmień, 2020, p. 118).

Each generation of employees has its own characteristics, different goals, needs, expectations and approaches to life and career development. Particularly for young people, choosing a career is not an easy task, especially in the current reality in which it is difficult to plan the future and predict the results of our actions. Obtaining a university degree nowadays is no longer a guarantee of a rewarding career. This is because tertiary enrolment rates are increasing and more and more people decide to go to university. However, young people are aware of the fact that in order to meet the requirements of employers they must ensure their competitiveness as early as during their studies and take initiatives that result in increased competencies. Not only taking up their first job, but also making skilful use of the support offered by those around them and by universities may improve their career prospects. There are many publications on people from Generation Z. Most of them focus on issues concerning the motivation of this group of employees, e.g. Paszkiewicz, Wasiluk (2022), or their chances of finding employment, e.g. Messyasz (2021). Additionally, there are reports presenting the situation of young people on the labour market on a national, EU or global scale. Detailed studies usually deal with the situation in a selected country, there is a lack of comparative studies taking into account the situation of young people from different countries who outwardly live in the same conditions and taking into account both their own needs and opportunities in their environment.

The aim of the article was identification and analysis of factors influencing students' career planning and development in Poland and Italy. The research sample consisted of full-time, first-degree students from selected universities. The authors' aim was to compare such aspects of students' careers as: ideas about future work; needs, expectations, motivation and values they follow in life; as well as to check the extent to which their career goals are reached. In addition, the authors made an in-depth analysis of the activities supporting students' career plans offered by universities and the problems faced by students at the beginning of their careers. The results of the research were juxtaposed with a number of published reports on the situation of young people on the labour market, required competencies and preferred professions.

This research will identify career areas that need to be improved by university centres as well as companies employing Generation Z people. In addition, the results of the research will help students set their goals and choose the strategies necessary to achieve them at the beginning of their careers. They will also make young people aware of the possibilities around them.

2. Individual career planning and management

A person's career is a sequence of career-related experiences, accumulated over a lifetime (Arthur, Hall, Lawrence, 1989, p. 8). Thus, an individual who develops his or her career is a particular person. His or her career is focused on work-related experiences that arise from undertaken tasks and solved problems. An employee is responsible for initiating his or her own career planning and identifying skills, values and interests. This person also seeks out career opportunities in such a way so as to achieve his or her goals.

Career planning involves an individual making informed choices about occupation, workplace and self-development as well as exercising control over their career (Hall et al., 1986). Career management means a balance between needs of an individual and need of an organisation. In case of an individualistic approach, it is the individual who manages his or her career, taking into account individual interests, abilities, motivation, rational choices as well as biological and social development. From organisations' point of view, career management is a support for employees' career development in a form of offering appropriate activities (Jarosik-Michalak, 2018, p. 128).

Career exploration is related to the information that a person collected and that concern themselves and their environment. This includes information about talents, values and interests, as well as opportunities and barriers they may encounter in their work environment. Awareness of these issues is crucial because people may not know themselves well enough to choose the right career path, or they may overestimate their strengths in certain areas and judge themselves to be more talented than they actually are (Jarosik-Michalak, p. 125). Exploring the environment, on the other hand, makes it possible to gather information about relevant aspects of the profession as well as present or future alternative jobs. Self-awareness and knowledge of work environment make it easier to set one's career goals. It is important to note that career management is an ongoing and continuous process, as work is a major part of an individual's life and a satisfying career can promote a sense of fulfilment. In contrast, a sequence of poor career decisions can have a negative impact on further development (Greenhaus, Callanan, Godshalk, 2000, p. 34).

From an individual's point of view career theories may be divided into: life-cycle theories, e.g. the theory of E. Ginsberg (1951) or the theory of D.E. Super (1990), in which an individual's actions are related to their career stage and theories based on an individual's

needs, interests and personality. These include, in particular, E.H. Schein's (1985) concept of career determinants or the hexagonal model of J.L. Holland (1973).

One's career identified with different stages of working life is represented by concrete activities and psychological adjustment (Arthur, Rousseau, 2001), it involves various events and specific tasks. Skills that have been already mastered are not sufficient to perform in a given position throughout one's career. Enabling employees to continuously learn and retrain is an important task for organisations. The process of knowledge development as a result of training requires an organisation to take advantage of this knowledge and create conditions for sharing it (Olkowicz, 2013, p. 412).

A person's life constitutes a cycle within which there is an ordered system of consecutive stages containing a component of conscious or unconscious choice, and resulting from individual characteristics of a person or from the pressure of external conditions (Miś, 2007, p. 97). The cycle includes stages of building and stabilisation and transitional stages. Transition periods are distinct stages in which new roles are undertaken after old roles have been analysed and abandoned. An individual usually makes a career choice at a very young age, but not everyone succeeds in achieving their goal. Sometimes a person chooses a career at a later age or is not able to take such a decision at all. An individual may also modify his or her career aspirations due to changes in his or her environment, recognition of his or her own limitations, changes in values and attitudes and those related to personal life. Career choices may be unintentional; even if planned, they do not guarantee the achievement of goals (Baruch, 2004, p. 40).

A university period is the time when an individual is looking for a career path that suits him or her. The point at which young people currently enter the labour market is not clearly defined, as it is difficult to specify when an individual completes their education, takes up their first permanent job and experiences regular employment. This period involves a number of activities in areas relating to education and work that overlap with the years of youth and early adulthood, as more and more students take up work during their studies (Tomaszewska-Lipiec, 2018, p. 123). Those who undertake work activities while still studying need to manage their time effectively in order to fulfil their tasks properly and responsibly. The lack of this skill may result in a lower level of motivation to study, compared to those only studying. Many students seek additional income mainly to satisfy their higher needs. A job does not only provide an income, but also gives an opportunity to gain experience, which is increasingly required of young people in the labour market. In addition to this, working students can also learn new things, improve their skills and build networks before getting their dream job. Taking up employment is also an opportunity to become independent.

It should be noted that students do not always find a job in line with their expectations and that their studies do not always coincide with their ideas about education. Setting career goals and choosing a right company is not an easy task, especially when there are different options of career plans implementation. Another problem is insufficient information about jobs,

employers or the requirements in case of a specific role in an organisation. A young person may then feel unprepared to take responsibility for their career and requires support from those around them. This may include guidance from immediate family, friends, employers or universities. The higher education system may define a new lifestyle for individuals in order to equip them with skills that will allow them to avoid problems (Ghiasi Nodooshan, 2022, p. 21). Gathering information about career options, i.e. exploring the environment, raises students' awareness of whether their interests, values or behaviours integrate with the expected job. Self-exploration, on the other hand, integrates an individual's goals, values and future behaviour with potential career paths. Students may engage in exploration of the environment, discovering career options and gaining knowledge about specific jobs or organisations as well as seeking information about specific areas of professional interests (Kleine, Schmidt, Wisse, 2021, p. 3). Exploring both their environment and themselves, they can discover available career options and ultimately choose a career path that is in line with their values and interests. Besides, a discovery of factors that favour or hinder career exploration can contribute to understanding the conditions for successful preparation for entry into the work environment (Kleine, Schmidt, Wisse, 2021, p. 3). Exploration of one's environment and the self may also in some cases reveal a lack of preparation for a future career, thus reinforcing negative emotions related to the decision-making process (Kleine, Schmidt, Wisse, 2021, p. 14).

The Covid-19 epidemic and the armed conflict in Ukraine have had a major impact on young people's career opportunities. Many of those who study nowadays try to find their way in a new environment that is unpredictable and changeable. Moreover, the crisis caused by COVID-19 has once again reminded everyone of the key role that leaders play in dealing with unexpected events that threaten functioning of an organisation (Olkowicz, Jarosik-Michalak, 2022, pp. 55-63). Young people expect not only clear and understandable messages from their supervisor, but also support, especially in crisis situations.

According to the research conducted, young people from Generation Z are ready to perform tasks entrusted to them to the best of their ability if they are also adequately remunerated, are able to develop and expand their competencies and have the opportunity to decide or co-determine certain activities of the company; in such a case they accept the possibility that they will bind themselves to a company for a longer period of time (Gajda, 2017, p. 170). Generation Z employees also value a good and comfortable life, based on the concept of work-life balance in which work will be a source of satisfaction and good experiences (Paszkiwicz, Wasiluk, 2022, p. 255).

3. Support for student career planning by universities

Young people make their plans, including setting career goals, in various ways. Some plan to stay in their country, others consider a possibility of moving abroad. There are also those who want to have a professional position that will allow them to work at various locations around the world. Due to the ongoing changes in the field of higher education resulting from the process of European integration, new opportunities, possibilities and challenges have opened up for universities and students. However, in order to meet the demands of the competitive EU labour market, students should start building their careers as early as during their studies (Krauze, 2012, p. 37). The authors of this study reviewed programmes at high-scoring universities in Poland and Italy. They used the rankings from *Perspektywy 2023* and *Lagunita Education* publications. The most important measures are summarised and described in the following section of the study.

As part of career planning Polish universities provide their students with, among other things, career counselling, i.e. getting to know one's career potential, preparing CV documents, assistance in preparing for job interviews, coaching/mentoring, training, psychological support, legal consultations, internship and apprenticeship programmes. Students who want to get to know their potential, may take career aptitude tests. This tool helps to discover one's own distinguishable strengths and the skills that need strengthening. What is more, these tools are used in recruitment interviews in order to determine candidates' professional predispositions and the level of skills they possess that are useful for a specific job. Students also have the opportunity to take the Extended DISC Behavioural Analysis tests. This is an online diagnostic tool that provides respondents with information about their preferred ways of behaving, so-called behavioural styles. The results are discussed together with a Certified Extended DISC Consultant, thanks to which a student finds out what motivates and demotivates him or her the most, which professional situations may be the most stressful for him or her, what may have the greatest impact on success in his or her career, which tasks will be the least comfortable for him or her and which types of superiors are the easiest and the most difficult to work with.

Another counselling support is the possibility to meet with a career counsellor. During individual sessions students may get advice regarding their career paths, plan their professional development, get information on how to recruit in a specific company or practice a recruitment interview. Qualified career office staff and career counsellors help graduates notice the practical skills needed to navigate the labour market, while informing them about its requirements and current trends.

Students can also take advantage of a wide range of training courses and programmes to improve their qualifications and stand out in the labour market. Management and leadership programmes are innovative forms of developing future leaders by dynamically developing their management skills and expertise at the same time.

Other development activities involve ambassador programmes used as tools to build employers' brands among students from the very beginning of their academic journey. Nowadays ambassador programmes are comprehensive projects that open up a number of inspiring opportunities for students. Thanks to them young people may get to know a company, its culture and values from the inside. Another activity that supports career planning is job interviews. As part of mock interviews, universities offer students a possibility to arrange a mock interview so that they can test their skills in self-presentation, giving impressive answers to recruitment questions or salary negotiations. Moreover, as part of the universities' internship programmes, students can apply for offers recommended by Careers Office, both to domestic and foreign companies.

Universities in Italy offer similar measures to those mentioned above in order to support a professional development of their students. They also use special platforms to help students find their perfect job. National and international offers can be found there. Universities in Italy also offer their students and graduates internship opportunities to help them enter the labour market. Internships are organised in such a way as to enable learning in practice. Universities organise various events throughout the year in collaboration with companies and institutions to foster interaction between universities and the labour market and to provide students with opportunities to meet recruiters and professionals from national and international companies. Students have an occasion to learn about each company's selection process, may present their CVs and have a mock interview with recruiters.

In addition, a Career Office offers students a professional career orientation service to support the development of their employability during the problematic phase of the transition from university to work. The office organises Career Labs, i.e. career orientation and skills development workshops designed and run by the Careers Office in order to help students and graduates take their first steps on the job path, make more informed choices about their career future and gain confidence in the selection process. Some universities have signed collaborative agreements to implement individual mentoring programmes for students who meet specific requirements. They also offer the opportunity to participate in talent programmes to provide guidance and support during a career start-up phase. During individual meetings which are freely arranged with a mentor, students' ambitions, skills and career goals can be discussed. Those who successfully complete the course receive a Career Management Skills Open badge.

Universities also launch a personalised CV review consultancy service for their students and graduates. Individual meetings are supposed to provide useful advice and strategies for creating a winning CV. An important support for development activities is the *NoiBene* psychological intervention programme, aimed at preventing mental disorders among students, providing knowledge about mental health and promoting positive, flexible behaviour and improvement of life skills.

4. Situation on the labour market in Poland and Italy

Among the main determinants of the labour market change mentioned by experts there are: technological development, demographic change, population migration, rapid urbanisation, resource scarcity and climate change (PARP, 2022, p. 34). Also, unexpected events in recent years, such as a pandemic or the war in Ukraine, as well as constant technological progress, the uncertainty of tomorrow and randomness have a strong impact on employment opportunities. In turn, trends transforming the labour market include the automation of manual work, increasing voluntary turnover of employees, decreasing employee attachment to employers, increasing expectations/new motivation tools, changes in work patterns and the development of alternative forms of employment, concern for the psychological well-being of employees, monitoring of employees (PARP, 2022, p. 34).

It is increasingly difficult to predict how the demand for employees in particular industries will evolve and what competencies will be required of employees. Current reports indicate that only 10 per cent of people have an occupation that will not change, 20 per cent of people have an occupation that will disappear, while 70 per cent of people will need to retrain (Jagielska, 2023, p. 25).

Among the generations on the labour market there are more and more people from Generation Z. A large proportion of the young working population are university students. This situation is related to the increasing massification of higher education, hence the share of university students in the workforce is steadily increasing, as students are often flexible with regard to working hours and look for work in the service sector and fast-growing industries, including IT (Beblavý, Fabo, 2015, pp. 23-24). Despite the benefits of a university degree it is also noticeable that the role of formal education is diminishing and certified courses and other forms of digital education are gaining in popularity, regarded as an indicator of the competences expected by employers (Warsaw University Incubator, 2022, p. 16).

In April 2023 the unemployment rate among young people (up to 25 years of age) was 13.8% in the EU-27 and 13.9% in the euro area (Eurostat, 2023). Poland's unemployment rate among young people (under 25) was 10.3% (overall unemployment rate – 2.7%), while in Italy it was 20.4% (overall 7.8%).

According to the 37th edition of the survey “Job offers in Poland. Monitoring of recruitment processes in the Polish labour market”, prepared by Grant Thornton in May 2023, employers published 308.5 thousand new job offers on 50 largest recruitment online services in Poland; the highest year-over-year increase in offers was recorded for the positions of: CIO/IT Director (67%), Accountant/Accounting Specialist (43%) and Physician (36%); the largest decrease was in the positions of Chief Financial Officer/CFO (83%) as well as HR Business Partner and Marketing/Sales Director (41% each). As many as 77% of employers worldwide declare problems in finding a qualified talent. Companies mainly expected candidates to have

experience (81%), relevant education (44%), foreign language skills (32%) and be available (39%) (Grant Thornton, 2023). Among the abilities valued by graduates and employers in the 21st century were communication and problem-solving skills. In addition, critical thinking, initiative and self-direction as well as social and intercultural skills were also identified as important (Karaca-Atik et al., 2023, p. 11).

According to the report prepared by PageGroup's experts who specialise in the analysis of talents in the labour market and are active in Page Insight group under Talent Trends 2023 research, work-life balance is one of the most significant factors influencing job satisfaction. As many as 40% of people are willing to turn down a promotion if they feel it will have a negative impact on their wellbeing (PageGroup, 2023).

The research "Young Poles on the labour market", which was conducted jointly by PwC, Well.hr and Absolvent Consulting, shows that:

- young people positively assess their chances in the labour market,
- more than one half of young Poles declare that high remuneration is one of the paramount aspects of work,
- an important motivating factor, apart from remuneration, is also gaining experience, sense of work, flexible working hours, possibility to combine professional and private life, good atmosphere, supervisor's support and taking care of their well-being,
- the most important competences in their opinion, are above all: openness to changes and quick adaptation in new conditions, combining different skills, quick learning of new things as well as IT and programming languages expertise,
- there are a number of things that young employees would find difficult to accept in the workplace: remuneration inadequate to expectations, high stress level, insufficient development and promotion opportunities, conflicts in a team, repetitive, boring tasks and long commuting times.

The Italian labour market is very diverse. Industrial activities are mainly concentrated in the north, while people in the southern regions work mainly in agriculture and tourism (EURES, 2023).

According to the report prepared by European Economy (2023), the labour market situation in Italy improved significantly in 2022. The unemployment rate continues to fall steadily from a peak of 12.9% in 2014. Large mismatches between local demand and supply persist, mainly due to an insufficient supply of skilled workers where they are needed. When considering employment opportunities, location is important. In the third quarter of 2022, the unemployment rate in the south of Italy (14%) was twice as big as in the centre (6.6%) or the north (4.9%).

Analysing the data contained in the report (2023), it can be established that:

- youth employment rates remain low, especially in the southern regions;
- overall, only 61.9% of Italians aged 15-34 are employed compared to 76.4% in the Eurozone;

- those who have obtained a tertiary education (academic or vocational) are as likely to be employed in the north of Italy as the Eurozone average. In the south of Italy, on the other hand, employment rates are much lower than in the country as a whole. Hence, those with higher education are more likely to find a job;
- the share of young people not in employment, education or training falls to 19% in 2022. However, it is much higher for young people with a migrant background.

The results of empirical research whose aim was to propose a typology of labour markets of the European Union Member States show that labour markets characterised by the most favourable position of young employees include those existing in the Netherlands, Germany and the Nordic countries; the least favourable situation concerned Greece, Spain and Italy; the situation of the Polish labour market was assessed as average (Potocki, 2021, p. 10).

As it was mentioned earlier, the Covid-19 pandemic had a major impact on the labour market and thus on career opportunities. As a result of the crisis caused by the pandemic, unemployment rate among young people increased significantly. Limited on-the-job training, financial insecurity, housing instability and often psychological problems became a cause of hardship for many representatives of the younger generation (Mazurkiewicz, 2022, p. 137). The imposed isolation resulted in a higher anxiety and other psychological problems among young people, which has translated into a deterioration of their emotional well-being (Cowie, Myers, 2021, p. 63). These aspects should be considered by employers wishing to attract and retain the best young employees.

5. Methodology of the research

The design of the research on planning and career opportunities for students in Poland and Italy aimed to provide effective methods for collecting, analysing and sharing information. It included the definition of research objectives, the selection of the research sample, the choice of methods for collecting information and the qualitative analysis of the results. The main objective was identification and analysis of factors influencing students' career planning and development in Poland and Italy. The following specific aims were also set:

1. To identify factors relevant to career planning and management by an individual, taking into account the student group.
2. To identify solutions proposed by universities for the development of students' careers.
3. To analyse the situation of young people in the labour market in Poland and in Italy.
4. To compare future work perceptions of students in Poland and in Italy.
5. To identify the needs, motivations and expectations of Polish and Italian students with regards to their future work.
6. To identify the values which guide students in both countries when taking up a job.

7. To identify and determine the degree of completion of activities undertaken in relation to the realization of professional goals by the students taking part in the survey.
8. To identify the activities undertaken by the selected universities to support students' career plans.
9. To formulate recommendations for students, employers and universities in order to enhance the career opportunities of young people who study as well as those who study and at the same time undertake professional activity.

The research group consisted of full-time, first-year students of selected universities from Poland and Italy. The authors deliberately chose such a research sample consisting of young people who are at the beginning of their career path; some of them only study, some of them have their first work-related experience. It is presumed that these people may have a low awareness of how to plan and manage their own careers, how to look for opportunities in their environment and to take advantage of the opportunities offered by universities.

In the first stage of the research a literature analysis on careers was conducted and the stages of individual career management were described. Attention was paid to aspects related to an individual's self-exploration and the examination of the environment, with a particular focus on young people working and/or studying. This was followed by a review of the measures taken by universities in order to support students in career planning. The authors of the article selected for analysis both public and non-public universities ranked high in the university rankings. These included five universities located in Poland and Italy. Then, secondary sources were analysed to identify the labour market situation in Poland and Italy. Reports prepared by various research entities from Poland and Italy were analysed. The last research method was a diagnostic survey in a form of a questionnaire addressed to students of two selected universities – one in Poland, located in Pomerania, and the other in Italy – in the Campania region. A total number of 76 students completed the questionnaire administered to students of these entities. In addition, the data obtained as a result of the survey was further analysed.

6. Survey results analysis

The questionnaire included two research areas, the first part concerned individual career planning and management while the second area concerned support for students' career planning by universities. In the first question the respondents were asked to indicate how they perceived their future career by selecting up to three answers. The highest number of answers among Polish students was self-employment (31%), work in large organisations/corporations (22%), work as an expert/specialist in a particular field (22%) and work related to a passion/hobby, e.g. travelling (21%). Italian students also rated self-employment (47.6%) and working as an expert/specialist (47.6%) highly. Interestingly, while working for non-profit

organisations is an important part of their future plans (42%), among Polish respondents no student wants to tie their future to a non-profit organisation. Such a high result may indicate that Italian students want to act in accordance with their own values and that this is a greater priority for them than the prestige of the employer or the amount of earnings, which will also be confirmed by the next question. In addition, it is clear from the answers obtained that when thinking about self-employment, students value independence, e.g. flexible working hours and the possibility of combining work and private life. Perhaps they also prefer to work remotely and be able to travel around the world at the same time, for example. This form of work has become an important alternative to stationary work and is an important part of young people's lives.

In the following part of the survey, respondents were asked to indicate, on a scale of 1 to 5, where 1 means a low need and 5 means a high need, their needs in relation to future work. While high salaries are very important for Polish students, as many as 75% of respondents marked this answer as the most important, Italian respondents singled out the need for full-time employment (71% of respondents). This may most likely be due to the more difficult situation and the lack of stability in the labour market in Italy. Furthermore, for both Polish (82%) and Italian (81%) students, fair treatment is very important. This result shows that the feeling of injustice at a workplace is a significant issue for young people. Students are aware that when someone feels that they are being treated unfairly, their morale decreases and their commitment to work becomes lower. This in turn can lead to a reduced productivity, increased absenteeism and lower loyalty to the company. These problems may include, for example, inequalities in remuneration, lack of clear criteria for promotion, ineffective communication, insufficient access to training or limited decision-making. In order to eliminate these negative effects, organisations should focus on building a fair working environment. Only the introduction of clear promotion criteria and fair decision-making processes can help to minimise the sense of injustice. Communication also plays a key role in eliminating misunderstandings and strengthening trust between employees and organisations.

The same needs in relation to future work in both groups were also found for: opportunities for professional development and qualification, flexible working hours and health and safety.

As far as other needs are concerned, significant differences were observed. For Italian respondents a high salary was not as important as for Polish respondents. On the other hand, they were more interested in material non-wage motivation tools (e.g. multisport card, a company car, tickets for events) and a prestigious job position. Respondents from Poland had a high need to work with competent staff, while students from Italy had a higher need to work with modern devices, machines, equipment and the need to stand out, succeed and combine their professional and personal lives. Furthermore, the research shows that Polish respondents do not need additional social and pension benefits and are not interested in working fixed hours. The latter were also less important for Italian respondents.

In the next question, respondents were asked to indicate which values they valued in relation to their future work. Among the values listed, respondents could rate on a scale of 1 to 5, where 1 means low value and 5 means high value, values such as respect and dignity, gaining knowledge, recognition of expertise and talent, a sense of pride in one's work, involvement in the life of the company, the company's care for the environment, care for physical and mental health and good interpersonal relations.

Respondents from Poland rated care for physical and mental health and interpersonal relationships highest, with 89% correspondingly. Respect and dignity (87%), gaining knowledge (86%) and recognition of expertise and talent (82%) were also important to them. Italian respondents also considered respect and dignity (76%), followed by the acquisition of knowledge (76%), recognition of expertise and talent (72%), a sense of pride in one's work (71%) and good interpersonal relationships (71%) as valuable aspects.

Placing these values at such a high level indicates that people want to be noticed, valued for their skills and achievements. Moreover, they want to know that their merits will be appreciated. The importance of respect and dignity indicate that most people want to be respected for who they are. Besides, the respondents' care of their health may show their a desire for ways to organise their lives and their work from the point of view of current and future health maintenance. This quality of life is also strongly influenced by company policies and practices.

Another analysed issue was the identification of professional and personal goals. The study showed that Polish students want to be independent, with 54.5% of respondents giving this answer, while Italian respondents dream about an international career (43.6%), want to develop talents 43% and to be entrepreneurial or creative 42.9%. The common goals of the respondents were to have a stable, secure job and to enjoy a work-life balance. As for the personal goals, respondents from both countries recognised financial independence (83.6% in Poland and 66.7% in Italy). Students from Poland also want to enjoy life and be happy, 65% of respondents answered yes.

Interestingly, in both countries, respondents are not interested in raising a family and having a child. The survey shows that students need a stable job and a steady income, as well as safe working conditions. This may be related to recent unpredictable events in the world, such as the pandemic or the war in Ukraine. Workers who fear losing their jobs may not be as innovative as expected, similarly to those who work in unsafe conditions. On the other hand, placing the need for independence at the top of the list may offer many benefits, such as feeling confident, being able to make own decisions or developing creativity. The results show that young people want to feel confident, do not want to be dependent on others in many aspects of their lives and want to think and act freely. Furthermore, independence can lead to success, satisfaction and a happy life, while lack of independence may cause a limited personal and professional development, loss of control over one's life and decisions, which can negatively affect one's wellbeing.

In order to find out how future employees entering the labour market would like to achieve the above career goals, the authors prepared the next question, namely what actions young people take to accomplish their objectives. The respondents from Poland are most likely to go to university 98.2%, start work 60% and attend courses/training 43.6% in order to reach their goals.

The respondents from Italy take advantage of more opportunities, such as being active in study clubs (as many as 72% of respondents marked this answer), studying 66.7% and working 62%. Many respondents also attend conferences and seminars 57.1% and take advantage of internship and apprenticeship opportunities in selected organisations 52.4%.

The results show a large disparity between the respondents of the two countries. Italian students are aware that in order to be able to develop their international career, their talents or their creativity, it is crucial to take advantage of the availability of additional development activities offered by the university. This attitude can foster a better exploration of the environment and thus develop their careers in line with their strategy. Moreover, attending conferences helps to understand one's career prospects better. These activities enhance competences, promote personal development and can help to gain knowledge about the latest trends, technologies or working methods. The interest of young Italians in the activities offered by educational institutions may also be due to the difficult situation of Generation Z in the labour market, as the available reports show. Awareness of the realities of work necessitates using the opportunities available in the environment.

Further analyses of the survey conducted among respondents concerned the support provided for them in pursuing a career. When asked who supports you most in your career plans, Polish respondents rated parents 81.8% highest, followed by a partner and friends 45%. The research showed that employers do not support young students in their career development. This situation shows that employers lack the awareness that if they educate students so as they meet their expectations, they will get a loyal, competent and familiar employees in the future. The situation is slightly different among the respondents in Italy. They receive the most support from their parents 53%, followed by employers 43%, partners and friends 38% and a career counsellor 9.5%.

The next stage of the research was to find out what support offered by the university the respondents use for their professional development. Their answers varied significantly. A higher level of activity was noted among Italian students. Respondents from Poland are most likely to use library resources, as many as 40% of respondents marked this activity, participate in job fairs 22%, engage in study clubs 18.2% and only 5.5% of respondents use Erasmus programmes. In Italy, on the other hand, the respondents use Erasmus programmes most frequently, with as many as 86% of them indicating this activity, followed by using available language courses 48%, research internships 43% and library resources 33.3%. This leads to the conclusion that young Italians want to go on Erasmus for various reasons. One of them may be a change in the labour market and a desire to gain international experience. Besides, these

programmes help them discover their own talents, adapt to new situations, acquire new competencies related to language, digital, social and professional skills, among others.

The research shows that students in both countries are mostly development conscious and want to have a satisfactory career. The economic situation of the country, unstable career paths and difficulties in adapting to changes in the labour market had an impact on the results. The change in mentality and attitude towards work of the younger generations is different from that of the older ones, the pandemic because of which many people had to change jobs and did not to return to their previous work are some of the reasons that have influenced the current situation.

The final aspect addressed in the research were problems in the labour market. The respondents were asked what difficulties they had encountered when looking for a job. As many as 65% of the Polish respondents and 76% of the Italian students indicated unreasonable expectations. Nowadays, browsing job advertisements, one may indeed notice that most employers require several years of experience and high competencies. It is very difficult for people entering the labour market to meet such expectations and they may feel like losers from the start of their career path. Another problem concerned the expectation that students will be fully available at work. In Poland, as many as 51% and in Italy 47% of respondents indicated such an answer. It is difficult to study and work at the same time. This attitude of employers certainly does not encourage young people to pursue formal education. Other problems encountered by Polish students were: the scope of duties incompatible with the job position (40%), unstable working conditions (37%) and lack of development (29%). In Italy, on the other hand, additional problems were discrimination (38%) or lack of introduction to work (33%).

On the basis of the analysis of the above information, it can be concluded that students in the labour market may face a number of problems in finding employment. One reason for this is the choice of popular fields of study or the lack of attempts to enter the labour market. Problems with high requirements can lead to frustration and a sense of injustice among employees. However, these expectations do not have to be negative when they go hand in hand with managerial support. Moreover, the adaptation of new employees, as indicated by the students, is an important process in which new employees adapt to work in a new environment, role and organisation. Obviously, this is an activity that involves several stages, but it is worth taking care of it in order to have an employee who will be fully productive in the future. Moreover, besides the fact that employers should create conditions and support young employees, young people should also think about how to improve their chances on the labour market. The list of tasks is long, since Generation Z should already be learning new contacts, skills such as communication and teamwork. It is a good idea to do internships so that they can gain valuable experience and practical skills, which may also be of interest to a future employer. It is worth taking advantage of the fact that universities encourage their students to participate in conferences, workshops or study clubs. These activities do not only give valuable experience, but may also increase young people's chances in the labour market.

7. Conclusions and recommendations

The research has made it possible to identify factors important for the planning and development of careers of students from two European Union countries – namely Poland and Italy. The analysis of the literature on the subject enabled the identification of factors subject to self-exploration and examination of the environment undertaken by individuals managing their career. These aspects were taken into account in the survey targeted at university students in the region of Pomerania in Poland and in the region of Campania in Italy.

The review of the career support activities offered by leading universities to students and graduates in both countries revealed that leaders in higher education propose a wide range of solutions to help young people who are looking for employment. Among others, universities offer career counselling, coaching, mentoring, training, competency-enhancing workshops, psychological support, legal consultations, career labs, internship and apprenticeship programmes, numerous aptitude tests, Erasmus trips, job platforms, management and leadership schedules and even ambassador programmes. In addition, they enable people with neuroatypicalities to pursue careers by adapting programmes dedicated to them. Therefore, students in Poland and Italy may take advantage of various opportunities available in their academic environment.

The analysis of reports on the labour market situation of young people in Poland and Italy revealed that students, despite studying in the EU, have different employment opportunities. The situation on the Polish labour market is assessed as average compared to European countries, while the job prospects in Italy, especially in the southern regions, are unfavourable. Hence, the career expectations of the students surveyed in the two countries differed in many aspects.

The survey conducted showed that both Polish and Italian university students are aware of what they want to do in life and are able to name their needs and values in relation to future work. For both groups of respondents, independence and self-employment were important factors in pursuing a career. Fair treatment, ethical behaviour, flexible working hours, job stability and physical and psychological security, as well as social relations, were also found to be important.

Polish students furthermore highly value high salaries and working as experts. Many of them see themselves as development-oriented corporate employees. They also expect support from competent leaders. They cannot imagine working fixed hours and are not interested in additional social benefits. The majority of Polish students are simultaneously active in their careers. The people who support them in the realisation of their professional plans are mainly family and friends.

Italian students would mostly like to hold a prestigious position, not necessarily in a large company. For some of them, working in non-profit organisations is also important. They pay attention to non-salary material factors to motivate employees, but their salaries do not have to be very high. Instead, they expect access to new technologies and modern tools in their work. They are primarily helped by their family, but also by their employers in pursuing their careers.

When it comes to the opportunities offered by universities, these options are definitely used more often by Italian students, who are not only interested in the basic activities offered in most universities, but are also keen to get involved in study circles, attend conferences and seminars.

Interestingly, both young people from Poland and Italy no longer want to start a family. This situation may be due to an unstable and uncertain future, fears of a pandemic and the war in Ukraine. It is clear that young people are primarily focused on their development and a comfortable life. They are not making long-range plans.

It is evident from the conclusions cited that Polish students do not take full advantage of the opportunities around them. They care primarily about material benefits and their needs are a factor in their decision to work. This attitude may be due to the favourable, at the moment, situation on the labour market. Nevertheless, in order to be competitive, they need to take care of their development. Italian students, whose labour market situation is much more difficult, realise that additional skills and higher education can contribute to their success in the labour market. They take advantage of the opportunities offered by their universities and are willing to take a job that gives them a sense of security. To gain competitiveness in the labour market, they seek access to innovative technologies and are willing to gain experience in international markets.

The results presented here can add practical information to the literature on how students pursue careers. Young people will gain knowledge on how to manage their own careers and the opportunities provided to them by universities. Employers in both countries should pay attention to the values and needs of young people, making it easier for them to tailor their job offers to this group of employees. The role of universities is to reach out to young students with their wide range of career-enhancing activities and encourage them to take advantage of the various opportunities. It is also worth making students aware at all times that the labour market is changing, that the range of competences required will be modified, and that it is therefore worth taking advantage of the opportunities in the environment and continuously acquiring new qualifications, skills and experience.

Acknowledgements

This research was supported by funds from “Project D.S.A. PLUS - Didactics, Science, Administration - Integrated Development Programme of Development of WSB University”, co-financed by the European Union from the European Social Fund POWR.03.05.00-00-Z211/18.

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STAFF ATTRIBUTES AND THE QUALITY OF HOSPITAL SERVICES

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Purpose: Improving the quality of medical services is one of the key focus areas of hospital management. The search for opportunities for improvement, addressing real problems and meeting the needs of customers becomes particularly important in the face of such challenges as technological, especially the development of digitization and e-medicine, demographic changes, including, among others, aging societies, political and financial. The study was conducted to identify and analyze staff attributes that determine the achievement of a level of patient satisfaction with the quality of hospital services.

Design/methodology/approach: Based on desk research and interviews with patients of a sample hospital, six key staff attributes important for achieving satisfaction with the quality of hospital services were identified. These attributes were subjected to empirical studies conducted in accordance with the methodology of the Kano model (first stage) and the survey method (second stage). The results of the studies made it possible to identify gaps between the highest desired degree of satisfaction and the level resulting from the patients' actual evaluation. Subsequently, the authors formulated their own recommendations for strengthening human capital for increasing the quality of hospital services.

Findings: Based on the research, the map of key staff attributes affecting patient satisfaction with the quality of hospital services was developed. The attributes with the greatest importance and strength of influence on the quality of services, characteristic of the three professional groups studied, were then identified. Among them were: professionalism, kindness and politeness towards the patient and his family members, individualized approach to the patient. Recognizing the opinions of patients of a particular hospital, the attributes that were important but at the same time rated lowest were identified. On this basis, gaps between the expected and actual state were identified, and suggestions were made for improvement in the areas of knowledge, communication and cooperation.

Research limitations/implications: Some limitations were recognized in the research process, primarily due to the size of the research sample and the scope and scale of empirical research. It seems desirable to expand the research field to include the international environment. Conclusions made against the background of other cultural or systemic conditions of health care in a given country could enrich the conducted comparative analysis with interesting insights. In addition, the study of correlations between an expanded set of factors influencing the quality of hospital services and the level of patient satisfaction could provide a direction for further research.

Practical implications: The results of the study may be of interest to stakeholders in the health care industry. Identifying the key personnel attributes of greatest importance and power to influence service quality seems important for designing changes that strengthen a hospital's human capital. The presented suggestions for improvement in the areas of knowledge, communication and cooperation based on the results of patient satisfaction surveys of a specific hospital have application value.

Social implications: Implementation of changes designed on the basis of the research results presented and suggestions for improvement in the areas of knowledge, communication and cooperation can realistically improve patient satisfaction with the quality of hospital services. In addition, hospitals' interest in improving the quality of services in response to patients' needs and expectations demonstrates social responsibility.

Originality/value: The paper identifies key staff attributes important for achieving patient satisfaction with the quality of hospital services. It also provides practical recommendations for improvement in the areas of knowledge, communication and cooperation. The article is dedicated to academic and healthcare professionals, including hospital managers, as well as local government administration.

Keywords: hospital services, quality of hospital services, staff attributes, patient satisfaction, Kano method.

Category of the paper: research paper.

1. Introduction

The quality of hospital services is an interesting area of theoretical and empirical research undertaken in the social sciences. Especially in the face of such challenges as: technological, especially the development of digitalization and e-medicine, demographic changes, including, among others, aging societies, political and financial in the form of constant social pressure to increase the healthcare budget. It is also a very important aspect of hospital management in the context of recognizing opportunities for improvement, solving real problems and meeting customer needs. Although it may seem that achieving high quality services is determined primarily by technical, organizational or economic factors, human factors are also important. Staff attributes become more and more important during hospitalization, when building relationships with the patient based on mutual trust and understanding, as well as developing a sense of security, can have a real impact on the treatment process.

The theoretical and empirical considerations undertaken in the article were aimed at interpreting the issue of the quality of hospital services from the point of view of achieving patient satisfaction. The analysis was based on the attributes of medical staff. The aim of the study is to identify the attributes that most determine the level of patient satisfaction with the quality of hospital services. Taking into account the current challenges facing health care systems, an attempt to identify the factors of greatest importance from the perspective of influencing the level of satisfaction seems even more necessary. An interesting research field is determined by the pursuit of a state where the patient's needs and expectations are met and

the values co-created by patients and medical staff translate into the quality of hospital services. To put it very simply, patient satisfaction is a subjective and variable state related to individual perception.

2. The status of research on the quality of medical industry services

The literature on the subject indicates that the issue of quality assurance in the broadly understood sphere of health care is an extremely complex issue. The analysis most often requires the use of an interdisciplinary approach in the area of not only the basic interpretation of the quality of services but also the planning and organization of activities necessary to meet the quality requirements of the final therapeutic effect. Hence, the basis of special interest is usually the context of the quality of the process and the quality of the achieved result (Vandamme, Leunis, 1993). Many authors (Anderson et al., 2013; Jaakkola, Alexander, 2014; McColl-Kennedy et al., 2017; Kim, 2019; et al.) point out that the quality of medical services is the result of co-creation of value by patients and medical staff.

The quality of medical care in a hospital can be expressed by, among others: availability of services and medical staff, waiting time for hospitalization, therapeutic procedures and diagnostic tests, etc. (Boomija, 2019; Rourke, 1991). Other authors define the quality of health care through the factor of accessibility and effectiveness, i.e. "whether individuals can access the health structures and processes of care which they need and whether the care received is effective" (Campbell et al., 2000, p. 1614). The effectiveness of clinical methods, techniques and therapies and the effectiveness of medical procedures are also important (Cheng, 2005; Ivanková et al., 2020).

In terms of ensuring and improving the quality of medical care, it is important to use the latest achievements in technology to increase the effectiveness of treatment processes (Cohen, 2002). As well as continuous learning and improvement of procedures and processes through accreditation and certification (Marzban et al., 2017; Hoseinpoufard et al., 2012). It is worth noting, however, that some studies indicate that the quality of medical services should be considered mainly in relation to the technical aspects of health care and interpersonal relations of patients and medical staff (Andaleeb, 2001; Babakus, Mangold, 1992; Zeithaml, Bitner, 2000).

The literature on the subject emphasizes the importance of organizational culture, the involvement of medical staff and management processes in the development of the quality of health care in hospitals (Lega et al., 2013). Referring to research conducted in Finland, it can be concluded that it is necessary to use the patient-centered approach and strengthen leadership as a condition for improving the quality of management of health care facilities and the medical services provided (Pihlainen et al., 2019). The patient centered health care system

is increasingly recognized as a key approach in improving the quality of hospital services in the perception of patients (Sofaer, Firminger, 2005).

The issue of the quality of services provided by a hospital is also discussed in the context of achieving patient satisfaction (McConnell et al., 2016; Wang et al., 2022; Zhao et al., 2023). In this regard, it is emphasized, among others, the importance of lasting relationships with patients and effective communication. Satisfaction with the quality of services is achieved through, among others: increasing the level of treatment, care and internal service processes (Akthar et al., 2023; Alibrandi et al., 2023; Meesala, Paul, 2018; Wang et al., 2021). Particular importance is attached to medical activities and health services, care during and after hospitalization, internal services, including cleaning, storage and provision of hospital clothing and underwear, etc.

Since patient satisfaction with the quality of hospital services is recognized as a holistic phenomenon (Naidu, 2009), looking from the perspective of treatment effectiveness, it is difficult not to see the need to describe the factors determining its level. All the more so because patient satisfaction is treated as a cumulative construct, which implies the possibility of recognizing a rich set of factors characterizing the diverse and heterogeneous organizational environment of hospitals. These factors most often describe technical and functional aspects, infrastructure, interaction and atmosphere variables (Zineldin, 2006, p. 61). The factors determining patient satisfaction with the quality of hospital services include: professionalism and competence of medical staff, maintaining cleanliness in and around the hospital, or access to parking lots (Alibrandi et al., 2023). As a complement, the reliability of treatment processes and the speed of response of medical staff can be indicated (Meesala, Paul, 2018).

Researching satisfaction with the quality of hospital services in connection with the characteristics of the staff and the specificity of patients' perception of the hospital as a place of stay and treatment is a very complex research and practical challenge (Elbeck, 1987). The problem results, among other things, from the very essence of the services provided, as well as the characteristics of medical care. The basic features include intangibility, heterogeneity and simultaneity, which de facto characterizes an intangible product. Intangibility, understood as "cannot physically be touched, felt, viewed, counted, or measured" (Mosadeghrad, 2014, p. 78) becomes crucial in this respect.

Attention should be paid to the difficulties in identifying and distinguishing satisfaction and quality of services in health care settings. The literature on the subject indicates difficulties of a conceptual and operational nature (Taylor, Cronin, 1994, p. 34). Conceptual difficulties usually concern the process of naming and defining, while operational difficulties - developing procedures and establishing rules enabling the characterization and identification of significant features. Therefore, it is difficult to disagree with the belief that "quality of care can only be understood within the overall context in which health care is provided" (Campbell et al., 2000, p. 1617).

In research on the quality of medical services in connection with the characteristics of staff, three main categories are distinguished (Mosadeghrad, 2014):

- patient related factors,
- provider related factors,
- environmental factors.

Each category is described by analyzing subsequent properties. The category: patient related factors is defined by explaining such issues as patient socio-demographic variables, patient cooperation and type of patient illness. In the group: provider related factors, analysis is carried out taking into account provider socio-demographic variables, provider competence and provider motivation and satisfaction. In turn, the third group of factors includes: healthcare system, resources and facilities, leadership and management, collaboration and partnership development (Mosadeghrad, 2014).

When considering satisfaction in connection with staff characteristics, it is worth paying attention to research on the gap between patients' expectations regarding the quality of medical services and the beliefs of service providers, i.e. medical care units. The research conducted leads to very interesting conclusions. Firstly, service providers believe that patients have lower expectations regarding the quality of services than in reality. Secondly, both patients and service providers consider attributes such as explanations, level of knowledge and attention dispensed by health professionals to be equally important (Cammpos et al., 2017).

The first conclusion may seem quite surprising. Especially with the increasing awareness of patient rights, including: to comprehensive and understandable information about your health, access to medical records, and to raise objections and assert your rights. However, from a researcher's perspective, recognizing patients' expectations and identifying factors contributing to satisfaction and those causing dissatisfaction, supplemented by a broad information campaign among medical staff, opens new interesting fields for empirical exploration. Taking into account the importance of factors such as explanations, level of knowledge and attention dispensed by health professionals, it seems justified to attempt to explore the phenomenon of satisfaction with the quality of hospital services in connection with the characteristics of the staff.

3. Material and methods

Empirical research was conducted in accordance with the following research procedure:

- adopting the research assumption and formulating the research problem,
- indication of the research purpose and research question,
- formulating research hypotheses,

- development of a research project,
- determination of the research sample, selection of the research method and development of the research tool,
- conducting the actual examination.

For the purposes of the study, the following assumption was made: it is possible to improve the quality of hospital services by strengthening human capital. The research problem concerned the search for staff attributes in the context of achieving patient satisfaction with the quality of hospital services.

The aim of the research was to identify the staff attributes that most determine patient satisfaction. The following research question was asked: how can human capital be strengthened to increase the quality of hospital services? The search for an answer to this question set the direction of the research procedure. The research hypotheses were formulated as follows:

- H0: professionalism is the most important staff attribute determining patient satisfaction with the quality of hospital services,
- H1: it is possible to identify gaps between the staff attributes of the greatest importance and impact on achieving the level of satisfaction with the quality of hospital services and the level resulting from the actual assessment of satisfaction of patients hospitalized in the hospital,
- H2: it is possible to indicate ways of strengthening human capital to increase the quality of services provided in the hospital.

The intention of the conducted research and analyzes is to verify the above statements.

When designing the study, a finite set of 41 factors determining the quality of hospital services were taken into account, including those describing the material infrastructure, organization of hospital services, quality of medical services, quality of additional services and staff. Six attributes characterize hospital staff (Table 1).

Table 1.

Attributes related to the staff

No.	Attribute
1	professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment
2	inspiring trust and a sense of safety among patients
3	kindness and politeness towards the patient and his family members
4	individualized approach to the patient as openness and responsiveness to their problems and needs
5	communicativeness i.e. adaptation of the way of communicating information to the needs of the patient and his family members
6	professional appearance adapted to the role, function and responsibilities

Source: Own study based on theoretical and empirical research.

The set of 41 factors was selected as a result of a review of the subject literature and interviews conducted with patients of the selected hospital. Literature research was aimed at identifying the state of knowledge about the quality factors of hospital services (based on: Alibrandi et al., 2023; Andaleeb, 2001; Asiamah et al., 2022; Akthar et al., 2023; Alibrandi et al., 2023; Babakus, Mangold, 1992; Boomija, 2019; Cheng, 2005; Cohen, 2002; Hoseinpourfard et al., 2012; Ivanková et al., 2020; Luna-Aleixos et al., 2023; Marzban et al., 2017; Meesala, Paul, 2018; Mosadeghrad, 2014; Rourke, 1991; Salomon, 1999; Shuv Ami, Shalom, 2020; Teng et al., 2007; van Loenen et al., 2014; Wang et al., 2021; Zeithaml, Bitner, 2000, p. 61; et al.).

An interview based on a free dialogue with 10 patients of the Internal Medicine Department of the Blessed Virgin Mary Provincial Specialist Hospital in Częstochowa (Poland) was carried out on February 6, 2023. The selection of the research sample was random. The sample was diverse in terms of gender and age. Free dialogue with patients mirrored the course of an informal conversation, giving the subjects the opportunity to freely express their opinions and share their own thoughts. The research material obtained reflected the respondents' spontaneous statements.

The features distinguished in Table 1 served to characterize three professional groups, i.e.:

- doctors (D),
- nurses, midwives and medical lifeguards (NM),
- other medical staff (laboratory diagnosticians, physiotherapists, nutritionists, etc. (OMS)).

The empirical research project included two stages. The first one involved distinguishing attributes and classifying them into classes with different impact on the quality of hospital services. In this regard, the correlation between a given attribute and patient satisfaction was examined using satisfaction and dissatisfaction coefficients. Distinguishing the attributes with the greatest impact on the level of satisfaction and those determining the dissatisfaction of potential patients is the result of the first stage. In turn, in the second one, six staff attributes were assessed by patients of the selected hospital. The assessment of satisfaction resulting from the hospital stay is the basis for analyzing the factors determining the quality of hospital services. An attempt to identify gaps between the highest desired level of satisfaction and the level resulting from the actual assessment of patients will be the starting point for formulating recommendations regarding strengthening human capital to increase the quality of hospital services.

Empirical research was conducted at the national level (first stage) and among patients of the Blessed Virgin Mary Provincial Specialist Hospital in Częstochowa (second stage). In the first stage, the research sample consisted of 212 respondents, and in the second – 149. The characteristics of the research samples by age and gender are presented in Figure 1 (where "KANO respondents" refers to the first stage of the research and "patients" - the second). It should be noted that the research method used as well as the method of obtaining the results

influenced the collected research material. The use of the CAWI method (the first stage of the research) obligatorily imposed the requirement to answer each question included in the questionnaire. In turn, completing the questionnaires in paper form (during the second stage) resulted in missing answers to some questions.

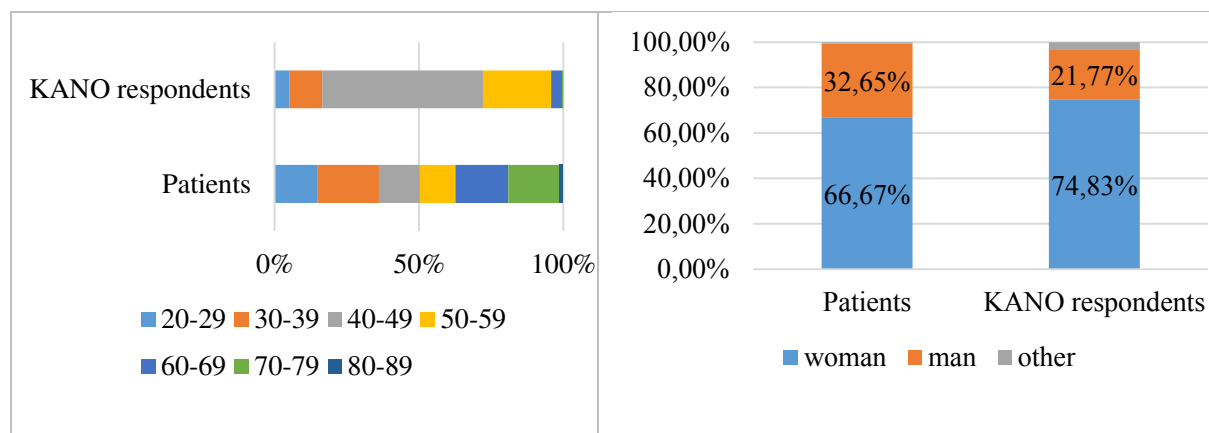


Figure 1. Age and gender of respondents.

Source: Own study based on empirical research.

The first stage of the research was carried out in July and August 2023 using the CAWI (Computer-Assisted Web Interview) electronic survey questionnaire in accordance with the Kano model construction methodology. In the area of quality management, this model is intended to identify and classify customer expectations towards products and services. In this case, patients' expectations towards the hospitalization process. Although the description of the Kano model is well-established in the literature on the subject (Mikulic, 2006; Lee, Newcomb, 1996; Jonsson Kvist, Klefsjo, 2006; Schvenefeldt et al., 1991; Nilsson-Witell, Fundin, 2005), this methodology is still insufficiently used in the practice of empirical research (Parasuraman, 1986). Which, in a sense, may indicate the use of an innovative research approach.

Table 2.

An example question related to attribute D1

D1. professionalism				
understood as the ability to make fast and correct diagnoses and select appropriate treatment				
a. What if it is the case? (functional form of the question)				
like it	expect it	don't care	live with it	dislike it
b. What if it is not the case? (dysfunctional form of the question)				
like it	expect it	don't care	live with it	dislike it

Source: Own study based on Kano's Methods.

The electronic survey questionnaire included a total of 41 factors determining the quality of hospitalization services, of which 6 of them directly concerned hospital staff. Two questions were asked for each attribute: the first one identifying the occurrence of a given feature, the second one identifying its absence. The set of answers included the following phrases: absolutely essential, expect it, don't care either way, can tolerate it, unacceptable (Matzler, Hinterhuber, 1998; Santhoshkumar et al., 2022). Table 2, for example, presents questions

(functional: what if this is the case? and dysfunctional: what if this is not the case?) for the selected attribute doctors: professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment (marked with the symbol D1 in the survey questionnaire). Then, compiling the obtained answers, the attributes were classified, assigning each of them to a given class: questionable (QE), attractive (AE), reverse (RE), indifferent (IT), one-dimensional (OD) and must-be (ME) - Table 3.

Table 3.

Kano evaluation table

Requirements		Dysfunctional				
		Like it	Expect it	Don't care	Live with it	Dislike it
Functional	Like it	QE	AE	AE	AE	OD
	Expect it	RE	IT	IT	IT	ME
	Don't care	RE	IT	IT	IT	ME
	Live with it	RE	IT	IT	IT	ME
	Dislike it	RE	RE	RE	RE	QE

Source: Own study based on Kano's Methods.

In the study of the correlation between a given staff attribute and patient satisfaction with the quality of hospital services, the following coefficients were used: satisfaction - CC (1) and dissatisfaction DC (2) (Berger et al., 1993). The CC value ranges from zero to one, and the closer it is to one, the greater the impact on patient satisfaction. In turn, in the case of the DC coefficient, the value remains close to one and patient dissatisfaction affects a given quality feature (Matzler, Hinterhuber, 1998).

$$CC = (AE + OD) / (AE + OD + ME + IT) \quad (1)$$

$$DC = (OD + ME) / (AE + OD + ME + IT) \quad (2)$$

In the second stage of the research, patient satisfaction with respect to the distinguished attributes of the quality of hospital services was assessed, including six attributes characterizing hospital staff, based on a paper survey questionnaire. Unlike the Kano methodology, in this case the assessment was carried out on a five-point scale, where the value of 5 meant patient satisfaction and 1 - dissatisfaction. The study was carried out in July and August 2023 with the participation of patients hospitalized in a selected hospital. Participation in the study was voluntary.

4. Results

The research material obtained in the first stage of the research allowed for the classification of staff attributes in accordance with the Kano model methodology. The study was divided into three professional groups, hence the results obtained were the basis for distinguishing key attributes for: doctors (D), nurses, midwives and medical lifeguards (NM) and other medical staff (OMS). The summary of the answers obtained along with the interpretation of the satisfaction (CC) and dissatisfaction (DC) coefficients of patients with the quality of hospital services were reflected in the categorization of attributes in individual professional groups of staff.

Among doctor's attributes, four out of six are considered attractive (Table 4). These included such features as: professionalism ((D1), inspiring trust and a sense of safety among patients (D2), kindness and politeness towards the patient and his family members (D3) and individualized approach to the patient (D4). For the distinguished features, the satisfaction coefficient (CC) is at a very similar level and only slightly exceeds the value of 0.5. This means that these attributes indeed influence the achievement of satisfaction by patients, however, which seems quite surprising, none of them reached the level close to unity. This is particularly puzzling in the case of professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment, where intuitively we can expect a much greater impact on patients' satisfaction with the quality of hospital services.

Table 4.

Set of response statistics from respondents according to the Kano methodology for attributes D1-D6

Attribut	ME	OD	AE	IT	CLASS	CC	DC
D1	18.40%	26.89%	31.13%	23.58%	AE	0.58	0.45
D2	18.40%	25.00%	31.13%	25.47%	AE	0.56	0.43
D3	18.40%	25.00%	31.13%	25.47%	AE	0.56	0.43
D4	18.40%	23.11%	35.85%	22.64%	AE	0.59	0.42
D5	18.40%	17.92%	26.89%	36.79%	IT	0.45	0.36
D6	8.49%	5.66%	22.17%	63.68%	IT	0.28	0.14

D – doctors.

Source: Own study based on empirical research.

Taking into account nurses, midwives and medical lifeguards, professionalism (NM1) is included in the attractive class, but with a slightly higher (0.03) level of satisfaction coefficient compared to doctors (Table 5). In the case of this professional group, two attributes: NM2 - inspiring trust and a sense of safety among patients and NM6 - professional appearance adapted to the role, function and responsibilities reach the IT class, i.e. a neutral state. This means that these attributes will not affect patients' feeling of satisfaction or dissatisfaction. This is confirmed by the indications of satisfaction coefficients (CC), where the value of 0.51 and 0.32 was obtained for this set of attributes, respectively.

Table 5.

Set of response statistics from respondents according to the Kano methodology for attributes NM1-NM6

Attribut	ME	OD	AE	IT	CLASS	CC	DC
NM1	13.21%	29.25%	31.60%	25.94%	AE	0.61	0.42
NM2	17.92%	21.70%	29.72%	30.66%	IT	0.51	0.40
NM3	17.92%	22.64%	31.60%	27.83%	AE	0.54	0.41
NM4	25.96%	17.31%	30.29%	26.44%	AE	0.48	0.43
NM5	22.64%	15.09%	32.55%	29.72%	AE	0.48	0.38
NM6	8.02%	5.66%	25.94%	60.38%	IT	0.32	0.14

NM - nurses, midwives and medical lifeguards

Source: Own study based on empirical research.

A similar distribution of satisfaction coefficients (CC) values was obtained for other medical staff (Table 6). In the case of this professional group, only one of the attributes, i.e. OMS6 - professional appearance adapted to the role, function and responsibilities, does not affect the level of patient satisfaction (IT class, i.e. a neutral state). This means that respondents participating in the study do not attribute the importance of this attribute to the quality of hospital services, which is reflected in the low value of the CC coefficient (0.29). In turn, all other attributes were classified as AE, i.e. attractive, with a slightly higher level of CC for the OMS1 attribute - professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment (as in the case of nurses, midwives and medical lifeguards).

Table 6.

Set of response statistics from respondents according to the Kano methodology for attributes OMS1-OMS6

Attribut	ME	OD	AE	IT	CLASS	CC	DC
OMS1	15.57%	26.89%	33.96%	23.58%	AE	0.61	0.42
OMS2	15.57%	21.23%	36.79%	26.42%	AE	0.58	0.37
OMS3	17.92%	19.81%	38.68%	23.58%	AE	0.58	0.38
OMS4	15.57%	19.81%	34.91%	29.72%	AE	0.55	0.35
OMS5	17.92%	17.92%	34.91%	29.25%	AE	0.53	0.36
OMS6	12,74%	5.66%	23.58%	58.02%	IT	0.29	0.18

OMS - other medical staff.

Source: Own study based on empirical research.

The second stage of the survey concerned the assessment of satisfaction of patients hospitalized in the selected hospital. Six staff attributes were assessed, of which four were extended to include another professional group - nonmedical staff. This was a purposeful procedure to compare the results obtained for medical and non-medical staff.

Table 7.*Basic statistics for staff attribute: professionalism (1) es in the patient satisfaction study*

		doctors	nurses, midwives and medical lifeguards	other medical staff	nonmedical staff
N	Valid	145	146	146	146
	Lack of data	2	1	1	1
Mean		4.68	4.71	4.68	4.77
Standard error		.052	.050	.048	.041
Median		5.00	5.00	5.00	5.00
Dominant		5	5	5	5
Standard deviation		.620	.601	.584	.495
Variance		.385	.361	.341	.245
Skewness		-1.789	-1.903	-1.705	-2.144
Standard deviation		.201	.201	.201	.201
Kurtosis		1.931	2.406	1.856	3.885
Standard deviation		.400	.399	.399	.399
Gap		2	2	2	2
Minimum		3	3	3	3
Maksimum		5	5	5	5
Percentiles	25	5.00	5.00	4.00	5.00
	50	5.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00

Source: Own study based on empirical research.

The assessment of patients' satisfaction with staff professionalism divided into four professional groups is similar and oscillates around the average value of approximately 4.7 (Table 7). The data show little variability, as confirmed by the low standard deviation values. Despite the noticeable slight skewness to the left and slightly higher kurtosis, the distribution of grades seems close to a normal distribution.

Table 8.*Basic statistics for staff attribute: inspiring trust and a sense of safety among patients (2) es in the patient satisfaction study*

		doctors	nurses, midwives and medical lifeguards	other medical staff
N	Valid	146	145	145
	Lack of data	1	2	2
Mean		4.51	4.74	4.68
Standard error		.065	.046	.052
Median		5.00	5.00	5.00
Dominant		5	5	5
Standard deviation		.781	.553	.620
Variance		.610	.306	.385
Skewness		-1.454	-2.030	-1.966
Standard deviation		.201	.201	.201
Kurtosis		1.116	3.132	3.319
Standard deviation		.399	.400	.400
Gap		3	2	3
Minimum		2	3	2
Maksimum		5	5	5
Percentiles	25	4.00	5.00	5.00
	50	5.00	5.00	5.00
	75	5.00	5.00	5.00

Source: Own study based on empirical research.

In view of inspiring trust and a sense of safety among patients, the results of patient satisfaction assessment indicate little variation in individual professional groups (Table 8). A slightly lower average was obtained for doctors compared to nurses, midwives and medical lifeguards (4.51 and 4.74, respectively) and other medical staff (4.68). The greatest variance and therefore greater variability of ratings concerns nurses, midwives and medical lifeguards. For this professional group and for other medical staff, a higher kurtosis was achieved, which means that the distribution of scores in this case is flatter than in the normal distribution. The skewness is negative for all surveyed professional groups (slightly to the left), which means that most of the satisfaction scores obtained are higher. The range varies between 2 and 3, i.e. there is limited variability between the ratings of this attribute.

Table 9.

Basic statistics for staff attribute: kindness and politeness towards the patient and his family members (3) es in the patient satisfaction study

		doctors	nurses, midwives and medical lifeguards	other medical staff	nonmedical staff
N	Valid	145	145	145	145
	Lack of data	2	2	2	2
Mean		4.58	4.70	4.77	4.74
Standard error		.068	.053	.042	.049
Median		5.00	5.00	5.00	5.00
Dominant		5	5	5	5
Standard deviation		.822	.636	.510	.589
Variance		.676	.405	.260	.348
Skewness		-1.968	-2.283	-2.528	-2.545
Standard deviation		.201	.201	.201	.201
Kurtosis		2.921	4.911	7.356	6.833
Standard deviation		.400	.400	.400	.400
Gap		3	3	3	3
Minimum		2	2	2	2
Maksimum		5	5	5	5
Percentiles	25	4.00	5.00	5.00	5.00
	50	5.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00

Source: Own study based on empirical research.

Similarly, slight differences in the assessment of the degree of patient satisfaction were noted for the next attribute, i.e. kindness and politeness towards the patient and his family members (Table 9). Although the ratings in this case are still quite high, some differences in individual professional groups are noticeable. In the case of doctors, nurses, midwives and medical lifeguards, the average satisfaction score is 4.58 and 4.70, while in the case of other medical and nonmedical staff, higher values were obtained (4.77 and 4.74, respectively). The standard deviation is relatively high, i.e. greater variability of assessments occurs in each professional group examined. Skewness is negative for all groups (slightly to the left) and the distributions of scores are concentrated more around higher values.

Table 10.

Basic statistics for staff attribute: individualized approach to the patient (4) es in the patient satisfaction study

		doctors	nurses, midwives and medical lifeguards	other medical staff	nonmedical staff
N	Valid	145	145	145	145
	Lack of data	2	2	2	2
Mean		4.51	4.70	4.70	4.74
Standard error		.071	.051	.049	.047
Median		5.00	5.00	5.00	5.00
Dominant		5	5	5	5
Standard deviation		.859	.614	.591	.562
Variance		.738	.377	.349	.316
Skewness		-1.733	-2.100	-2.067	-2.363
Standard deviation		.201	.201	.201	.201
Kurtosis		2.343	3.847	4.047	5.590
Standard deviation		.400	.400	.400	.400
Gap		4	3	3	3
Minimum		1	2	2	2
Maksimum		5	5	5	5
Percentiles	25	4.00	5.00	5.00	5.00
	50	5.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00

Source: Own study based on empirical research.

Analyzing the results presented in Table 10, the individualized approach to the patient nonmedical staff was rated highest - the average score was 4.74 (while among doctors the average score was 4.51, nurses, midwives and medical lifeguards - 4.70 and other medical staff - 4.70). Greater variability of assessments occurs in the doctors group (high variance). Skewness is negative in the case of all professional groups (slightly to the left), hence the distributions of scores are concentrated more around higher values and are more flattened (relatively high kurtosis).

Table 11.

Basic statistics for staff attribute: communicativeness (5) es in the patient satisfaction study

		doctors	nurses, midwives and medical lifeguards	other medical staff
N	Valid	144	146	144
	Lack of data	3	1	3
Mean		4.48	4.72	4.67
Standard error		.074	.049	.051
Median		5.00	5.00	5.00
Dominant		5	5	5
Standard deviation		.893	.596	.615
Variance		.797	.355	.378
Skewness		-1.701	-2.194	-1.854
Standard deviation		.202	.201	.202
Kurtosis		2.145	4.414	3.039
Standard deviation		.401	.399	.401
Gap		4	3	3
Minimum		1	2	2
Maksimum		5	5	5
Percentiles	25	4.00	5.00	4.00
	50	5.00	5.00	5.00
	75	5.00	5.00	5.00

Source: Own study based on empirical research.

Ratings for communicativeness of staff in individual professional groups are generally stable, with higher average values obtained for nurses, midwives and medical lifeguards and other medical staff (Table 11). The data shows greater variability in ratings compared to other attributes with higher standard deviation and variance. The distributions of ratings seem to be flatter, which indicates greater variability in the studied professional groups.

Table 12.

Basic statistics for staff attribute: professional appearance adapted to the role, function and responsibilities (6) es in the patient satisfaction study

		doctors	nurses, midwives and medical lifeguards	other medical staff	nonmedical staff
N	Valid	143	145	145	144
	Lack of data	4	2	2	3
Mean		4.76	4.81	4.78	4.81
Standard error		.042	.039	.042	.042
Median		5.00	5.00	5.00	5.00
Dominant		5	5	5	5
Standard deviation		.507	.471	.506	.506
Variance		.257	.222	.257	.256
Skewness		-1.987	-2.571	-2.601	-2.942
Standard deviation		.203	.201	.201	.202
Kurtosis		3.185	6.001	7.775	9.412
Standard deviation		.403	.400	.400	.401
Gap		2	2	3	3
Minimum		3	3	2	2
Maksimum		5	5	5	5
Percentiles	25	5.00	5.00	5.00	5.00
	50	5.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00

Source: Own study based on empirical research.

The analysis of the results presented in Table 12 leads to the conclusion that staff professional appearance is rated very highly by hospital patients. The average ratings in all professional groups remain at a similar level and range from 4.76 to 4.81. It is worth emphasizing that, despite some variability, the distribution of scores is concentrated around the highest values.

5. Conclusion

The conducted research allowed for the identification of six staff attributes that influence the level of patient satisfaction with the quality of hospital services. The search for attributes that most determine the achievement of a state of satisfaction was carried out in accordance with the Kano model methodology. Table 13 presents a summary of key staff attributes that are considered attractive from the perspective of a potential patient (i.e. classified as attractive). Study participants clearly perceived these attributes. It is important that these attributes meet the needs of the respondents, which in turn affects their level of satisfaction.

Table 13.

Map of key staff attributes influencing patient satisfaction with the quality of hospital services

Staff	Attribut					
	(1)	(2)	(3)	(4)	(5)	(6)
D						
NM						
OMS						

D - doctors; NM - nurses, midwives and medical lifeguards; OMS - other medical staff.

(1) professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment; (2) inspiring trust and a sense of safety among patients; (3) kindness and politeness towards the patient and his family members; (4) individualized approach to the patient as openness and responsiveness to their problems and needs; (5) communicativeness i.e. adaptation of the way of communicating information to the needs of the patient and his family members; (6) professional appearance adapted to the role, function and responsibilities.

a gray field in the table indicates a key attribute in a given professional group.

Source: Own study based on empirical research.

Taking into account the categorization of factors adopted in the Kano model (according to Table 3), it is worth emphasizing that none of the six examined attributes was included in the must-be (ME) class. Hence, the hypothesis H0: *professionalism is the most important staff attribute determining patient satisfaction with the quality of hospital services* was not confirmed. Professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment has been classified as AE - attractive with a satisfaction coefficient of 0.58 (for doctors) and 0.61 (for nurses, midwives, medical lifeguards and other medical staff).

Map analysis of key staff attributes influencing patient satisfaction with the quality of hospital services allows for the identification of key staff attributes for potential hospital patients. However, taking into account the context of the practice of managing a specific hospital and improving the quality of services, it is important to distinguish attributes that:

- have the greatest importance and the power to influence the quality of services,
- are characteristic of three professional groups.

It seems advisable to strengthen these attributes first. These attributes include (according to table 13):

- professionalism (1),
- kindness and politeness towards the patient and his family members (3),
- individualized approach to the patient (4).

In turn, for the effectiveness of designing and implementing solutions for the needs of a specific hospital, it is important to recognize the opinions of its patients. Therefore, referring to the results of research conducted at the Blessed Virgin Mary Provincial Specialist Hospital in Częstochowa makes it possible to indicate the attributes that are important but at the same time the highest or lowest rated. Due to high patient satisfaction ratings, an average level equal to or less than 4.71 is conventionally considered low (according to Tables 7-12).

The comparison of the results of the first and second stages of the study, i.e. staff attributes with the greatest importance and impact on the quality of hospital services and at the same time rated the lowest by hospital patients, leads to the identification of gaps between the expected and actual status (Table 14). Hence, the hypothesis H1 was confirmed.

Table 14.

Identifying gaps between key staff attributes and low patient satisfaction scores

Staff	Attribut					
	(1)	(2)	(3)	(4)	(5)	(6)
D	//////////	//////////	//////////	//////////	//////////	
NM	//////////	//////////	//////////	//////////		
OMS	//////////	//////////		//////////	//////////	

D, NM, OMS, (1), (2), (3), (4), (5), (6) - designation as in table 13.

a blue field in the table indicates a key attribute in all three professional groups.

////////// a field in the table indicates an average rating less or equal to 4.71.

a blue and ////////// field in the table indicates the gap between the expected and actual state.

Source: Own study based on empirical research.

The detailed analysis of staff attributes can be a starting point for designing solutions that strengthen the hospital's human capital. It seems reasonable to first focus on two attributes (Table 14):

- professionalism understood as the ability to make fast and correct diagnoses and select appropriate treatment (1),
- individualized approach to the patient as openness and responsiveness to their problems and needs (4).

Due to the complexity, diversity and dynamics of the hospital's organizational environment, it becomes advisable to use a comprehensive approach. With a view to strengthening the distinguished attributes, a comprehensive approach may mean developing the attitudes and skills of staff, as well as shaping a high organizational culture. In this respect, selected proposals for improvement in the area of knowledge, communication and cooperation are presented (Table 15). The hypothesis H2: *it is possible to identify ways of strengthening human capital to increase the quality of services provided in the hospital* was confirmed.

Table 15.

Selected ways for strengthening human capital to increase the quality of services provided in the hospital. Own proposal

Areas	Staff attitudes and skills	High organizational culture
Knowledge	active participation in training in the field of modern methods, techniques, clinical therapies and pharmacotherapy	development of professional development programs
	participation in seminars and industry conferences	
	free exchange of information based on the principle of mutual benefit	an atmosphere friendly to acquiring and sharing knowledge and improving professional qualifications

Cont. table 15.

Communication	improving the ability to listen to others without stereotypical thinking, interrupting speech and judging	developing a code of principles of good interpersonal communication
	active participation in training in interpersonal communication and dealing with conflict situations	developing soft skills improvement programs
	receiving and responding to patient feedback	developing an effective system for collecting patient opinions
Cooperation	active and voluntary involvement in teamwork	creating interdisciplinary teams
		promoting teamwork
	cooperation of clinical mentors (with extensive experience) with other staff	climate encouraging cooperation
	the practice of building lasting relationships with patients based on mutual respect and trust	
	active participation in consultation meetings	practicing the formula of consultation meetings

Source: Own study.

It is worth emphasizing that strengthening professionalism is a long-term process that requires the involvement of not only staff and hospitals, but also the environment of medical facilities. Similarly, developing an individualized approach to patients requires the conscious involvement of both medical staff and management staff. As reported in the literature on the subject, staff play an important role in increasing the quality of hospital services (Walston, Chadwick, 2003). It seems important to create an organizational climate friendly to the conscious, responsible and active participation of staff in the improvement process. Undoubtedly, patient satisfaction surveys play a key role. And informing staff about the degree of satisfaction or dissatisfaction of hospitalized patients may be a factor strengthening change for the better. For example, Rozenblum et al. indicate a relationship between providing doctors with information on patient satisfaction and acceptance of implemented improvement programs (Rozenblum et al., 2013).

Undoubtedly, continuous strengthening of the medical environment and investing in the development of organizational culture can significantly improve the quality of care and the effectiveness of the treatment process. However, the inference made is subject to certain limitations. They result primarily from the size of the research sample and the scope and scale of empirical research. It can be assumed that expanding the research field to include the international environment could significantly enrich the considerations with comparative analysis. Then the conclusions formulated would become more universal. Moreover, supplementing the study of correlations between e.g. the length of hospitalization or the number of hospital stays and the level of patient satisfaction may be an interesting direction for further research.

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FINANCIAL MARKETS FOR THE GREENER FUTURE: THE ROLE OF GREEN BONDS IN ENERGY TRANSITION. EVIDENCE FROM EUROPE

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Purpose: The aim of the article is to assess the role of the green bond market in financing investment activities in the field of energy transition. Attention was focused on the European green bond market, considered the most mature and developed market for assets of this class.

Design/methodology/approach: Critical analysis of domestic and foreign scientific achievements regarding the development and importance of the green bond market in the energy transition process. Analysis of secondary data from statistical reports showing the state of development and the degree of use of the green bond market in financing energy transition tasks in 2014-2022.

Findings: On the basis of the conducted research, it is concluded that the European green bond market is developing quite dynamically, and its structure is dominated by issues of green bonds intended to finance expenditures supporting the energy transition process.

Originality/value: The green bond market - due to its relatively short history of operation, high dynamics of value growth and internal diversification process - is a relatively new object of research in economic sciences.

Keywords: green bonds, sustainable development, sustainable finance, energy transition, financial market.

Category of the paper: Research paper.

1. Introduction

With the progress of civilization and economic development, the demand for electricity increases. It is estimated that in 2022 global energy consumption increased by 2.5% (y/y), at a level similar to the average growth of the last decade (2.6% per year for 2010-2021) (Wiatros-Motyka, 2023). At the same time, over 80% of the world's energy supply comes from fossil fuels (Figure 1), the energy production sector is responsible for 40% of global carbon dioxide emissions, and fossil fuels for energy production generate two-thirds of global greenhouse gas emissions (Ayaz, Majeed, 2022).

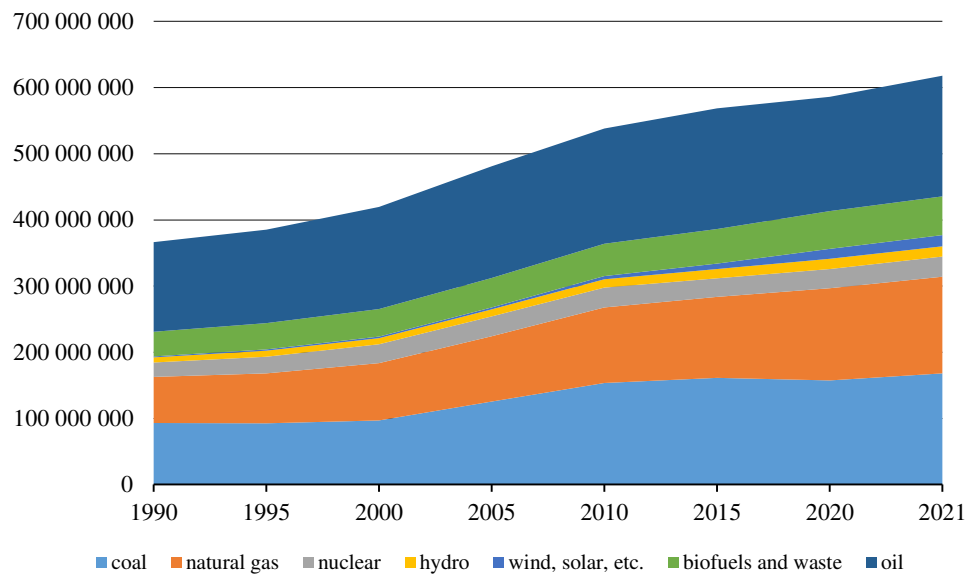


Figure 1. Total energy supply by source in years 1990-2022 (in TJ).

Source: own study based on: <https://www.iea.org/>

The high degree of dependence of the energy sector on fossil fuels (coal, oil and gas) and the resulting negative impact on climate change and the management of natural resources have made the transformation of current economic models towards systems focused on sustainable development and obtaining energy from renewable sources. not so much a need, but an imperative and challenge of modern times. The paradigm of contemporary energy policy clearly emphasizes the need to increase the role and importance of renewable energy sources, such as wind, water and sun. However, the development of these energy sources requires significant investment in research and development, infrastructure, and technology (Andersen, 2017). It is estimated that achieving the goals of the Paris Agreement (i.e., achieving net zero greenhouse gas emissions and limiting global warming to 1.5°C) will require global capital expenditures of \$4 billion per year by 2050 (Lorentz et al., 2023). Only in 2023, 500 billion was invested in the energy transition, and almost 70% of this amount came from private investors through the debt securities market. The above-mentioned situation illustrates the global trend of financing expenditure on energy transition - in the years 2018-2023, two-thirds of the value of investment expenditure allocated to energy transition investments came from the debt capital market (Saha, 2024).

In view of the above findings, the objective of the article was to assess the role of the green bond market in financing investment activities in the field of energy transition. Attention was focused on the European green bond market, considered the most mature and developed market for assets of this class.

2. Understanding the green bond phenomenon

One of the most important financial innovations in the area of sustainable finance over the last ten years has been the development of the market for green bonds and other labelled debt instruments (e.g. social bonds, sustainable bonds or green securitisation). The financial structure of these instruments does not differ from plain-vanilla bonds, except that green bonds contain a clause to use the proceeds from debt issuance to finance (or refinance) projects related to broadly understood pro-ecological activities. This means that, unlike classic debt instruments that supply the issuer's general capital, green bonds finance projects consistent with sustainable development goals. However, the financial risk of these instruments is secured by the general economic situation of the issuer - the bond buyer is not directly exposed to the financial risk related to specific projects that finance green bonds (Maltais, Nykvist, 2020).

The year 2007 is generally considered to be the beginning of the green bond market, when the European Investment Bank issued the first Climate Awareness Bonds (CABs). The value of the green bond issue was \$0.9 billion and its aim was to raise capital that would form the basis for loan financing for investment projects in the field of renewable energy sources (wind, water, solar, geothermal) and improve energy efficiency (district heating, cogeneration, building insulation, reducing energy losses in distribution networks) (Cortellini, Panetta, 2021; Pawłowski, 2017). Although after more than 15 years of operation, the market for these instruments constitutes slightly more than 1% of the global bond market (Chasan, 2019), it shows above-average value growth and is successively expanding the spectrum of listed instruments and green debt (Figure 2).

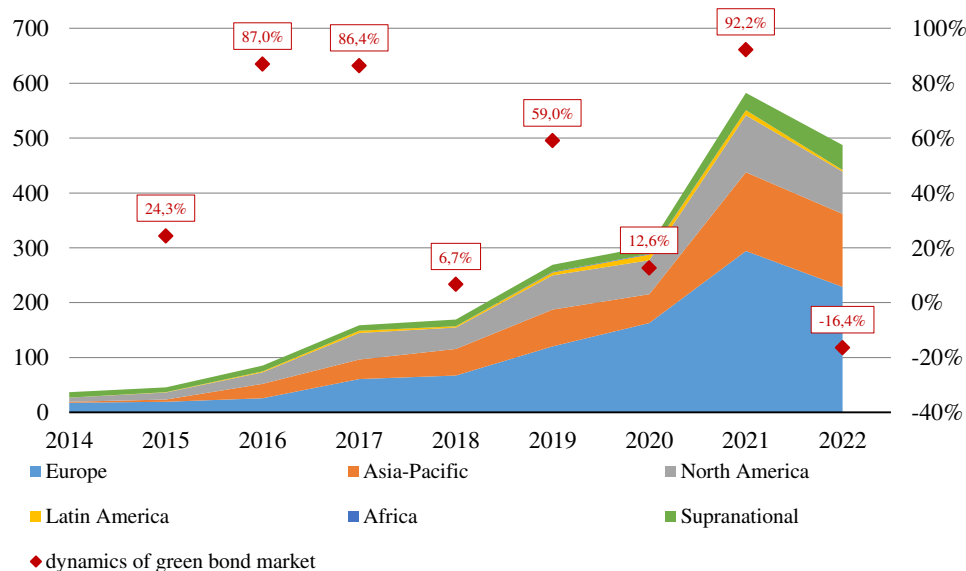


Figure 2. Volume of green bond issuance by region (left axis; in \$billions) and dynamics of green bond issuance (right axis) in 2014-2022.

Source: Own study based on: <https://www.climatebonds.net/>

The green bond market is seen as a catalyst for the metamorphosis of economic systems toward a resource-efficient and low-emission economy. The green bond market is therefore within the scope of perception of national governments, supranational institutions and organizations supporting the development of financial markets, because only a well-developed and properly functioning green bond market will constitute a source of financing for pro-ecological investments that is complementary to public funds. It is worth mentioning that Europe is not only the cradle for the development of the green bond market, but also an area where numerous initiatives and activities are undertaken aimed at the development of this segment of the financial market.

The presentation in 2014 can be considered a milestone in the development of the green bond market. Green Bond Principles (GBP) by the International Capital Market Association (ICMA). This document was the first internationally recognised standard to unify the rules for the issuance of green bonds and introduce good practices to promote and support the further development of the market for these instruments. Experience shows that the introduction of GBP has led to greater market integrity and set a global standard for the definition of green bonds. In addition, the document established an issuance framework (based on transparency, pre-issuance disclosure, post-issuance reporting, third-party verification) to help investors assess the environmental performance of climate bonds and the credibility of issuers. Moreover, GBP has also become the basis for subsequent methodological approaches to standardize and classify forms of green debt (Ehlers, Packer, 2017).

It is also worth mentioning that in Europe in 2010 One of the first institutions monitoring the development of the green bond market was established - Climate Bonds Initiative (CBI). This institution focusses its activities on providing broadly understood tools supporting the development of debt financial instruments dedicated to financing activities consistent with the goals of sustainable development. CBI not only monitors and reports data on the size of the green bond market, but also provides recommendations on green bond issuance standards, provides advisory services on green debt issuance, and formulates proposals for policy models supporting the future development of the green bond market. Importantly, CBI's activities are not only highly diversified in terms of subject matter, but also geographically - with the development of CBI's activities, the scope of its research covered basically all economies in the world.

Table 1.

The structure of the global green bond market by the county as a % of total volume in 2014-2022

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Europe	48,9%	43,1%	30,4%	38,2%	39,7%	44,7%	53,8%	50,5%	46,9%
Asia-Pacific	4,4%	7,9%	31,1%	22,4%	28,7%	24,9%	17,4%	24,6%	27,4%
North America	20,2%	28,1%	24,4%	30,7%	23,0%	23,3%	20,3%	17,8%	15,7%
Supranational	25,7%	18,5%	12,0%	6,0%	7,2%	4,9%	4,6%	5,4%	9,3%
Latin America	0,5%	2,4%	1,9%	2,5%	1,3%	1,9%	3,6%	1,6%	0,6%
Africa	0,3%	0,0%	0,2%	0,2%	0,1%	0,3%	0,3%	0,1%	0,1%

Source: Own study based on: <https://www.climatebonds.net/>

Referring the previous observations to scientific research, which shows that among the many factors influencing the development of the green bond market, the most important are market infrastructure, legal regulations, and the economic situation (Tu, 2020), one can find a justification for the dominance of the European green bond market in the structure of the global market for these instruments (Table 1.). Analysis of the structure of the global green bond market indicates that basically half of the global value of green debt is issued on the European continent. Therefore, the European green bond market can be considered a more mature market structure, and further analysis will be devoted to this part of the global green debt.

3. Energy Transition as a Beneficiary of the European green bond market

The global dissemination of the concept of sustainable development and the building of a new paradigm of economic development on its foundations give the contemporary understanding of climate risk a dual character. In the first (typical) approach, climate risk refers to the interaction of climate-related threats with the enterprise's operations (in the physical aspect), resulting in losses in the enterprise's assets or disruptions in the proper functioning of supply chains. The second dimension of climate risk results from changes in policy, technology, social pressure, or investor expectations regarding a business model adapted to a low-emission economy and concerns losses arising as a consequence of reputational risk (Tuhkanen, Vulturius, 2022).

Regardless of the source of materialisation, climate risk, in its essence, leads to the variability of a company's operating profits and changes in its market position, so there is a growing awareness of the importance of climate risk in the activities of modern organisations. The issuance of green bonds can therefore be perceived as a corporate response to the need to manage climate risk (in each of the discussed aspects), as well as as a way of communicating with the market (declaration of undertaking activities aimed at reducing the carbon footprint of the business).

The above highlights the economic importance of the green bond market and is one of the foundations of the dynamic growth of its value. However, apart from quantitative criteria, the green bond market is also characterized by qualitative changes. The first is the type of diversification of entities issuing green debt (Figure 3). The findings so far show that the green bond market was initiated by issues made by supranational financial institutions. This brought lasting consequences for the subjective structure of issuers present in this market, because until 2013 the green bond market was created by issues of supranational financial institutions with a small share of issuers representing local governments. We have been watching the process of diversification of the group of issuers involved in the issuance of green bonds since 2014,

and it should be emphasised that the differentiation of the market's entity structure is quite clear (Pawłowski, 2018). It turns out that in the analysed period, the importance of supranational financial institutions in shaping the value of the green bond market decreased dramatically (from 95% in 2012 to 1.3% in 2022). At the same time, based on the statistics presented, three main categories of issuers can be distinguished, which can be attributed a significant share in shaping the value of the green bond market - financial corporate, sovereign and non-financial corporate (respectively responsible for 33%, 30% and 24% of the value of the green bond market in 2022). A decrease in emission activity in 2022 should be noted. within each issuer group (for the entire green bond market, the value growth rate for 2022 = -16.4%). The above is a consequence of inflation, which causes the collapse of the fixed income market (CBI, 2024).

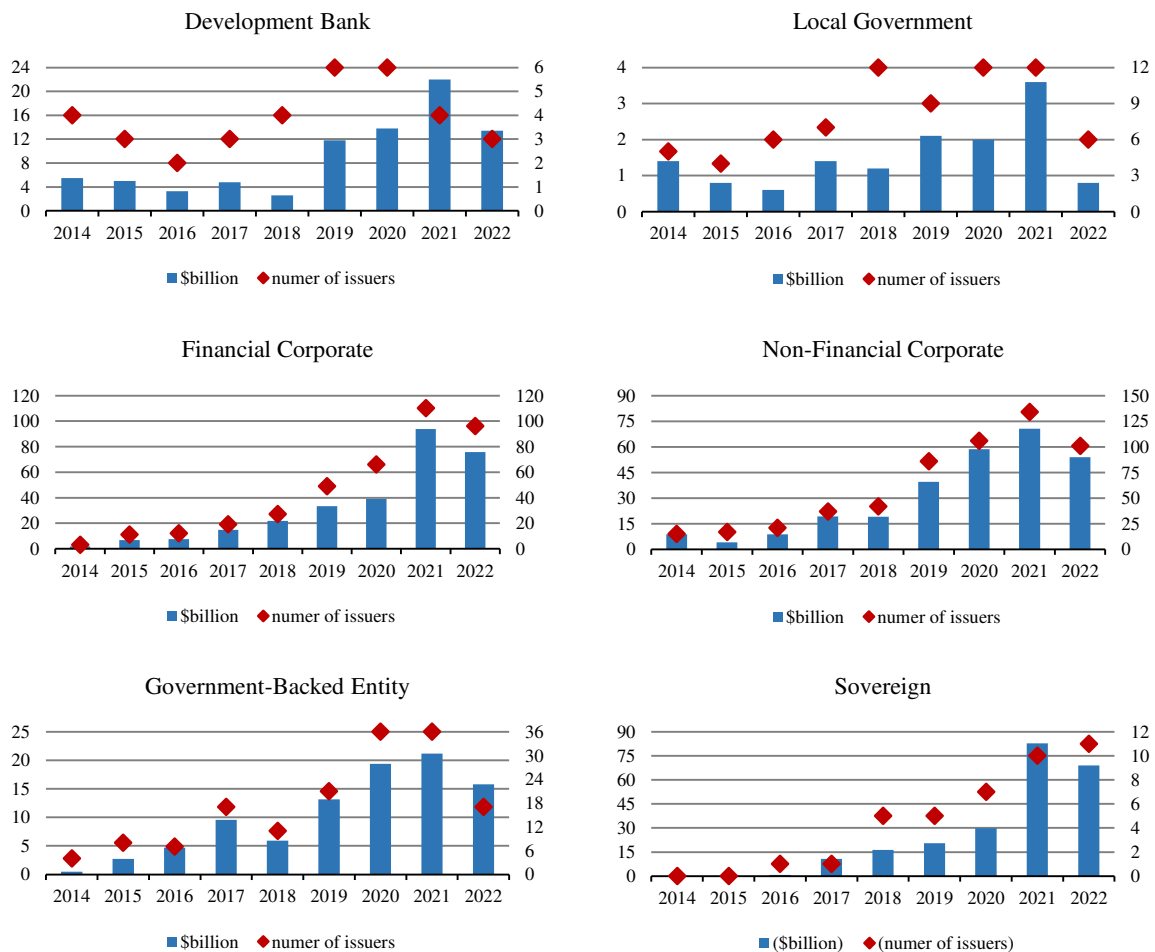


Figure 3. Green bond issuance volume by the issuer type (left axis; in \$billions) and number of issuers by the issuer type in years 2014-2022 (right axis).

Source: Own study based on: <https://www.climatebonds.net/>

As the structure of issuers making up the green bond market changes, the types of pro-ecological activities financed through it change. The analysis of the green debt market through the prism of the direction of use of proceeds from the issuance of green bonds indicates the dominance of investment tasks in the field of energy transition (Figure 4). Since 2014, the energy sector has received proceeds from the issuance of green debt, and green bonds issued

to finance this type of expenditure represent the largest part of the debt. Although the share of green bonds intended to finance pro-ecological energy projects decreased from 63% in 2014. up to 34% in 2022, however, this segment of the green bond market is gradually gaining in importance and value (the average growth rate of the value of green bonds intended to finance expenditures in the energy sector in 2014-2022 is 33% annually).

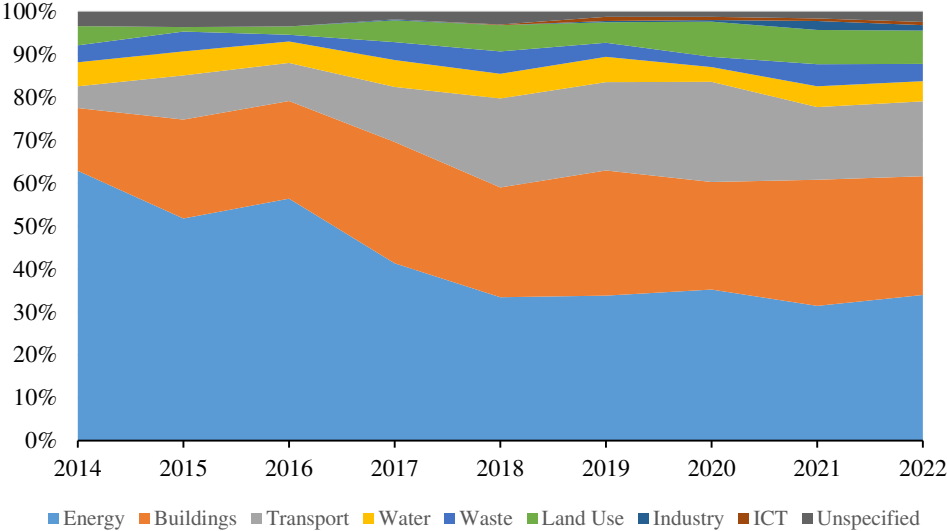


Figure 4. The structure of the Green Bond Market by the use of proceeds in years 2014-2022.

Source: Own study based on: <https://www.climatebonds.net/>

It is also worth noting that in the years 2014-2022 the energy sector is responsible for the largest value of green bond issues. Their total value is \$350 billion (Figure 5).

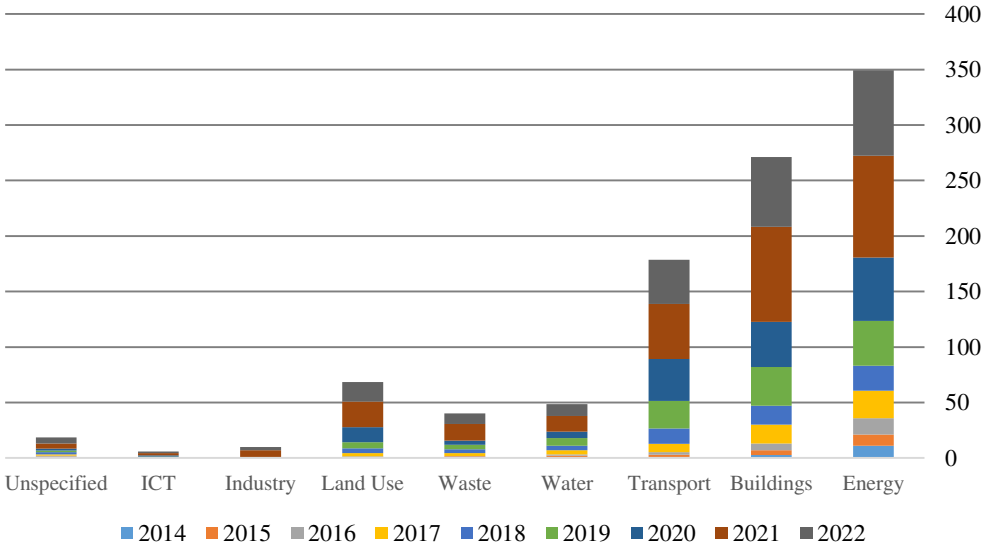


Figure 5. Total value of green bond issues by use of proceeds in years 2014-2022.

Source: Own study based on: <https://www.climatebonds.net/>

4. Conclusions

Commitments by governments and the private sector to ambitious emissions reduction goals and the transformation towards a resource-efficient economy make the green bond market increasingly important and characterized by above-average dynamics of value growth. The implementation of the concept of sustainable development requires significant investment in technical infrastructure, assets, and R&D. In this respect, public funds turn out to be insufficient, thus creating the need for private capital to participate in financing pro-ecological investments.

The green bond market fills the capital gap in financing tasks covered by the Sustainable Development Goals. From the point of view of the problem of energy transition, issuers' motivations for financing through the issuance of green debt may focus on the desire to diversify the investor base and access to a greater value of capital not limited by the capabilities of a single investor (as opposed to the banking sector) and/or use the green debt market to communicate with market (as an instrument signaling commitment to environmental protection activities, with all the benefits that result from it).

Regardless of the reasons for the issuance of green bonds, the analyses discussed in this article have shown that the energy sector is the largest beneficiary of the green bond market. The scale and value of the bonds issued to finance energy transition tasks clearly dominate the structure of the green bond market. Moreover, there is a progressive diversification of the group of green debt issuers, which only emphasizes the role and importance of the green bond market in the accumulation of capital for activities aimed at environmental protection.

It can be assumed that the scale of needs related to the energy transition and the development of alternative energy sources will only fuel the further development of the green bond market, both in quantitative and qualitative terms. However, for the green bond market to play its role in the energy transition process, further in-depth research is needed, including: premises determining the choice of the green bond market as a source of financing expenditures intended for the energy transition process, or even the issue of the effectiveness of financing these expenditures through the issuance of green debt.

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JUSTICE AND SUCCESS: HOW TO COMBINE THESE ISSUES IN TEAMWORK?

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Purpose: Temporary teams are created to perform a specific task, e.g., to implement a project or solve a problem. They are dissolved when the goal is achieved or the set time has elapsed. The study's primary purpose was to identify the most critical challenges managers should pay attention to manage temporary teams effectively and fairly.

Design/methodology/approach: The study covered 110 managers from medium and large enterprises - all having practical experience in the functioning of temporary teams. The study adopted a modified Colquitt scale and used the importance-performance analysis technique.

Findings: Factors influencing the sense of fair treatment among participants of this type of team were identified. Experienced managers assessed: the impact of each of these factors on the success of the temporary team and the degree of difficulty involved in providing each of these factors. On this basis, eight challenges for managers have been identified, i.e. factors which, on the one hand, are very important and, on the other hand, difficult to ensure.

Research limitations/implications: The potential limitation of the study concerns the fact that it covers enterprises from the high-tech industry. Employees of public organizations or other industries may perceive justice differently. The research considered two variables that may affect the success of temporary teams' work. A different type and/or a more significant number of variables may contribute to a better understanding of this issue and the holistic approach. Elements related to relations, as well as ethical and moral issues, are worth paying attention to. It seems that the last ones belong to the commonly emphasized matters; hence they can be perceived as functioning, obligatory, and as relating somewhat to the individual leaders-team members relations, while those seen as more difficult as relating to relations within the group or between the leaders and the whole group.

Originality/value: We see value in relating the issue of equity to interim teams and identifying challenges to its application by managers.

Keywords: organizational justice, team performance, temporary teams, success, managers perception.

Category of the paper: Research paper.

1. Introduction

Recognizing that employees' attitudes and actions matter for the functioning of organizations in the modern world, attention is increasingly being paid to the individual level in the context of organizational behavior. The importance of fairness is emphasized (Song et al., 2012; Suifan, 2019; Unterhitzberger, Bryde, 2019, Wu et al., 2017), which influences motivation, job satisfaction, well-being at work and organizational commitment, etc. that is so valuable today (Ambrose et al., 2021; Bensemmane et al., 2018).

This points to the importance of the manager as the person who is "the most visible and relevant interpreter and communicator of policies, systems and practices that affect employees" (Frenkel, Bednall, 2016, p. 21). Thus, on the perception of fairness and interpretation of how they are treated in the organization.

At the same time, teamwork is indicated as a desirable, necessary activity in relation, among other things, to achieving set goals, innovation, expanding knowledge and gaining competitive advantage (Chen et al., 2020; Liu et al., 2015, Tröster et al., 2014). While the literature on teamwork and permanent teams is ubiquitous, relatively few publications on temporary teams are (Lv, Feng, 2021). It is difficult to understand why, since they are frequently invoked and have many characteristics that significantly distinguish them from permanent teams (Zapata et al., 2017, Burke, Morley, 2022).

People participating in the work of temporary teams have to deal with many specific problems, such as, for example, being appointed to work in a team urgently (because a problem suddenly appeared), lack of time to get to know each other and integration with other team members, working under solid time pressure, the need to reconcile basic (existing) duties with new tasks, prioritize what needs to be done ASAP – they regular tasks or new duties, etc. This can lead to a feeling of unfair treatment among members of temporary teams. Even if everybody is aware of "new situation", not everybody can switch to the new role the same way. This, in turn, could have a negative impact on the team's performance.

Previous research on organizational justice has focused mainly on managing subordinates who experience a sense of unfairness, as this feeling is justifiably conceived as a problem for employee performance (Reb et al., 2019). For this reason, most justice research has heavily focused on how perceptions of fairness can be controlled or how unwanted consequences can be alleviated (Kurdoglu, 2020). There is a lack of research to show managers how fair management can contribute to the success of a temporary team or organization.

The paper aims to answer the following research question:

RQ: What factors (referred to as challenges) should managers focus on to ensure the temporary teams work effectively and fairly?

The study offers a new framework for efficient and fair management of temporary teams because:

1. refers to the individual behavior of employees but also as team members,
2. combines justice with efficiency,
3. takes into account the point of view of managers (people who have a tangible impact on justice) and not employees (people who only judge whether they are treated fairly),
4. two criteria are integrated to evaluate the actions and decisions: the importance of the factor and the degree of difficulty in providing it.

This study is structured as follows. The next section presents the theoretical background to explore the issue of temporary teams and justice in the organization. The following part depicts the research methodology, including developing a research tool, sampling and data collection. The next part is the presentation of the findings. The final section discusses the results, identified limitations and recommendations for future research.

2. Background

2.1. Temporary teams

The concept of temporary teams comes from temporary organizations. Also, the project as a complex social construct is considered a temporary organization (Unterhitzberger , Bryde, 2019). Therefore, it is assumed that project teams are a variation of temporary teams.

The first person who put forward the concept of temporary organizations and structures was Warren G. Bennis. It happened in 1965. More and more scholars are now studying temporary organizations or structures (Lv, Feng, 2021a). Burke and Morley (2016), based on the results of a systematic literature review, identified five leading research areas related to temporary organization. They were presented together with the substantive themes in Table 1.

Table 1.
Research areas related to temporary organizations

Research on:				
1	2	3	4	5
individual/team attributes and interior processes	task attributes	tensions with permanent organization	networks and organizational fields	outcomes
<ul style="list-style-type: none"> ▪ coordination processes ▪ leadership ▪ cognitive incongruence ▪ team tenure and turnover ▪ temporal phenomena 	<ul style="list-style-type: none"> ▪ exogeneity and temporal limitation ▪ uncertainty and ambiguity ▪ complexity ▪ uniqueness 	<ul style="list-style-type: none"> ▪ autonomy and embeddedness ▪ learning and knowledge transfer ▪ human resource management ▪ resource dependence 	<ul style="list-style-type: none"> ▪ networks and institutional embeddedness ▪ network routines and path dependence ▪ project ecologies 	<ul style="list-style-type: none"> ▪ temporary organization versus permanent organization perspectives

Source: (Burke , Morley, 2016).

The essence of the temporary organization is usually explained using four basic concepts: (1) time, (2) task, (3) team and (4) transformation. In temporary organizations, time can be envisaged as a linear section of a continuous-time flow that is cut out and thus made predictable and plannable. Temporary organizations have an ex-ante determined termination point, fixed either by a specific date or by the attainment of a predefined state or condition, resulting in them being described as transient, of limited duration, or subject to 'institutionalized termination' (Burke, Morley, 2016). The presence of a task, something that needs attention, is the main reason for creating a temporary organization. The emphasis on the task can be compared to the emphasis on goals and the repeated revision of goals in permanent organizations. The team focuses on interpersonal relationships, how teams can function by building engagement, and how they connect with the surrounding environment through legitimation processes. Transformation is the primary goal of temporary organizations; something must be achieved in terms of transition before success can be declared. In permanent organizations, the emphasis is on production, not transition. When transition becomes necessary as part of a permanent organization, temporary organizations are often created to deal with it (Lundin, Söderholm, 1995). It is worth noting that the concept of temporary organization is not limited to the functioning of specific temporary structures within traditional permanent organizations (e.g. enterprises). More recently, scholars are drawing attention to alternative configurations of temporary organizations: inter-organizational project ventures and project-based organizations (Burke, Morley, 2016, 2022).

Temporary teams (understood as temporary structures within organizations) are commonly used in modern enterprises (Lv, Feng, 2021a; Tyssen et al., 2013). They are assembled to finish a specific task in a finite timeframe (Altschuller, Benbunan-Fich, 2010). The most significant difference between the teams of permanent ones is that it is known in advance that when the task is completed, the team will be disbanded. The second characteristic of temporary teams is that after completing the task (and disbanding the team), some members can remain together with each other and other members of teams maybe never get together (Tannenbaum et al., 2012). These features imply the specificity of temporary teams. For example, they often do not have enough time to develop roles and norms, establish deeper trust, develop communication patterns, and resolve sources of deep-lying conflict (Saunders, Ahuja, 2006).

There are many types of temporary teams. The literature on the subject describes, among others, the following:

- 1) project teams (working on highly skilled projects) and ad hoc teams (problem-solving teams, typically with seasoned professionals) (Saunders, Ahuja, 2006);
- 2) virtual teams and traditional teams (Panteli, Duncan, 2004),
- 3) short-time teams and long-time teams (Bakker et al., 2013),
- 4) teams driven by expected events and teams driven by unexpected events (Jacobsson, Hällgren, 2016).

It is widely reported that temporary teams can generate a positive impact on the performance of different organizational processes, such as increased individual involvement, better problem-

solving, creative solutions and effective implementation of decisions (Jugend, da Silva, 2012; Maciejovsky et al., 2013; Maylor, Turkulainen, 2019; Sydow et al., 2004, Zapata et al., 2017). This applies to enterprises and other organizations, e.g., from the public sector (Stipp et al., 2018).

With regard to temporary teams, previous research has demonstrated some significant problems. The teams tended to experience less cooperation between the parties involved, more relational conflict, and fewer regulatory strategies than ongoing or functional teams (Bakker et al., 2013). Lichtarski (2008) identified six critical barriers of temporary structures' development, i.e. competence regulation problem, boundaries among projects, low acceptance of multi-subordination and heterarchy, lack of opportunities for safety needs fulfilment, complex and changeable nature of project, structure and problems with knowledge creation and exchange.

2.2. Organizational justice

Organizational justice addresses the issue of fairness in an organization. As Japsen and Rodwell note (2009), it refers to how employees judge whether something is fair or unfair. Thus, factors taken into account by employees can be considered essential. However, as Greenberg writes (Zhang et al., 2019), such an approach is subjective, calculated and egocentric. Therefore in the case of organizational justice, it is worth to base on the designated criteria. Those proposed in the source literature have been defined based on knowledge about human behavior in the organization and the conducted research. It should be added that they all relate to the decision-making process. At the same time, these criteria relate to different aspects/areas of this process.

They are the basis for distinguishing three main types of justice (Andrews et al., 2008). The first type is *distributive justice*. It relates to the outcome of the process, the perception of fairness of the decisions outcomes and resource allocation¹. As indicated by Cropanzano and Gilliland (2007) three allocation rules can be applied within it, i.e. equality (to each the same), justice (to each by contributions), and need (to each in accordance with the most urgency)². The second is *procedural justice*. It refers to controlling the decision-making process and the integrity in making decisions. According to Leventhal, it is essential to follow Six Principles for this kind of justice (Przęczek et al., 2020): consistency (procedures must be consistent), impartiality (procedures must treat all employees the same way), accuracy (when implementing procedures, it is required that decision-makers read all the information relevant to the implementation of the procedure and use it correctly in the process), the possibility of repair (procedures must include the possibility to appeal against a decision or other mechanism correcting wrong decisions), participation (all interested parties should be able to participate in the process) and ethics (all decisions should be based on moral and ethical principles acceptable by employees). At the same time, it is worth adding that employees "choose" those that are important to them from these principles. This means that employees can assess fairness considering other criteria (relevant to them). Thus, the results of their perception may be

different in the same organization, that is, in one company, employees may indicate a different level of procedural fairness. The third type is *interactive justice*. It concerns mutual relations between persons or between persons and social groups participating in the process. In the workplace, on the one hand, they relate to communication (honesty, promptness, accuracy) and participation, on the other hand, they are related to the way of treating subordinates (regarding respect, tolerance and openness – see: Chang et al., 2020, p. 286). That is why some authors, like Greenberg (1990), make an additional distinction between informational and interpersonal justice. As Chang et al. (2020) write, even if a manager has taken care to communicate when making a particular decision (informational justice), a subordinate may still feel unfair if the superior treats him or her in a rude manner (interpersonal justice).

Considering the meta-analyses carried out³ concerning justice in the organization, it can be noted that the considerations covered three issues, i.e. (Przęczek et al., 2020; Silva, Caetano, 2016; Wolfe, Lawson, 2020):

1. The effects of justice, including indications for pro-social and pro-organizational attitudes of the employees, their commitment to work, productivity, and a positive impact on health.
2. Antecedents justice. As shown by Silva and Caetano (2016), about 77% of empirical research concerns such antecedents as: allocation (20%), procedural (15%) or situational (17%) criteria, and organizational features (12%). Some analyzes cover both causes and outcomes of justice, and about 60% of research include the effects of justice, that is: satisfaction (17%), commitment (15%), turnover and trust (12%).
3. Method of measurement and conceptualization.

The authors of the analyses focused mainly on distributive and procedural justice⁴ as well as the perspective of employees. The leading role of these three identified issues related to justice is also indicated by other authors, e.g. (Cugueró-Escofet, Fortin, 2014; Hastings, Finegan, 2011; Magnan, Martin, 2019).

A limited number of analyses relating to team⁵, also considering their type (see Table 2) should be emphasized.

Table 2.

Number of publications in the EBSCO database related to justice by team type⁶

Team type	Number of publications in database	Number of articles included in the analysis*
Temporary teams	1	1
Project teams	6	1
Ad hoc teams	2	-
Development team	8	3
Short-time teams	0	-
Virtual teams	5	1
Teams driven by expected events	0	-

* Results were verified according to the following criteria: scientific journal, English language, duplication, subject matter.

Source: Own study.

It can be seen that procedural justice and the employees' perspective were primarily analyzed in these studies. Of course, the aftermath of this kind of justice has been studied. The positive impact on the involvement of project team members strengthening of reflectivity in teamwork, which favors this type of team's productivity, efficiency and creativity was mentioned. It was established that the reflectivity of the team⁸ is enhanced by the perception of being treated fairly (Lee , Sukoco, 2011). This enables unlearning, which contributes to changes and innovation, which is essential - also under stressful conditions. By contrast, Akgün et al. (2010) showed that joint problem-solving, knowledge expansion and information sharing in the case of *new development teams* facilitate the detection of errors and their repair, learning in a team and favours the speed of decisions and responsibility of actions.

In many analyzed articles, their authors treat procedural fairness as an atmosphere of procedural justice, i.e. collective perception of fairness of applied procedures. In this approach, internal relations between team members are taken into account: mutual treatment, quality of cooperation and communication. The factors that determine them are searched for.

Dayan and Colak (2008) indicated the importance of functional diversity, team size, team stability and collectivism for the level of procedural fairness, thus achieving success (creativity, speed of product launch) by the team programmers. According to the results of these authors' research, the latter two have a positive effect on the climate of justice, while the second has a negative effect, and the first requires a moderate level.

Ganesh (2011) drew attention to the need to design team tasks, which he related to the interdependence of tasks. At the same time, he considered participatory security, i.e., participation in decision-making at every stage of the process (allocation of resources, distribution of rewards, etc.) as necessary, as an opportunity to express one's opinions without feeling threatened (fears related to expressing opinions; their consequences).

Wu et al. (2019) wrote about trusting managers as a possible outcome of team members' perceptions of procedural fairness. For its creation, they emphasized the need for managers to act according to designated and known norms and rules and not introduce new ones on their own.

Likewise, Valentine (2018) stresses the importance of the division of labour within and between task forces (role structures, i.e. clarity of tasks, interdependence between members) as well as the sense of the possibility to enforce justice (i.e. the perception that authorities will be able to act fairly, taking into account the potential of others cheating) in terms of the result of work. It should be added that the author formulated these conclusions searching for conditions conducive to coordination and extra-role behaviours in temporary teams. Indicated conditions were considered important due to the specific nature of the teams. According to Valentine, the time factor is vital for effective teamwork in the context of relational social exchange, which favours, inter alia, trust. Temporary teams "do not have" that time. They are also characterized by the low responsibility of their members and their low motivation.

Also the specifics of virtual teams (i.e., characterized by geographical dispersion of members and based on the use of information technology) - as indicated by Hakonen and Lipponen (2008) - promotes particular sensitivity to the perception of justice. Taking care of it enables reducing the feeling of uncertainty and identification with the team in the conditions of rare encounters and direct communication.

The role of managers in the work of teams can be noticed. On the one hand, in their creation, on the other - in their functioning, relating to organizational aspects (e.g., division of tasks, adoption of rules as well as compliance to them) and social aspects (concerning own credibility and shaping relationships in the team). For this reason, summing up, it is worth pointing to the proposals formulated by Akgün et al. (2010, pp 1105-1106) for project team managers:

- "Establish a psychologically safe environment, where team members are safe to interact with each other without feeling punished, to exchange knowledge, skills, and feelings during the interactions.
- Respect and listen to everybody's ideas and oppositions during the project and try to understand why they are sometimes in opposition.
- Promote cooperation and mutual interaction between members to complete task requirements.
- Define team members' task boundaries and clarify norms and project goals.
- Seed an external focus on developing information about customers and competitors.
- Set knowledge-questioning values by facilitating team members to try out new ideas and seek out new ways to do things”.

3. Methods

3.1. Goal, questions and tasks

The main goal of the research was to determine factors (referred to as challenges) that managers should focus on to ensure the temporary teams work effectively and fairly.

Therefore, four detailed research questions were posed:

RQ1: What factors impact the sense of justice among temporary team members?

RQ2: Which factors influencing the sense of justice among temporary team members do managers consider essential for the success of temporary teams?

RQ3: Which factors influencing the sense of justice among temporary team members do managers consider difficult to implement?

RQ4: Which factors are challenging for managers, i.e., are important and also difficult to implement?

Answering these research questions and achieving the primary goal of the study requires the implementation of four tasks:

- T1: Identification of factors influencing the sense of justice among temporary team members.
- T2: Assessment of these factors impact the temporary team's success.
- T3: Assessment of the difficulty in providing each of these factors in practice.
- T4: Defining challenges for managers. Identification of factors characterized by both a high impact on the success of temporary teams and a high difficulty in providing them.

3.2. Measures

It was decided to use in the research one of the most valued and most frequently used (Jepsen, Rodwell, 2009; Kiersch, Byrne, 2015; Le, Pan, 2021; Özsahin, Yürür, 2018; Zapata et al., 2017) tool for measuring the sense of justice, i.e., the Colquitt scale (2001). This scale includes 20 items and comprises four subscales corresponding to the types of justice: procedural, distributive, informational, and interactive. However, some modifications were introduced in this set, which adjusted the scale to the specifics of the research conducted. At the same time, the number of 20 factors included in the Colquitt questionnaire was kept.

Respondents were asked to consider to what extent each of these factors positively influences the success of the temporary team and then what the level of difficulty related to the implementation of this factor. In both cases, a 7-point rating scale was used, in which "1" meant the lowest rating (no impact on the team's success / no difficulties with providing a given factor), and "7" was the highest rating (very strong impact on the team's success / very high level of difficulty related to the provision of a given factor). It was assumed that the results would be interpreted according to the guidelines in Table 3.

Table 3.

Interpretation of the results

Assessment of the significance (impact on the temporary team success)		Assessment of the degree of difficulty	
<i>Evaluation value</i>	<i>Interpretation</i>	<i>Evaluation value</i>	<i>Interpretation</i>
<6,7>	very important	<6,7>	very difficult
<5,6)	important	<5,6)	difficult
<4,5)	rather important	<4,5)	rather difficult
<3,4)	rather unimportant	<3,4)	rather easy
<2,3)	not important	<2,3)	easy
<1,2)	not important at all	<1,2)	very easy

Source: Own study.

3.3. Participants

The study covered senior and middle-level managers from medium and large high-tech enterprises. The condition the respondents had to meet was a practical experience in the functioning of temporary teams.

The sampling operator was the Bisnode Base. The selection of the sample was random. Computer-Assisted Telephone Interviewing (CATI) was used to collect the information.

The study was carried out in June and July 2021. It was conducted following the "ESOMAR International Code of Conduct for Market and Social Research" and the provisions on personal data protection.

Information from 110 respondents was collected as a result of the interviews. The most significant number of responding managers worked in the electronics and automotive industries. In total, they accounted for 73% of the research sample.

Most respondents were managers responsible for the entire enterprise or several departments (20%). The rest were people handling: production, sales, human resources, maintenance, marketing, finance, research and development, supply and quality.

3.4. Method of analyzes

To perform the first task, an appropriately modified Colquitt scale was used. The reliability of the created scale was assessed using Cronbach's alpha test.

The second and third tasks were carried out based on a survey. The arithmetic mean was used to analyze the obtained results.

In order to achieve the fourth objective, empirical data was also taken into account. However, the importance-performance analysis (IPA) was used in this case. This business research technique was developed as a marketing tool to examine and suggest solutions to management decisions. Although initially developed for marketing purposes, its application has been extended to various fields, including food services, education, banking, public administration, e-business, and science. In its typical application, IPA involves assessing different aspects of an organization's features regarding customer perceptions of performance and importance. Typically, such features are represented in a 2x2 grid, where each quadrant can be divided among specific suggestions.

4. Results and discussion

Task1: Identification of factors influencing the sense of justice among temporary team members

The Colquitt scale was used as a starting point for determining the factors influencing the sense of justice. However, some changes have been made to it. They aimed to:

1. Adjust the scale to the character of respondents that were the managers. The early Colquitt scale was mainly used for employee opinion surveys.
2. Take into account the character of the functioning of temporary teams. A person who is a member of the temporary team belongs both to this team and to an organizational unit in a permanent organizational structure. This can lead to the need to meet more

responsibilities and be subordinate to two different superiors. Collaboration in a team also means that the result of work depends both on the employee's individual commitment and the involvement of other team members. If it is a new form of cooperation for a team member (other than the current one, e.g. an individual workplace), one can also speak of a feeling of being in a new situation. Undoubtedly, it is also characterized by a lower level of routine.

Due to the fact that the employees perform both the tasks of their job and the team's, in the case of interactive justice, one item was added related to the treatment of a team member by the managers and employees (colleagues) from the organizational unit in which they work on a daily basis (X16) and procedural fairness items regarding voluntary participation in the temporary team (X1) as well as the possibility of completing the task (X9). In this type of justice, based on the item from the Colquitt scale regarding "influence over the results arrived at by those procedures" and taking into account teamwork, two were distinguished: the possibility of implementing the decisions made (X10) and the impact on the rules (following with the Leventhal participation principle) - X3). The described character of work in a temporary team was the basis for modifying items in distributive justice, i.e., appreciating the effort and performance of the team as a whole (X11 and X12) as well as the individual contribution of each team member (X13). Similarly, in interactive justice, by taking into account two directions of the relationship: inside the team (between its members - X14) and the leaders with the team (X15).

The strong point of the above set is that it includes 4 most important types of organizational justice, which makes it holistic.

A complete list of justice measure items is presented in Table 4.

Table 4.

Justice measure items of temporary teams

No	Measure items	Type of organizational justice
X1	Rules governing functioning of the temporary team give each person the right to accept or refuse working in a task team	procedural
X2	These rules enable each team member to express his views and feelings about the functioning of the team	
X3	These rules may be modified at the request of members of the temporary team	
X4	These rules are not biased - they do not favour anyone and do not discriminate against anyone	
X5	These rules are consistently applied to each team member	
X6	These rules were established on the basis of a thorough analysis taking into account the specifics of the temporary team	
X7	These rules allow team members to appeal against decisions made in the team or concerning its functioning	
X8	These rules are consistent with the ethical and moral standards adopted by the members of this team	
X9	These rules make the task force able to complete the task (by selecting the right employees, availability of the necessary resources, etc.)	
X10	These rules ensure a high probability that the decisions made by the team will be implemented	

Cont. table 4.

X11	The task force (as a whole) is appreciated, materially and immaterially, according to the effort put into the task	distributive
X12	The task force (as a whole) is valued materially and immaterially according to the results achieved	
X13	Each member of the temporary team is valued (materially and immaterially) according to their contribution to the team's work	
X14	Relationships between all members of the temporary team are based on mutual respect (manifested by the lack of non-constructive criticism, spite, etc.)	interpersonal
X15	Each participant in a temporary team is treated with respect by the leader of that team	
X16	Participation in the task team does not have a negative impact on the employee's relationship with both the manager and other employees of the organizational unit with which he is permanently associated	
X17	The leader of the temporary team is honest and open with team members	informational
X18	Rules governing the functioning of the temporary team are understood by and fully communicated (and explained) to team members	
X19	The information needed for the work of the temporary team is provided exactly on time	
X20	A temporary team leader will customize communication to suit individual needs of members of the temporary team	

Source: Own study based on (Colquitt, 2001).

Cronbach's alpha coefficient was calculated to test the reliability of the latent constructs (Table 5). Only in one case does the construct's reliability proves too low ($\alpha = 0.64$). However, satisfactory reliability was achieved after removing the factor (i.e., X16), satisfactory reliability was achieved. For this reason, in further analysis, not 20 but 19 factors were considered.

Table 5.

Reliability of constructs

Type of justice	The importance	The difficulty
Procedural justice	0,71	0,81
Distributive justice	0,87	0,84
Interpersonal justice	0,64 / 0,74*	0,77
Informational justice	0,72	0,70

* before the removal of factor X16 / after the removal of factor X16.

Source: Own study.

Task 2: Assessment of the influence of each factor on the temporary team's success

As part of the survey, the respondents assessed the importance of each of the previously identified factors (impact on the temporary team's success). The obtained results are presented in Table 6.

Table 6.*Assessment of the significance of justice measure items for the success of the temporary team*

Measure items (the explanation of the symbols is shown in table 4)	The impact assessment on the success of the temporary team
X17	6,00
X18	5,99
X15	5,97
X19	5,91
X14	5,85
X20	5,75
X2	5,70
X9	5,70
X5	5,57
X11	5,49
X3	5,42
X12	5,40
X6	5,37
X4	5,33
X13	5,33
X8	5,26
X1	5,03
X10	5,00
X7	4,78

Source: Own study.

The average assessment of the importance of each of the analyzed factors was higher than 4. On this basis, it can be concluded that, according to the surveyed managers, all factors presented in the table have an impact on the temporary team's success. Similar results, indicating the importance of all types of equity for project success, were obtained by (Shafi et al., 2021). The most critical element was the honest and open communication leaders with team members (6.0). This factor (as the only one) was defined as very important. As many as 17 other factors were indicated as critical. Among them, the highest scores were given to the comprehensible and complete presentation (explanation) of rules of the functioning of the team to team members (5.99), treating all team members with respect (5.97) and access to the information team members need when they need it (5.91).

The least important factor was allowing temporary team members to appeal against the decisions made in the team or those made regarding the team's functioning. The average score for this item was 4.78. It was the only factor that was identified as somewhat important.

When analyzing the results, it can be noticed that communication issues prevailed among the most important factors. This applies not only to the thorough explanation of the rules of the team functioning, but also to their understanding by those who are to cooperate in it; timely provision of information and adaptation of communication methods to the individual needs of employees. This observation is consistent with the results of other studies in which communication management is indicated in source literature as an element of key importance for the success of project teams' work (Boerner et al., 2012; Chiaburu, Lim, 2008; Muszyńska, 2017; Resick et al., 2014; Shafi et al., 2021).

The second important issue proved to be both the leaders treatment of team members and team members among themselves¹. It is worth adding that among the principles of procedural fairness, the first to be mentioned is the one that is related to the above issues: the possibility of expressing one's own opinions, views and feelings. Only after those the principles that focus on success, such as: selecting team members, availability of necessary resources, consistency in applying the rules, appreciating the work, and impartiality, appear. Interestingly, as the least important, managers indicated voluntary cooperation in the temporary team, the adoption of rules enabling the implementation of decisions, or an appeal against the decision. Such observation provides the basis for many questions, including: Are managers not aware of the relationship between a voluntary decision regarding participation in a team and the dynamics of working in it? Or maybe the result is due to the popularity of inviting employees to teamwork? Is it related to managers confidence in the implementation of advanced solutions? Or maybe they were the subject of the teams' work that the surveyed managers had to cope within the first place? And will the solution be implemented by other units? Finally, did they not have to face situations of contesting the decisions made? Do they consider them unacceptable? Or do they understand the team's success in the context of a collective (democratic decision) and not an individual?

Task 3: Assessment of the difficulty in providing each of the factor in practice

The respondents were also asked to estimate the degree of difficulty associated with providing each item included in the study. The results obtained in this way are presented in Table 7.

Table 7.

Assessment of the degree of difficulty in implementation justice measure items

Measure items (the explanation of the symbols is shown in table 4)	Assessment of the degree of difficulty in implementation the factor
X19	4,17
X13	4,15
X11	4,10
X20	4,09
X3	3,97
X7	3,89
X1	3,87
X9	3,85
X10	3,84
X5	3,78
X6	3,78
X12	3,72
X14	3,69
X2	3,55
X4	3,45
X18	3,33
X8	3,22
X15	3,13
X17	3,12

Source: Own study.

The difficulty of providing each of the examined factors was rated significantly lower than the degree of their importance. Only 4 items were considered rather important. Providing team members with temporary access to the information they need when they need it was indicated as the most challenging element to implement (4, 17). Appreciating each person in a team according to their contribution to the team's work (4, 15) was described as only slightly easier. Further, recognition of the team's work according to the effort put into the task (4.10) as well as the adaptation of the ways of communication between the leaders and the team members to the individual needs of team members (4.09) were listed.

All other items were considered relatively easy. The factor identified as the easiest to implement was ensuring honest and open communication between the leaders and team members. The average difficulty rating for this issue was 3.12.

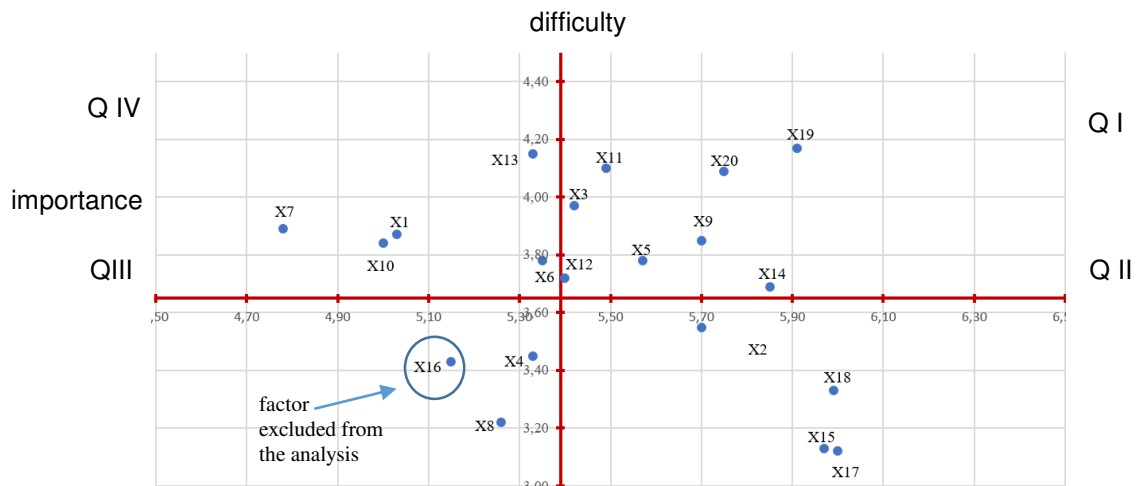
In this case, the crucial element for the success of temporary teams was determined as the easiest (the last one in the ranking), i.e., openness and honesty of the leaders with team members. Individual treatment was also seen as simple to implement. Issues related to the appreciation of each person in the team, voluntary work in a temporary team, and appealing against decisions were assessed as difficult. It is worth recalling that they have been indicated as essential for success.

Task 4: Defining challenges for managers. Identification of factors characterized by both a high impact on the success of temporary teams and a high difficulty in providing them

For the analysis taking into account both the importance and the degree of difficulty related to providing a given factor, an approach modelled on the IPA technique was used. Thus, all factors have been divided into four parts:

- *Quarter I (QI)* - factors that are important and difficult to ensure (challenges for managers).
- *Quarter II (QII)* - factors that are important and easy to provide.
- *Quarter III (QIII)* - factors of less importance and easy to provide.
- *Quarter IV (QIV)* - factors that are less important but difficult to ensure.

The effects are presented in figure 1 and table 8.



Explanations for the symbols: X1 ... X20 are presented in table 4 and table 8.

Figure 1. Matrix for factors influencing the feeling of justice among members of temporary teams.

Source: Own study.

There are 8 items in the first quarter, 4 items in the second, 2 in the third, and 5 in the fourth. It should be noted that most of them are the first quarter (QI), i.e., elements that are both important and difficult to implement. Among them, the following aspects should be indicated: communication as in the timing of information transfer (X19), managers individual approach in conversations (X20); appreciation, including more effort, daily work (X11) than results (X12) and participation - the possibility of influencing (X3). The last aspect also corresponds to the elements (X1, X7) of the fourth quarter (QIV): less essential but also challenging to ensure.

Table 8.
Categorization of the researched factors

Less important but difficult	Important and difficult
<ul style="list-style-type: none"> ▪ X1 Rules governing functioning of the temporary team give each employee the right to accept or refuse working in a task team ▪ X6 These rules were established on the basis of a thorough analysis taking into account the specifics of the temporary team ▪ X7 These rules allow team members to appeal against decisions made in the team or concerning its functioning ▪ X10 These rules ensure a high probability that the decisions made by the team will be implemented ▪ X13 Each member of the temporary team is valued (materially and immaterially) according to their contribution to the team's work 	<ul style="list-style-type: none"> ▪ X3 Rules governing functioning of the temporary team may be modified at the request of members of the temporary team ▪ X5 These rules are consistently applied to each team member ▪ X9 These rules make the task force able to complete the task (by selecting the right employees, availability of the necessary resources, etc.) ▪ X11 The task force (as a whole) is appreciated, materially and immaterially, according to the effort put into the task ▪ X12 The task force (as a whole) is valued materially and immaterially according to the results achieved ▪ X14 Relationships between all members of the temporary team are based on mutual respect (manifested by the lack of non-constructive criticism, spite, etc.) ▪ X19 The information needed for the work of the temporary team is provided exactly on time ▪ X20 A temporary team leader will customize communication to suit individual needs of members of the temporary team

Cont. table 8.

Less important and easy	Important and easy
<ul style="list-style-type: none"> ▪ X4 Rules governing functioning of the temporary team are not biased - they do not favor anyone and do not discriminate against anyone ▪ X8 These rules are consistent with the ethical and moral standards adopted by the members of this team 	<ul style="list-style-type: none"> ▪ X2 Rules governing functioning of the temporary team enable each team member to express his views and feelings about the functioning of the team ▪ X15 Each participant in a temporary team is treated with respect by the leader of that team ▪ X17 The leader of the temporary team is honest and open with team members ▪ X18 Rules governing the functioning of the temporary team are understood by and fully communicated (and explained) to team members

Source: Own study.

Based on the above considerations, it was stated that the most critical leader's task is to manage communication in the team and appreciate participation. The challenges (to which one should pay particular attention) for managers who intend to effectively and fairly manage a team were formulated in relation to the stages of the teams' work. The following were considered as such:

1. Ensuring such principles of creating and functioning of the team (e.g., selecting appropriate employees, availability of the necessary resources, etc.) which will give the team a real chance to complete the assigned task (X9). This will be possible, among other things, by allowing team members to modify these rules when justified (X3).
2. Caring for compliance with the adopted rules of the team's functioning (X5) and consistency in their use:
 - a) it will strengthen the indicated real chance to complete the task,
 - b) it is one of the characteristics of genuine leadership and it has to do with a sense of justice (Kiersch, Byrne, 2015),
 - c) it will influence the atmosphere in the team. In this respect, relationships based on mutual respect must be fostered (X14).

During the team's work, particular attention should be paid to the availability (right on time) of information necessary for the team's work (X19). Moreover, individually – to adjust the communication methods with team members to the diverse needs and capabilities (X20).

3. Team members' compensation, material and immaterial, by noticing not only the result obtained (X12), but also the effort invested (X11).

5. Conclusions

The sense of fair treatment is an issue that pertains to a person's private life and professional activities. In source literature, there is ample evidence that fairness (more precisely, organizational fairness) also affects business outcomes.

The above study presents the results of research on temporary teams. Factors influencing the sense of fair treatment among participants of this type of team were identified. Experienced managers then assessed: the impact of each of these factors on the success of the temporary team and the degree of difficulty involved in providing each of these factors. On this basis, eight challenges for managers have been identified, i.e. factors which, on the one hand, are very important and, on the other hand, difficult to ensure. These challenges include: (1) ensuring that the team is created in such a way that it has a realistic chance of completing the task, (2) consistent compliance with the adopted rules of the team's functioning, while (3) allowing the possibility of modifying these rules at the request of employees, (4) providing the information needed by team members on time and (5) ensuring relationship based on mutual respect (6) adjusting methods of communication to the needs of team members, appreciating the employees' contribution according to their (7) contribution and (8) achieved results. In the event of disregarding the challenges mentioned above, managers must take into account the emergence of various types of problems, such as, for example, suspension of efforts of team members or withdrawal from the team, deterioration of communication or division (s) of the team (Jordan et al., 2004; Kang et al., 2012).

The study used two different variables simultaneously (i.e. significance and severity). It is worth noting that a different interpretation of each of these variables' values leads to conclusions different when they are taken together. For example, the most crucial factor was honesty in communication between the managers and employees. At the same time, however, this element was assessed as the easiest to achieve; therefore, it was not included in the identified challenges.

Further research should concern methods of formulating the rules of the temporary team's functioning, including the aspect of participation of team members. In the context of this type of team, the sense of lack of time to analyze and modify the rules for each created team is probable. It is easier to rely on pre-established rules than change them each time. Then, it is worth relating the mentioned methods (level of participation/degree of flexibility of changes in rules) to the effectiveness of the task performance. One should also pay attention to elements related to relations as well as ethical and moral issues. It seems that the last ones belong to the commonly emphasized matters; hence they can be perceived as functioning, obligatory, and as relating rather to the individual leaders-team members relations, while those seen as more difficult as relating to relations within the group or between the leaders and the whole group.

One potential limitation of the current study concerns the fact that it covers enterprises from the high-tech industry. Employees of public organizations or other industries may perceive justice differently. There are also other limitations. The research considered two variables that may affect the success of temporary teams' work: the importance of justice and the difficulty of its implementation. A different type and/or a more significant number of variables may contribute to a better understanding of this issue and the holistic

approach. Additionally, organizational culture was omitted from the research. It influences shaping factors recognized in procedural, interpersonal or informational justice. Hence, its implementation in the study could have deepened research and expanded knowledge of using justice in the functioning of temporary teams about their work environment.

Two significant contributions to project management can be identified. First, modifying the Colquitt tool allows for the study of temporary (including project) teams justice. Second, formulating recommendations allows managers to effectively and fairly manage the work of temporary teams (including project teams). The results will contribute to a better understanding of the relationship between justice and teamwork effectiveness.

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Footnotes

1. It is based on Adams' theory of justice, understood as an assessment of the ratio of the result (the reward received) to the effort.
2. When performance is the goal, rewards are distributed according to each member's relative contribution; equality - when the goal is interpersonal; harmony, each group member receives the same; finally, the need - when the goal is the prosperity and development of members, each member receives enough to meet his needs (Silva, Caetano, 2016).
3. The text is the result of a literature review conducted by the authors in July 2021. The EBSCO database searched for scientific publications with the following phrases: "organizational justice" and "meta-analysis or" systematic review "in the title. articles published in scientific journals and in English were obtained.
4. 66% of the studies were about distribution, 61% of procedures, and about 24% of the studies were about interactive justice (Silva, Caetano, 2016).
5. According to the EBSCO database, the search result for the words in the title of the article: "organizational justice" and "team" is 16 publications. Five of them were analyzed (limitations according to the criteria: scientific journal, English language, elimination of duplicate items, availability). Attention was paid to: interpersonal treatment of team members and procedural fairness (taking into account and appreciating individual contribution to the team's work, adopted rules and their observance) in the context of the consequences of the work of a sports team (Jordan et al., 2004) the impact of procedural fairness on organizational attitudes and behaviour (Kang et al., 2012), showing the possibility of applying this type of justice in a sports team (Ha, Ha, 2015) and the importance of matching the person with the team as well as the supervisor-employee relationship (Zhang et al., 2019). It is worth noting that the search for the words in the title "justice" and: "teams in (the) workplace" / "teams in organization" gave a negative result, i.e. no articles.

6. Search for words in the title: "justice" and type of team.
7. Team reflexivity refers to the extent to which team members collectively reflect on, plan, act, and adapt to their team's objectives, strategies, and processes.
8. Some results of this survey were presented in (Rogala et al., 2022).
9. It is worth noting that the importance of relational issues for team members at individual and group level was demonstrated by Pichler et al. (2016).

COOPERATION BETWEEN VOCATIONAL SCHOOLS AND BUSINESSES – GOOD PRACTICES

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Purpose: The main aim of the article was to present good practices in the field of cooperation between vocational schools and enterprises.

Design/methodology/approach: The study employed a survey method. The survey was anonymised and it was addressed to two types of respondents: school principals and industry representatives (employers). The first group of respondents was selected based on the school type – only vocational school principals were eligible to take part in the study – while the latter group of respondents was selected at random.

Findings: All reforms of vocational education must, first and foremost, be aligned with actual labour market needs. The data obtained can provide a reference point for streamlining cooperation between vocational schools and industry representatives, improving the organisation of practical classes in the form of dual education and patronage classes, and fostering other forms of cooperation with businesses.

Research limitations/implications: The main research limitation is that the issue is a new topic that has not yet been widely discussed in the literature. Another threat is the reluctance of entrepreneurs to cooperate with schools (fear of the need to carry out new tasks). On the other hand, however, these behaviours are slowly changing, which is caused by the lack of staff on the labour market, which in turn motivates entrepreneurs to look for employees already at the school stage.

Practical implications: The presented proposal of the concept of cooperation between entrepreneurs and vocational schools is a valuable initiative for the immediate implementation of business activity in practice, which in the near future will become a necessary action due to the lack of employees on the market.

Originality/value: The topic addressed is new and original, rarely discussed in the literature so far. The article presents the results of original research on the cooperation of vocational schools with enterprises and includes proposals for the practical application of the indicated solutions.

Keywords: vocational education, practical vocational education and training, employer, dual education, patronage classes.

Category of the paper: Research paper.

1. Introduction

The involvement of third-party stakeholders in vocational education is critical to the development of skills and qualifications that meet actual market needs. Under the education law, vocational school principals are obligated to cooperate with industry representatives. The form and scope of such a cooperation decide on the effectiveness of practical vocational education.

The article aims to analyse the cooperation between schools and industry representatives regarding vocational education and training, show how it is viewed and assessed by educators and business owners, and give recommendations using the Wielkopolska (Greater Poland) region as an example. For the purpose of the analyses, the authors used a survey method; the surveys were carried out in 2022 among principals of vocational schools and industry representatives in the Wielkopolska Wschodnia (Eastern Greater Poland) region by the Łukasiewicz Research Network – Institute for Sustainable Technologies, Radom, Poland and the Centre for Craftmanship, Dual Education and Vocational Education in Konin, as part of the project entitled: Innovative Vocational Education and Training in the Eastern Greater Poland Region in the Context of Energy Transition (no.: EOG/21/K3/W/0046).

The surveys allowed the authors to collect detailed information on the forms of the school-industry cooperation, educators and business owners' preferences, and drivers of and impediments to this cooperation. Based on the survey results, the authors were also able to produce recommendations concerning the future improvement of this cooperation and practical vocational education and training, with a view to designing a model of vocational education and training that would better prepare and make vocational school leavers' more likely to gain employment in their chosen professions. The search for solutions that facilitate cooperation between vocational schools, industry representatives (employers/businesses) and labour market institutions aims to improve the quality of vocational education and make it more attractive to and engaging for students. To be valid, the curriculum, particularly the practical vocational education and training curriculum, must be well aligned with labour market demand and tailored to the needs of students and their potential future employers; additionally, synergies must be created.

The main reason for creating the publication is the research gap between the education sector and business, as these two worlds often diverge from each other. Given the situation diagnosed in this way, a research question arises, which can be formulated as follows: how large are these discrepancies, i.e. how large is the indicated research gap? The aim of the

article, resulting directly from the previously described phenomena, is to examine and indicate how the above gap should be closed. However, in order to achieve the main goal, it is necessary to indicate several specific goals, including:

1. Defining the framework for cooperation between education and business.
2. Identifying opportunities for joint activities between school and business.

To achieve the above-mentioned objectives, a specific research procedure was used, which involved preparing a survey in schools and among entrepreneurs. The research results and their interpretation are presented later in the article.

Challenges facing the vocational education sector have been widely studied and discussed in the literature, and authors agree that modernisation of the vocational education process will, among other things, increase vocational school leavers' employability (Białczak, Radomski, Żurek, 2021). Researchers also point out that the implementation of solutions provided for in education laws and stipulating the establishment of cooperation between vocational schools and local stakeholders may have a crucial impact on the organisation of vocational education and training as well as on the adaptation of the curriculum to the local labour market needs and requirements (Bieszk-Stolorz, Gdakowicz, Markowicz, 2017). Important aspects of the vocational education analysis include the following: the teaching venue (school, training centre, company or university); the source of vocational education funding (private and public); and the entity in charge of the curriculum and quality assurance (state, company or social partners) (Biostat, 2019). According to S. Golinowska, the strategy directed at developing human capital and creating job opportunities was not properly prioritised (Cedefop, 2020). The analyses by the Ministry of Family and Social Policy show that school leavers and graduates find it difficult to gain employment in their chosen professions mainly because they lack relevant experience and their qualifications are not adapted to the labour market needs (Chatzichristou, Ulicna, Murphy, Curth, 2013). To be effective, vocational education should receive systemic support, as it is far more capital-intensive than general education, and be harmonised with the labour market. P. Kolczyński states that this is impossible without centrally managed programmes and that in Poland a lot needs to be done when it comes to the organisation and implementation of practical vocational education (apprenticeships and internships) (Education Law of 14, 2023).

Contemporary vocational education should not only develop students' practical vocational skill and competences, but also provide them with general knowledge. Without well-organised vocational education, there is no strong economy (European Training Foundation, 2013). Development of solutions that guarantee effective cooperation between schools, industry representatives and labour market institutions is critical to designing a curriculum that will be tailored to the actual labour market needs and students' expectations (Golinowska, 2018). However, establishing cooperation between schools and industry representatives is not the only problem – maintaining it is far more challenging. Vocational education and apprenticeships/internships give students hand-on experience that directly increases their employability (Hanushek, Schwerdt, Woessmann, Zhang, 2017).

Making students more likely to gain employment in their chosen professions, by adapting the curriculum to labour market needs, complies with the 2020/2030 Strategy for Responsible Development (Information Office of the Wielkopolska Region in Brussels, 2021). The Strategy provides for the necessity to involve industry representatives in the process of designing the vocational education and training curriculum (mainly when it comes to apprenticeships/internships and dual education) and stresses the importance of boosting its effectiveness as well as the importance of harmonising it with the local labour market, in particular. It should be stressed that such measures also promote vocational education and enhance its prestige. The rules and principles of vocational school-industry cooperation are also laid down in applicable laws and regulations. The Ministry of Education and Science indicates that the so-called new vocational education system introduced under the Education Law and in force since 2017 (level 1 and level 2 vocational schools, technical schools and community colleges) must be based on close cooperation between schools and industry representatives (Kolczyński, 2019). Pursuant to Article 68 of the Education Law, school principals shall establish cooperation with relevant industry representatives, which can have the following forms: patronage classes, joint design of curricula, involvement in vocational education (including internships/apprenticeships), retrofitting of classrooms and laboratories, organisation of the vocational exam, upskilling vocational education teachers (organisation of training courses, provision of advisory services) and promotion of vocational education (Kozielska, 2019). Pursuant to Article 120 of the Education Law, internships/apprenticeships in companies or at farms that allow students to gain hands-on experience in real professional environment, as well as vocational education at vocational or continuing education centres or in school laboratories are the basic form for providing vocational education. Article 4 of the Regulation of the Minister of Education and Science on practical vocational education adds that practical vocational education may also have the form of practical classes at technical schools, level 2 vocational schools and community colleges, as well as the form of internships/apprenticeships (Local Government of the Wielkopolska Region, 2020). On the other hand, however, industry representatives are still under a very limited obligation to cooperate with schools. Legal regulations in this regard only provide for their involvement in the definition of the labour market needs pursuant to the Special Economic Zones Act. Additionally, cooperation with schools is unquestionably very capital-intensive and costly for industry representatives. This particularly discourages small enterprises for which such extra costs can simply be too high (Lodz Observation Centre for Territorial Development and Cohesion, 2017). The absence of specific formal procedures in this regard is definitely a huge impediment to effective cooperation between vocational schools and industry representatives.

On the one hand, legal regulations concerning vocational school-industry cooperation obligate schools to cooperate with industry representatives, and, on the other hand, no such obligations are imposed on industry representatives and no support is provided to them in this regard. Additionally, taking into consideration the costs of practical vocational education and

its formal restrictions resulting, among other things, from the occupational health and safety requirements or labour code provisions, one can also conclude that without institutional solutions and grants industry representatives, especially small enterprises, will not closely cooperate with vocational schools and fully engage in the vocational education and training processes.

To address the issues and problems of school-industry cooperation concerning vocational education and training, the authors aim to analyse current forms of cooperation between vocational schools and industry representatives, show how such cooperation is viewed and assessed by educators and business owners, particularly with reference to the forms of cooperation specified in the Education Laws, and give recommendations using the Greater Poland region as an example.

2. Discussion

2.1. Methods

Study location

The studies were carried out in the Eastern Functional Area (EFA) of the Greater Poland region – one of the biggest and strongly industrialised Polish regions, where over 36,000 manufacturing entities operate (with 99% of them representing the private sector) (Ministry of Economic Development, Strategy Development Department, 2017). Pursuant to the provisions of the 2030 Development Strategy for Greater Poland Voivodship, employees' qualifications are increasingly ill-aligned with employers' needs, which results in unemployment in certain professions and insufficient headcount in other sectors. However, the Greater Poland EFA is also a region where students' interest in vocational and technical education is not sufficient to meet the local labour market needs, and where the number of industry representatives cooperating with schools, particularly on vocational education and training, is pretty small. As per Objective 1.3: Higher and better use of human capital in the labour market of the Development Strategy, industry representatives need to be far more engaged in the vocational education and training process (dual education, also as regards crafts) and vocational education teachers must be better prepared and experienced in their respective fields. This requires closer cooperation between vocational schools and industry, easier access to vocational education (including dual education), combining theoretical and practical vocational education, and development of practical vocational education centres or school incubators of entrepreneurship (Ministry of Education and Science, 2016).

Subject of the study

The study aimed to analyse existing cooperation between vocational schools and industry representatives in the Eastern Greater Poland region. The analyses concerned current forms of cooperation. As part of the study, representatives of public vocational schools, educational institutions and employers from the Konin, Turek, Słupca and Koło district/counties were surveyed.

Research problem

The main problem addressed in the study was as follows: How do school and industry representatives view and assess cooperation between vocational schools and industry representatives in the Eastern Greater Poland region? The following auxiliary research questions were also asked:

- How many companies cooperate with vocational schools and what is the object of such cooperation?
- Who initiates cooperation between schools and employers?
- What are the terms and conditions of cooperation?
- What forms does cooperation between vocational schools and employers take?

Study method and procedure

The study employed a survey method. The survey was anonymised and it was addressed to two types of respondents: school principals and industry representatives (employers). The first group of respondents was selected based on the school type – only vocational school principals were eligible to take part in the study – while the latter group of respondents was selected at random. The surveys were conducted in 2022. Each respondent, no matter which group they represented, was asked to choose only those answers they found important.

2.2. Analysis of research results. Applications

A. Respondents' characteristics:

Questionnaires for principals of vocational schools in the Eastern Greater Poland region were completed by 26 respondents. The types of schools represented by this group of respondents (i.e. level 1 and 2 vocational schools, technical schools, and community colleges) are presented in Table 1.

Table 1.

Detailed list of school/educational institutions from Eastern Greater Poland that participated in the survey per county/district

District/county	Number of schools	Types of schools			
		Level 1 vocational school	Technical school	Level 2 vocational school	Community College
Konin (town)	8	7	5	2	2
Konin (county/district)	4	4	2		1
Turek (county/district)	3	2	2		
Słupca (county/district)	5	3	4		
Koło (county/district)	6	3	5		

Source: Own elaboration based on empirical research.

Schools participating in the study offer vocational education in 65 professions in total (vocational schools – 33, and technical schools – 32). The survey was also addressed to industry representatives (56 respondents). In their case, the questionnaire was made available in an online version. The number of respondents representing the industry per each county/district is presented in Table 2.

Table 2.

Surveyed businesses per county/district

City/district name	Total
Konin (town)	29
Konin (county/district)	8
Turek (county/district)	4
Słupca (county/district)	6
Koło (county/district)	9

Source: Own elaboration based on empirical research.

The majority of the surveyed businesses were micro-enterprises (43%), i.e. businesses with up to 9 employees. Small (10-49 employees) constituted 27% of the respondents, medium companies (50-249 employees) – 16% and large companies (with a headcount of over 250 staff) – 14%. As the respondents represented different sectors, they were asked to enter the respective PKD (business classification) codes (Ministry of Family and Social Policy, 2021). The respondents most frequently chose “other sections” (approximately 30%). This was followed by Sections F (Construction) – approximately 14% and C (Manufacturing) – approximately 9%. The remaining respondents represented Section G (Wholesale and retail, automotive repair), Section E (Water supply, sewerage, waste management and remediation activities), Section I (Hospitality) – 4 respondents (approximately 7%) per section; Section M (Professional, scientific and technical activities) and Section H (Transportation and storage) – 3 respondents each; Section K (Financial and insurance activities), Section A (Agriculture, Forestry and Fishing), Section Q (Human health and social work activities) – 2 respondents each; as well as Section J (Information and communication) and Section D (Electricity, gas, steam and air conditioning supply) – 1 respondent each. The data obtained from the respondents show that the oldest surveyed business was established in 1930. One in three of the surveyed businesses was established between 1990 and 2000, and one in four – before 1989.

Thirteen (13) businesses were established between 2001 and 2010, and ten (10) – between 2011 and 2020. The majority of the surveyed businesses (almost 50%) were sole traders, followed by limited liability partnerships/companies (ca. 36%), i.e. 20 entities.

The vast array of the respondents (businesses varying in terms of the legal form, size, age, profile, business environment, and experience in offering internship/apprenticeship opportunities for students) allowed the authors to gain a better insight into the perception and quality of school-industry cooperation concerning vocational education and training in the region. Additionally, the participation of level 1 and level 2 vocational schools as well as technical schools, which offer vocational education in different professions and industries, meant that the authors were also able to survey institutions that are legally obligated to establish cooperation with industry representatives, and learn what their opinions on this cooperation are.

B. Analysis of the quality of vocational school-industry cooperation in the Eastern Greater Poland region – selected aspects

From the survey it follows that approximately 62% of the respondents representing the industry cooperate with various schools and educational institutions that offer vocational education; most commonly these are level 1 vocational schools (approximately 34%) and technical schools (25%). The results show an improvement versus the 2010–2011 national study, where 23% businesses reported cooperation with vocational schools or practical education centres (Ministry of National Education, 2011), and versus the 2017–2018 study conducted in the Dolnośląskie (Lower Silesia) region, where business respondents stated that they cooperated with schools when organising apprenticeships (22.6%) and internships (44.2%) (Pachocki, Smolak, 2021).

The employers from the Eastern Greater Poland region participating in the survey were keen to report their cooperation with other institutions supporting, connected with or providing education, among others with county/district job centres (41%), universities (approximately 29%), and craft guilds (25%). Of all industry respondents, 25% stated that they cooperated with one educational institution, and 18% – with three. This data are analogous to the Biostat survey in the Lower Silesia region, where most businesses also cooperate with one educational institution only (Pachocki, Smolak, 2021). However, it should be stressed that this cooperation is mainly on a one-time basis only (as confirmed by 63% of the respondents). Of all the respondents, only 37% stated that they cooperate with such institutions on a regular basis.

Most respondents representing the industry (over 80%) stated that schools should be the ones to initiate cooperation. Similar opinions were expressed by the vast majority (90%) of the representatives of vocational schools and educational institution surveyed in 2013. The authors of the 2013 survey also stressed the importance of changing the employers' approach to cooperation with schools and encouraging them to make it more frequent (PKD codes classification, 2021).

As regards the respondents representing vocational schools and educational institutions in the Eastern Greater Poland region, the majority of them (23 of the 26 respondents) stated that the decision to establish cooperation mainly depended on the businesses' technical and technological infrastructure and on their willingness to cooperate (22 of the 26 respondents). This means that for schools these are decisive factors. However, the school principals surveyed also stated that the quality of past cooperation (i.e. the opinion of students) and the atmosphere in the workplace also play an important role, as they are conducive to effective practical learning of a profession in a real environment.

C. Types of vocational school-industry cooperation in the Eastern Greater Poland region – good practices

The analysis of the respondents' perception and assessment of cooperation between vocational schools and industry representatives was carried out for the forms of cooperation provided for in the Education Law. One of them is practical vocational education that requires employers to provide students with access to company's technical and technological infrastructure so as to help them gain hand-on experience in their selected professions. From the survey it follows that 53% of the respondents confirm that companies allow students of vocational schools and educational institutions in the Eastern Greater Poland region doing internships/apprenticeships to use their technical and technological equipment in the course of the practical vocational training. This result can be compared to the results reported in the publication regarding the survey conducted in Lodz Voivodship between 2014 and 2020, where the vast majority of schools (93%) indicated various forms of vocational school-industry cooperation (Regulation of the Minister of National Education, 2019), and to the results of the survey carried out by the Foundation for the Development of the Education System (FRSE), where it was found that more than 80% of businesses cooperating with the education sector provide internship and apprenticeship opportunities (Sitek, Stasiowski, 2022). The results of the authors' own survey show that of the 96 professions taught at the level 1 vocational schools surveyed, in 64 the schools provide practical vocational education and training in cooperation with up to 5 employers, in 16 – with 6 to 10 employers, and in 9 – with 11 to 20 employers. On the other hand, of the 72 professions taught at the technical schools surveyed, in 22 the schools provide practical vocational education and training in cooperation with 11 to 20 employers, in 19 – with 6 to 10 employers, and in 18 – with more than 21 employers. It should also be noted that some schools also stated that they cooperated with a relatively large number of industry representatives (e.g. schools in Konin indicated that they cooperated with 63 hair salons and with 48 garages, while a school in the Koło county/district stated that it cooperated with 50 agricultural businesses and farms. The results obtained correspond with the results of the 2014–2020 survey mentioned above, whose authors noted that cooperation was most effective in the case of vocational schools that teach typically technical professions. Besides, such broad participation of businesses in practical vocational education and training may be the result of schools' cooperation agreements under, for example, internships/

apprenticeships for individual students. This observation is valid in the context of the FRSE's survey findings, as per which only 2% of the businesses surveyed use contacts with schools in this regard (Skarzyński, 2015).

Another form of practical vocational education and training in a real work environment is dual education. The implementation of a dual education system at all levels of vocational education in Poland was recommended as early as 2015 by the Hanseatic Parliament, which unites the craft guilds and enterprises in the Baltic Sea region. Dual education is not uniformly defined in the literature (Skarzyński, 2015). Dual education refers to education or training that combines learning in the classroom with on-the-job learning at a company (Szlosek, 2012). Vocational education and training is characterised by the dualism of the teaching venue, as it takes place at school, where students learn theory, and at an enterprise, where they are provided with practical training. On the other hand, dualism may also concern entities (public and private) responsible for the vocational education and training policy and practice. The issue of dual education in Poland is regulated by the Regulation of the Minister of Education on practical vocational training (Journal of Laws, 2019), which states that practical classes are organised for students to help them master the professional skills necessary to gain employment in a given profession, and can be taught in a dual education model. As regards students, the indisputable advantages of this form of practical vocational education and training include contact with the real work environment and internal and external customers, and as regards business owners – reduction of costs associated with future employee onboarding (Wenclik, 2018). Dual education opportunities offered by the surveyed businesses are presented in Table 3.

Table 3.

Vocational Education and Training in the form of dual Education in the Eastern Greater Poland Region (N = 23)

Question	Number of answers	
	Yes	No
Does your educational offer allow students to take part in practical vocational training courses at enterprises offered in the form of dual learning?	7	16
Do you plan to expand your educational offer for the 2023–2030 period and provide students with the dual learning option, also in professions relating to energy transition in the Eastern Greater Poland region?	4	17

Source: Own elaboration based on empirical research.

Table 2 shows that 7 (30%) of the 23 schools offer practical vocational education and training in the form of dual education. Only four schools plan to offer such an opportunity by 2030, also in professions relating to energy transition in the Eastern Greater Poland region. The first school to offer practical vocational education and training in the dual education system was the Stanisław Staszic Mining and Energy School in Konin (2012). The respondents stated that 1,236 students completed practical classes in the dual education model in the 2021/2022 school year. The information provided by the schools surveyed also shows that practical vocational education and training in the form of dual education is offered in 42 professions taught

at 6 schools surveyed. On the other hand, the information provided by the industry representatives surveyed shows that students of vocational schools in Eastern Greater Poland can learn the following 9 professions in the dual education model: hairdresser/barber, electrician, electromechanical engineer, locksmith, carpenter, mechanic, cook, stonemason, and fitter. The observed differences between answers given by the school principals and industry representatives surveyed may result from the fact that the idea and specificity of dual education is not fully comprehended by business owners. Therefore, it is necessary to discuss in detail the principles of this form of practical vocational education when negotiating cooperation between schools and businesses.

The vocational school-industry cooperation can also take the form of patronage classes. As a patron, the business owner (employer) defines the scope of support. The survey shows that the professions for which patronage classes were set up were connected with energy transition in the Eastern Greater Poland region. They include: Renewable energy equipment and systems technician (planned patronage class), mechatronics technician, refrigeration and air conditioning technician (planned patronage class). From the survey it follows that patronage classes in Eastern Greater Poland were established at five (20%) of 26 vocational schools surveyed, and that three more schools were planning to establish four patronage classes by the end of 2030. Compared to a survey conducted in Lower Silesian Voivodship, where 35.7% of schools established at least one patronage class, this shows that such a form of cooperation between vocational schools and industry representatives in the Eastern Greater Poland region is less popular.

In the survey, the authors also included other forms of cooperation between schools and industry representatives aimed to improve the quality of practical vocational training. Nearly 60% of the respondents from the industry said they cooperated with vocational schools in the Eastern Greater Poland region in one form or another. All forms of cooperation between the schools and businesses surveyed are presented in Figure 1 (Employers N = 32, Schools N = 25).

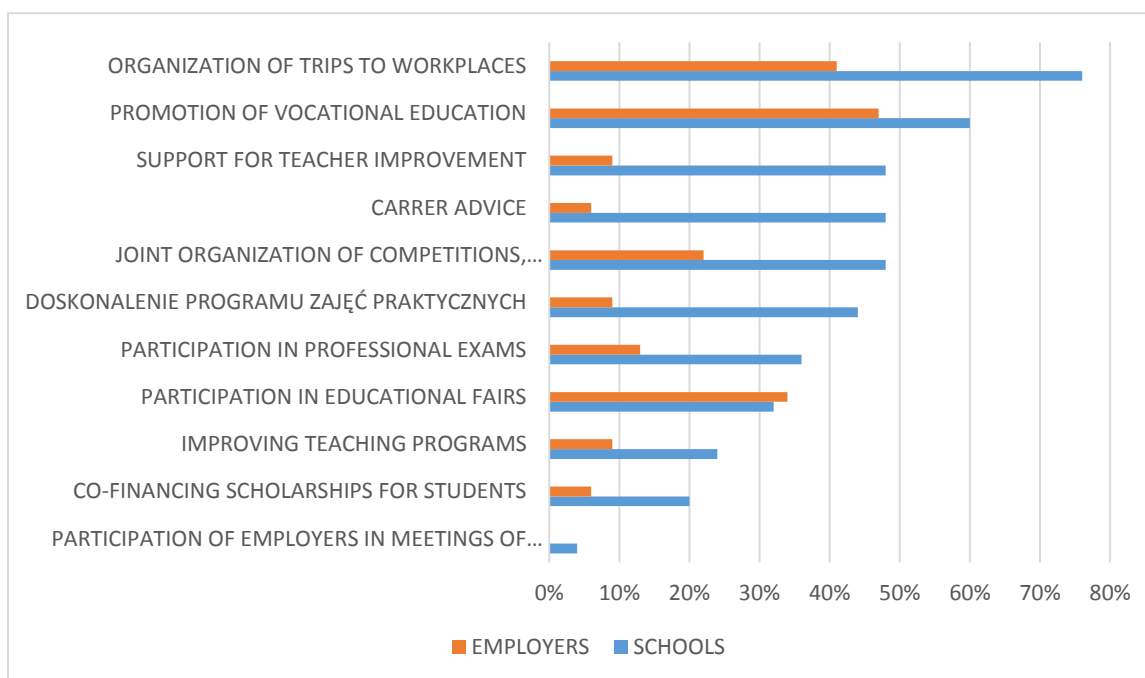


Figure 1. Forms of cooperation between schools and businesses participating in the survey.

Source: Own elaboration based on empirical research.

Figure 1 shows that nearly half of the respondents representing industry were involved in joint undertakings with vocational schools which aim at promoting vocational education. Other forms of cooperation frequently mentioned by the industry representatives include: organisation of company visits (41%), participation in education fairs (34%), co-organisation of competitions and contests (22%), participation of company's employees in vocational exams (13%). On the other hand, the school principals surveyed stated that the forms of cooperation with businesses they most frequently choose included organisation of company visits (76%) and joint undertakings aimed at promoting vocational education (60%). A comparative analysis of the forms of cooperation indicated by the respondents indicates varying preferences of schools and industry representatives, which, undoubtedly, is connected with the effectiveness and stability of a given form of cooperation, and – particularly in the case of business owners – with the limitations relating to the additional costs incurred. Besides, as noted by J. Kozielska (Kozielska, 2019), increasing changeability of the education system is one of the main problems and factors impeding successful cooperation (Zaręba, Kępczyk, Misztal, Hadrian, Biernat, 2013). The result of the survey shows that the form of cooperation preferred by schools and businesses alike are company visits. For industry representatives this form of cooperation does not involve any extra costs or formalities. Company visits also allow students to learn more about the local labour market. The survey results also show that businesses are unwilling to engage in cooperation that requires them to invest money (e.g. co-funding scholarships), or time (e.g. improving existing curricula, participating in career counselling or teacher training). These conclusions are consistent with the FRSE survey, which indicated that systemic changes, i.e. as regards laws and regulations (94% of the respondents) and financial support for

entrepreneurs earmarked for practical vocational education and training (93% of the respondents), would significantly improve the situation (Sitek, Stasiowski, 2022). Additionally, the conclusions are also consistent with the results of the study on dependencies between cooperation and external sources of funding carried out in Lodz Voivodship, which found that external sources of funding (e.g. EU funds or funds obtained by schools or county offices) foster cooperation between vocational schools and industry representatives.

Taking into account the varying preferences and the vocational schools' legal obligation to cooperate with industry representatives, the authors also analysed alternative forms of cooperation that can be used along with those indicated by the respondents (Table 4).

Table 4.

Alternative forms of cooperation per County/District (N = 25)

Question: Other forms of cooperation – good practices (please specify)	Number of affirmative answers
Implementation of pedagogical innovations	1
Co-organisation of vocational workshops, shows, training courses in latest technologies, etc.	1
ERASMUS+ (international internships for technical school students)	1
Job fairs	1

Source: Own elaboration based on empirical research.

The survey results show that good practices presented in Table 3 are not popular among the school principals surveyed. This may be because of the lack of sufficient funds, heavy workload, inability to comply with additional stringent legal requirements, understaffing or fear of potential problems caused by businesses. However, to gain better insight into the causes of this situation, additional studies on the dependency between the institutional support and regulations governing vocational school-industry cooperation and success of such cooperation concerning practical vocational education and training are required. The survey conducted by the authors can provide a starting point for such studies.

3. Summary

All reforms of vocational education must, first and foremost, be aligned with actual labour market needs. The data obtained can provide a reference point for streamlining cooperation between vocational schools and industry representatives, improving the organisation of practical classes in the form of dual education and patronage classes, and fostering other forms of cooperation with businesses. Based on the survey results, the authors recommend the following:

- Improving the quality and attractiveness of education through large-scale involvement of businesses in the process of vocational education.
- Introducing measures aimed to raise the awareness of industry representatives and schools of the need to put more emphasis on the development of students' practical skills by taking actions intended to gradually extend the scope of internships and apprenticeships, and enabling education in the real work environment (dual education).
- Developing incentive programmes encouraging industry representatives to cooperate with vocational schools to better adapt the curriculum to actual business needs.
- Strengthening the cooperation between vocational schools, local authorities and employers through the creation of a network of linkages.
- Introducing mechanisms for assessing the quality of practical classes (internal and third-party audits similar to audits by the Polish Accreditation Committee).
- Introducing regulations encouraging employers to tighten cooperation with vocational schools.

In conclusion, the survey results and recommendations presented in this article indicate potential ways for improving the quality and effectiveness of the vocational school-industry cooperation to better respond to the changing needs of the local labour market in the Eastern Greater Poland region.

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IMPLEMENTATION STATUS OF LEAN MANAGEMENT IN POLISH MANUFACTURING ENTERPRISES

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Purpose: The aim of this study was to assess the extent of Lean Management implementation in Polish manufacturing enterprises that declare the adoption of the lean philosophy. The study also aimed to identify areas for further development and provide practical recommendations for companies seeking to enhance their Lean Management practices.

Design/methodology/approach: A quantitative approach was employed, utilizing a survey of Polish manufacturing enterprises to assess the degree of implementation of Lean Management principles in key areas such as customer relationships, supplier relationships, employee engagement, Total Productive Maintenance (TPM), and pull/flow processes. The comprehensive survey covered a wide range of Lean Management practices and was administered online to a sample of Polish manufacturing enterprises. Data from the survey was analyzed using a variety of statistical techniques, including descriptive statistics, correlation analysis, and regression analysis. The data was used to identify patterns and trends in Lean implementation practices.

Findings: The results of the study indicated that Lean Management practices are relatively well-established in Polish manufacturing enterprises in each of the assessed areas. However, significant differences were observed between areas, with the highest levels of implementation observed in customer relationships and employee engagement, and the lowest in supplier relationships and pull/flow processes.

Research limitations/implications: The primary limitations of the study lie in its reliance on self-assessment data and the potential bias of respondents. Additionally, the generalization of results is limited to a specific sample of Polish manufacturing enterprises. Nevertheless, the study provides valuable insights into the current state of Lean Management implementation in Poland and identifies areas for further development.

Practical implications: The study suggests that Polish manufacturing enterprises should prioritize the continued implementation of lean practices in the areas of supplier relationships and pull/flow processes. This requires coordinated efforts to strengthen supplier relationships, optimize supply chain management, and implement lean production principles to eliminate waste and enhance efficiency.

Originality/value: The study contributes to existing knowledge on Lean Management implementation by providing a comprehensive assessment of its current state in Polish manufacturing enterprises. The findings offer practical guidance for companies seeking ways to improve their Lean Management practices and derive associated benefits.

Keywords: Lean Management, strategy, lean implementation.

Category of the paper: research paper.

1. Introduction

The term "lean production" first appeared in scientific literature through the work of Womack and Jones in 1990 (Womack, Jones, 1990). Nevertheless, the roots of this innovative strategy trace back further, with its genesis attributed to the Toyota Production System (TPS). Over time, the concept of "lean" has evolved, encompassing a broader context of enterprise management known as Lean Management (LM) (Psomas, Antony, 2019; Gil-Vilda et al., 2021). At the core of this concept lies the idea of creating a high-quality production system that effectively responds to changing customer needs while simultaneously minimizing waste, treated as inefficiency (Shah, Ward, 2003).

The popularity of Lean Management as an innovative management strategy has persisted continuously since the 1980s. This concept has not only gained recognition but has also become a key element of modern approaches to effective business management. According to the principles of LM, companies should shape their strategies based on delivering value to customers, striving to eliminate waste both internally and throughout the supply chain (Sinha, Matharu, 2019). Embracing this concept is a foundational decision for a company, determining operational effectiveness, process optimization, and delivering products with the highest value to the customer. Previous research on Lean Management in Poland has primarily focused on analyzing tools and methods used in this concept (e.g., Walentynowicz, 2013; Kleszcz et al., 2019; Ulewicz et al., 2022), and the impact of adopting the concept on organizational outcomes (e.g., Saudi et al., 2019; Piasecka-Głuszak, 2023). However, studies concentrating on the scale of implementation in the context of manufacturing enterprises that have declared the adoption of a lean strategy are very limited and scarce (e.g., Niewiadomski, Oleśków-Szłapka, 2017; Nowotarski, Paslawski, 2018; Łyszkowska, 2022).

To address this knowledge gap, the research question posed in this study is: To what extent have Polish manufacturing enterprises, declaring the adoption of lean philosophy, implemented lean management practices across key areas, and what are the observed variations in the implementation levels among these areas?

Therefore, the main aim of this study was to understand the degree of LM implementation in Polish manufacturing companies declaring the adoption of the lean philosophy. Additionally, our research seeks to develop specific recommendations for manufacturing companies in Poland regarding the further development of LM.

We would like to emphasize that our study provides original insights into the extent of Lean Management implementation in Poland, making a significant contribution to the advancement of knowledge on this subject.

2. Lean Management in manufacturing enterprises

The concept of Lean Management has been developing for many years and continues to evolve. Despite the vast amount of literature associated with it, definitively establishing its nature is a complex task. Different interpretations emphasize various aspects of this concept, with some arguing that creating a rigid definitional framework is impossible due to its constant development (Hines et al., 2004).

Authors present the lean approach to production processes in the form of five principles, applicable to both the entire enterprise and individual processes or actions of specific employees. These principles (Womack, Jones, 2003, p. 10; Trzcieliński 2011, pp. 27-29) include:

- Precisely defining the value that a given product presents to the customer (specify the value).
- Identifying the value stream for each product (identify the value stream).
- Ensuring uninterrupted flow for this stream (flow).
- Organizing the manufacturing process in a way that the customer "pulls" the product to the market from the producer (pull).
- Creating a culture of continuous improvement and striving for perfection (perfection).

Customer-oriented value is crucial in the lean approach, serving as the foundation around which the entire value chain of Lean Management is built. Customer orders trigger production in a streamlined environment (Hutchinson, Liao, 2009). All activities that do not meet customer expectations and needs are classified as waste (Shook, 2007; Liker, Ross, 2017). Customers, as stakeholders, define value, specifying what they appreciate in each product/service, the price they are willing to pay, and the acceptable delivery time (Womack, Jones, 2003; Kennedy, Brewer, 2005; Putnik, 2012).

Lean Management requires proper consideration of resources: how to handle them, their location, utilization, and management. The efficiency of resource utilization is determined by how they are used (Czarnecki, 2010, pp. 59-61). In this context, Lean Management focuses on four coherent goals: (Nogalski, Walentynowicz, 2007):

- short production cycle with simultaneous high integration of the production process,
- timely deliveries achieved through collaborative cooperation with suppliers,
- minimal inventory,
- maximum utilization of production capacity.

Avoiding dispersion and waste appears in all attempts to define the lean concept. Actions in this regard aim to reduce "muda" (a Japanese term for waste, futility, unnecessary consumption). Activities that do not add value include buffer stocks, safety stocks, waiting times, warranty repairs. The lean concept promotes the principle that every process can be further rationalized, eliminating often unnoticed waste (Gendo, Korschak, 1999, pp. 53-94).

Activities and processes that do not add value result in waste, which can manifest as (e.g., Womack, Jones, 2003, p. 15; Hicks, 2007; Wiśniewska, 2005, p. 4):

- Waste of overproduction – producing too many goods within ongoing processes, exceeding order levels.
- Waste of inventory – finished goods, materials not needed for production, interoperative, leading to increased transportation and storage costs.
- Waste of defects – concerning products, documentation, deliveries, information.
- Waste of waiting – long periods of inactivity for individual resources, e.g., people, machines, parts, materials, resulting from delays in deliveries.
- Waste of overprocessing – involving unnecessary tasks in the implemented process.
- Waste of transportation – unnecessary movement of objects within ongoing processes, resulting from improper designation of transport paths.
- Waste of motion – excessive, unjustified transport of resources, as well as unnecessary tasks performed by workers, e.g., due to poor workplace organization.

Waste of untapped human potential – manifested, for example, by a lack of employee engagement. The eighth type of waste, related to the underutilization of employee creativity, was proposed by J.K. Liker (2005) and has become permanently integrated into the Lean Management concept.

The concept of Lean Management permeates organizations through various systems, such as the Toyota Production System (TPS), Achieving Competitive Excellence (ACE), Continuous Improvement Project (CIP), World Class Manufacturing (WCM), or Six-Sigma. These systems constitute meta-concepts, combining many congruent ideas in the areas of organization and management (Pawłowski et al., 2010). These systems serve as tools enabling organizations to effectively implement Lean Management principles, leading to operational excellence and competitiveness.

While Lean Management is traditionally conceptualized as a set of practices (e.g., Shah, Ward, 2007), it is assumed that these distinct practices should operate collectively as a system (Womack et al., 1990). Stakeholders such as suppliers of raw materials and components, entities providing services in sales, customer service, or post-sales service have a significant impact on production costs, the quality of the final product, and the flexibility of organizational operations. Extending Lean Management beyond the boundaries of an organization, through interorganizational cooperation, necessitates convincing these entities to introduce improvements in their processes to jointly create the maximum value for the end customer. Therefore, it is crucial to treat stakeholders collaboratively and ensure a fair distribution of benefits obtained from jointly conducted activities. Hence, questions in the survey were included in the area of interorganizational relations.

An important feature of the supply chain where Lean Management principles have been introduced is the pursuit of reducing the number of suppliers. Simultaneously, emphasis is placed on establishing long-term relationships within cooperation, with a carefully selected group of partners, to ultimately improve common processes, enhance quality, and engage business partners in designing and refining products. If a company simultaneously aims to reduce inventory by implementing the just-in-time method, there is often a preference for suppliers in close proximity. However, some companies implementing Lean Management are concerned that limiting the number of suppliers, combined with reducing inventory size, may increase the risk of disruptions in operations in situations involving non-standard events resulting in delays or interruptions in deliveries. Such situations may include random events (fire, flood), strikes, or pandemics.

3. Research method

The aim of the conducted research was to assess the extent of the application of Lean Management in Polish manufacturing companies declaring the adoption of the lean philosophy. Empirical studies were conducted based on data obtained from anonymous surveys conducted in companies implementing Lean Management. The participating firms declared the use of methods and tools characteristic of LM.

The construction of the research tool stemmed from the research objectives. The questionnaire consisted of several groups of questions, although not all areas were utilized in this study. The first group of questions focused on company information and aimed to identify the general characteristics of the surveyed entities. Questions covered the ownership structure of the company, whether the company is part of a capital group, location of operations, size of the unit (measured by the number of employees), declared strategic goals of the studied company, and the sector and industry of activity. The second part of the survey was directed at information about the respondents, with questions pertaining to the department of employment, the role held, and the duration of work in the surveyed company.

The third part identified the level of implementation of LM in the surveyed company. As previously mentioned, since there is no exhaustive catalog of tools and methods of LM, the level of maturity in lean is diagnosed through a series of characteristics and attributes of leanness. Utilizing a method of reconstruction and interpretation of literature, a general catalog of descriptors related to the concept of LM was identified. The operationalization for the LM construct was based on existing literature and previous studies (Stroncsek, 2022). The discussed construct is multidimensional and has a latent nature. Lean is modeled as a second-order construct representing complementarities among first-order factors, which include relationships with suppliers and customers, pull and flow processes, employee empowerment, and TPM.

The dimensions (desiderata) adopted for assessing the level of implementation of the LM concept were described in Table 1. The developed instrument covered both internal and external practices. In this research area, modified measurement scales of lean production developed by R. Shah and P. T. Ward (2007) were used. In the third part of the survey, there was also a control question regarding respondents' self-assessment of the level of Lean Management implementation in the surveyed company. A 5-point Likert scale (where 1 - strongly disagree, 2 - somewhat disagree, 3 - neutral, 4 - somewhat agree, 5 - strongly agree) was used to assess operationalized variables.

Table 1.

The construction of a measurement tool in the field of the advancement of Lean Management practices

Area	Construct Descriptor	Construct Details
Customer Relationships	Customer Relationships are evaluated by assessing customer needs and expectations. Customers are actively engaged in quality improvement projects. Consumer satisfaction is measured. Close contact is maintained with key customers.	<ul style="list-style-type: none"> - We are often in close contact with our customers. - Our customers provide us with their opinions regarding the quality and timeliness of deliveries. - Our customers are actively involved in shaping the current and future product offerings. - Our customers frequently share with the marketing departments current and future demand-related information. - We regularly conduct customer satisfaction surveys.
Supplier Relationships	We use a small number of suppliers. Suppliers are engaged in product development and quality improvement projects. Suppliers are evaluated based on quality	<ul style="list-style-type: none"> - We are often in close contact with our suppliers. - We aim to establish long-term relationships with our suppliers. - Our key suppliers provide us with just-in-time deliveries. - We engage in corporate-level communication with key suppliers on important matters. - We take specific steps to reduce the number of suppliers for each specialty. - We provide feedback to our suppliers regarding the quality and timeliness of their deliveries. - Suppliers are directly involved in the process of developing new products.
Employee Engagement	A participatory organizational culture is preferred, where employees are trained and responsible for suggesting improvements, making decisions, and ensuring the quality of outcomes.	<ul style="list-style-type: none"> - The majority of production floor workers are cross-trained. - Operational employees are actively involved in improvement activities and have the authority to make changes. - The work environment is organized so that most tasks are performed in teams. - Employees regularly submit individual and team ideas for improvement. - Leadership is engaged in quality-related training. - All employees are encouraged to suggest solutions to problems. - A structured employee training program is implemented and adhered to.

Cont. table 1.

Processes: "Pull" and "Flow"	The manufacturing process is organized in a way that ensures the product is "pulled" to the market by the customer (both external and internal) (pull).	<ul style="list-style-type: none"> - Production is "pulled" by the shipment of finished products. - Production at each workstation is "driven" by demand from the next workstation. - We use containers, cards, or Kanban boards to control production.
	We strive to ensure uninterrupted flow (flow).	<ul style="list-style-type: none"> - Products are grouped based on similar processing requirements. - Equipment is grouped to ensure continuous flow of product families.
Total Productive Maintenance (TPM)	We implement comprehensive maintenance by systematically servicing equipment and maintaining documentation of related activities.	<ul style="list-style-type: none"> - We allocate time for planned equipment maintenance in our daily activities. - We regularly maintain all of our production equipment. - We meticulously document all activities related to equipment maintenance.

Source: Own work.

In the study, the format of closed-ended questions was considered most appropriate due to time pressure on the respondents and a cultural reluctance to open-ended questions requiring detailed answers.

The questionnaire was initially pre-tested and evaluated by two practitioners familiar with the concept of LM, three experts who are researchers in the field of management, and an academic statistician specializing in research across various management areas. The feedback and suggestions from the specialists, along with the pilot survey (12 surveys), allowed for the verification and improvement of the research tool.

The actual research was conducted from May to August 2021. The survey covered companies that declared the use of methods and tools characteristic of LM. To enhance the accuracy and reliability of responses, the research purpose was presented to respondents, and basic conceptual terms in the questionnaire were explained. Respondents provided answers based on their own knowledge, making the study declarative in nature¹.

4. Results and discussion

As a result of the conducted questionnaire surveys (electronically), a total of 128 complete surveys were obtained after verification, representing manufacturing enterprises. These companies encompassed small firms - 4 (3,12%), medium-sized enterprises - 42 (32,81%), and large enterprises 82 (64,06%). For research purposes, large firms were further divided into two subgroups based on employment size, namely those employing up to 500 people and those with a workforce exceeding this size. Despite variations in size and

¹ Conducting scientific research involving reference to respondents' perceptions is common in management studies (cf. Cyfert, 2012). This is directly driven by researchers' aspirations to advance knowledge in the field of management while simultaneously aiming for the practical applicability of the acquired knowledge.

employment levels among the surveyed entities, these differences did not impact the quality of the conducted research.

An analysis of the characteristics of the capital structure of the represented enterprises indicates that they are based on both Polish and foreign capital, with the majority representing mixed capital. Most of the participating companies were members of capital groups (75,8%). However, a significant portion of them maintained a separate managerial accounting or controlling system (68%). A detailed profile of the surveyed enterprises is presented in Table 2.

The majority of surveyed companies are located in the Silesian and Lesser Poland voivodeships (both at 15,53%), followed by the Masovian voivodeship (12,5%), Pomeranian voivodeship (9,34%), and Greater Poland voivodeship (9,34%).

Characterizing the enterprises participating in the study, it is also valuable to examine the profile of the respondents directly involved in the research. Respondents were individuals representing various areas of enterprise functioning, with the predominant group being employees from production departments (30,47%) and quality departments (28,13%). This situation appears evident in the context of the theory presented earlier (Chapter 1) – often, representatives of these departments become leaders of lean initiatives within companies. It is noteworthy that 10 individuals (7,81%) did not strongly identify with a specific functional area of the enterprise but rather with being a change leader in the lean area (characterizing a cross-functional role.).

Respondents were asked to indicate the area associated with the declared strategic goal of the surveyed enterprise. They could choose up to three areas. The majority of respondents pointed to quality (87,5%), cost (41,41%), and innovation (39,84%). In subsequent positions, but also with high indications, were reliability (34,38%), environmental goal (23,44%), and sustainable development (17,97%). Such a hierarchy of responses is an obvious consequence of choosing Lean as the leading management concept in the surveyed enterprises.

The conducted empirical research allowed for determining the state of LM implementation in the surveyed enterprises. Tables 2-6 present the analysis results considering individual Lean Management areas.

Collaboration with suppliers is a key pillar of effective management in the context of Lean principles. Supplier relationships, being an integral part of this approach, have strategic importance for companies aiming to optimize their supply chain. The research results clearly indicate that the surveyed companies are aware of this significance, emphasizing the building of strong relationships with suppliers.

The results indicate that the dimension "Supplier Relationship Management" (DS) in the surveyed companies was moderately implemented in the examined sample of enterprises. The average value for the entire DS dimension was 3,54 (see Figure 1), which means that practices related to supplier relationship management are common but not fully developed. The highest ratings were obtained for DS6, DS2, and DS1 factors, exceeding the average value

for the entire DS dimension (3,54). The analysis of standardized factor loadings indicates that all values within the DS construct are equal to or exceed 0,3, which is considered significant (see Table 2). Practices DS1, DS2, and DS5 have the greatest impact on the importance of the scale, confirming their crucial role in effective supplier relationship management.

Table 2.

Area: Supplier Relationships

Characteristics	\bar{x}	σ	Standardized Factor Loadings	The average correlations of the component with the remaining variables
We are often in close contact with our suppliers (DS1)	4,14	0,86	0,838	0,382
We strive to establish long-term relationships with our suppliers (DS2).	4,13	0,95	0,893	0,398
Our key suppliers provide us with just-in-time (JIT) deliveries (DS3).	3,24	1,11	0,393	0,205
We communicate at the corporate level with key suppliers on important matters (DS4).	3,37	1,19	0,488	0,285
We take specific steps to reduce the number of suppliers for each specialty (DS5)	2,80	1,22	0,411	0,317
We provide feedback to our suppliers on the quality and timeliness of their deliveries (DS6).	4,45	0,79	0,435	0,254
Suppliers are directly involved in the process of developing a new product (DS7).	2,63	1,27	0,300	0,230

\bar{x} - the average.

σ - standard deviation.

Source: Own work.

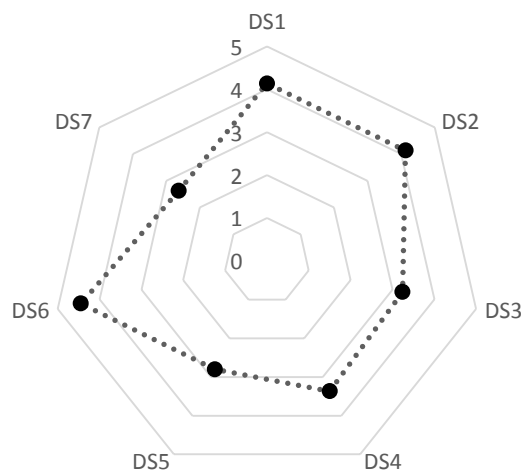


Figure 1. Averages of implementations of practices in the area of "Supplier Relationship Management" in the surveyed companies.

Source: Own work.

The research indicates that companies prioritize building strong relationships with suppliers. However, to reap full benefits from LM, they should focus on further developing these relationships, especially in ensuring timely deliveries and engaging suppliers directly in the process of developing new products.

LM enables companies to achieve various benefits, with key aspects being the optimization of the supply chain, cost reduction, access to new technologies and knowledge, and enhanced competitiveness. The surveyed firms seem to understand this relationship, as confirmed by the obtained results. Nevertheless, to unlock the full potential of LM benefits, there is a need to concentrate on further developing supplier relationships.

The aim of Lean is to create value for the customer by delivering products and services that align with their needs and expectations. Customer relationships are a crucial element of LM (Nogalski, Niewiadomski, 2017). Through these relationships, companies can:

- understand the needs and expectations of customers,
- tailor their offerings to these needs,
- ensure high-quality products and services,
- maintain customer loyalty.

Adapting offerings to customer needs allows companies to create products and services that are genuinely desired by customers and provide them with value. Customer relationships are also important for ensuring the high quality of products and services. Companies that prioritize customer relationships are more inclined to listen to customer opinions and needs. This enables them to quickly identify and address issues with the quality of products and services.

Loyal customers form the foundation of success for any business. Customer relationships help companies maintain customer loyalty by building trust and mutual connections.

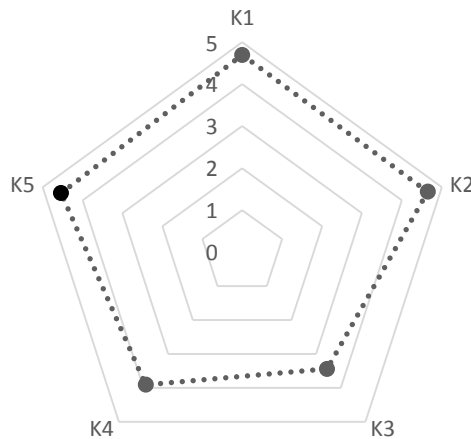
In the area of "Customer Relations" (K), the surveyed companies have implemented relevant practices to a significant extent, achieving an average score of 4,25 for the entire dimension K (see Figure 2). The results indicate that practices K1, K2, and K5 have scored above this average. Detailed analyses within this area revealed that all standardized factor loadings for individual practices (compared to the value of 0,3) are at or above this threshold, with the first two practices (K1 and K2) exhibiting the highest loadings.

The achievement of the scale significance is a result of the impact of all practices, confirmed through both the analysis of standardized factor loadings and the average correlations of the component with the remaining variables forming the construct. Although these values are at a low level, they are statistically significant (see Table 3).

Table 3.*Area: Customer Relations*

Characteristics	\bar{x}	σ	Standardized Factor Loadings	The average correlations of the component with the remaining variables
We are often in close contact with our customers (K1)	4,70	0,60	0,975	0,495
Our customers provide us with feedback on the quality and timeliness of deliveries (K2)	4,65	0,75	0,674	0,379
Our customers are actively involved in shaping the current and future product offerings (K3)	3,44	1,31	0,518	0,331
Our customers frequently share current and future demand information (K4)	3,91	0,99	0,341	0,262
We regularly conduct customer satisfaction surveys (K5)	4,54	0,84	0,500	0,327

Source: Own work.

**Figure 2.** Averages of implementations of practices in the area of "Customer Relationships" in the surveyed companies.

Source: Own work.

High scores in practices K1, K2, and K5 indicate that the surveyed companies prioritize building close relationships with customers. They regularly maintain contact, pay attention to customer opinions and needs, and conduct satisfaction surveys regularly.

Lower scores in practices K3 and K4 may suggest that the surveyed companies have room for improvement in engaging customers in product offerings and obtaining information about their demand.

In the context of LM, close customer contact (practice K1) enables ongoing dialogue, allowing for quicker detection of potential waste areas. Customers providing feedback on quality and timeliness of deliveries (practice K2) enables the adjustment of production processes to meet their expectations, resulting in improved quality and the elimination of unnecessary actions.

Furthermore, active customer engagement in shaping offerings (practice K3) and regular customer satisfaction surveys (practice K5) are key elements of the continuous improvement process. Thanks to these practices, companies can tailor their products and services to real customer needs, thus eliminating unnecessary elements from the production process.

As a result, maintaining close relationships with customers not only influences process improvement but also contributes to building customer loyalty. Companies that actively listen to customer opinions and needs create products that are genuinely desired, leading to customer satisfaction and retention. In this way, customer relationships become an integral part of Lean Management strategy, promoting waste elimination and continuous quality improvement, which are crucial for achieving success in a competitive market environment.

The results indicate that the surveyed companies prioritize building lasting relationships with customers. This is a significant aspect because satisfied customers are more likely to make repeat purchases and recommend the company's products and services to others.

To further improve customer relationships, the surveyed companies may consider the following actions:

- increase customer engagement in shaping product offerings, for example, by organizing contests, surveys, and workshops,
- actively encourage customers to share information about their needs, for instance, by introducing loyalty programs or special offers,
- implement technological solutions that facilitate communication with customers, such as chatbots, live chats, or virtual assistants.

Internal logistics is a crucial component of LM. It is responsible for the flow of items through successive production stages and the delivery of finished products to the warehouse. Its goal is to ensure a smooth and efficient flow of materials, products, and information within the company.

In lean enterprises, internal logistics is based on a pull system. This system involves producing only those components that are needed at a given moment. This approach allows the company to eliminate waste that may occur during the flow of goods.

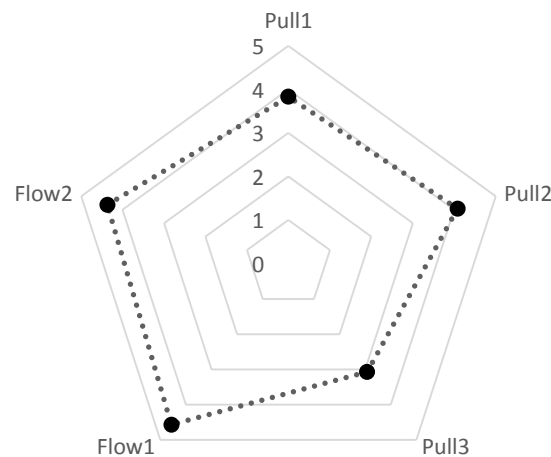
In the surveyed companies, the "Pull" area was assessed at a level of 3,66, indicating a moderate implementation of the principles in this area (Figure 3). The most effectively implemented practice was Pull2, where production at a workstation is "driven" by demand shown by the next workstation. The average rating for this practice was 4,08, suggesting a high degree of compliance with the principles of the pull system. However, despite the high rating, the standardized factor loading for this practice is only 0,298, which may indicate certain areas for further analysis and improvement (Table 4).

If we look at the practices in the "flow" processes area, it can be observed that although they are rated significantly above the scale's average, the standardized factor loadings are relatively low. This suggests that despite the overall high rating, these practices may be applied in a subjectively positive manner but require some adjustments or enhancements to better meet the criteria of lean system efficiency.

Table 4.*Processes: "pull" and "flow"*

Characteristics	\bar{x}	σ	Standardized Factor Loadings	The average correlations of the component with the remaining variables
Production is "pulled" by the shipment of finished products (Pull1)	3,83	1,35	0,575	0.205
Production at each workstation is "driven" by demand from the next workstation (Pull2)	4,08	1,10	0,298	0,132
We use containers, cards, or Kanban boards to control production (Pull3)	3,07	1,38	0,797	0,249
Products are categorized into groups with similar processing requirements (Flow1)	4,57	0,61	0.167	0,123
Equipment is grouped to ensure a continuous flow of product families (Flow2)	4,37	0,79	0.235	0,159

Source: Own work.

**Figure 3.** Averages of implementations of practices in the area of "pull and flow processes" in the surveyed companies.

Source: Own work.

Based on the obtained results, it is suggested to focus on further improving the Pull2 practice, despite its high rating, to increase its standardized factor loading. This will allow for a more precise assessment of the impact of this practice on the overall efficiency of the pull system. Additionally, it is worthwhile to undertake a detailed analysis of practices in the "flow" processes area, identifying areas where improvements can be introduced to enhance their consistency with lean principles.

Maintenance is another key element of LM. It allows for the maintenance of the efficiency and reliability of machinery and equipment, which is essential for ensuring effective production (Czerska, 2014; Furman, 2014).

The implementation of the "Maintenance" dimension (Total Productive Maintenance - TPM) in the surveyed enterprises was positively evaluated by the respondents. The average rating was 4,06, and the low standard deviation (0,97) suggests consensus in the respondents' assessments. The highest average score was obtained for the TPM2 factor, which pertains to the regular maintenance of the entire production equipment. On the other hand, the lowest rating was given to the TPM3 factor, related to meticulous documentation of equipment maintenance (see Table 5 and Figure 4).

The ratings of individual components are close to each other, indicating a consistent assessment of various aspects of maintenance in the surveyed enterprises. All components of the TPM construct show significant correlations, confirming consistency in the perception and evaluation of respondents regarding equipment maintenance.

TPM3 has the highest factor loading, suggesting that meticulous documentation related to equipment maintenance is particularly important in the context of TPM assessment. However, it is worth noting that all standardized factor loadings within the TPM construct are at a level equal to or higher than 0,3, confirming the significant importance of each element of the construct.

Table 5.
Maintenance (TPM)

Characteristics	\bar{x}	σ	Standardized Factor Loadings	The average correlations of the component with the remaining variables
We dedicate part of our daily activities to planned equipment maintenance (TPM1)	3,92	1,23	0,387	0,285
We regularly maintain all our production equipment (TPM2)	4,35	0,62	0,547	0,359
We maintain meticulous documentation of all activities related to equipment maintenance (TPM3)	3,90	0,91	0,927	0,433

Source: Own work.

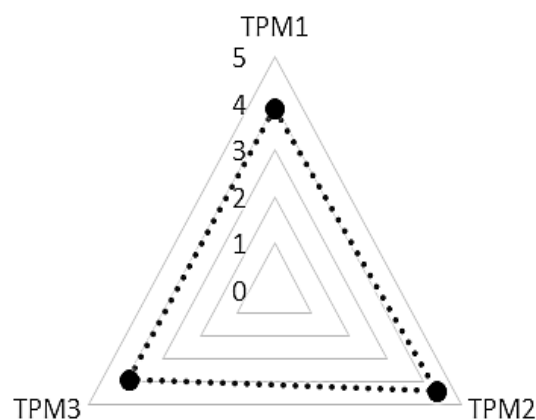


Figure 4. Averages of implementations of practices in the area of "Total Productive Maintenance (TPM) maintenance" in the surveyed companies.

Source: Own work.

The research results suggest that companies should focus on further developing maintenance practices. In particular, they should concentrate on the following areas:

1. Implementation of a preventive maintenance system: Currently, the surveyed companies focus on corrective maintenance, which is carried out only after a breakdown occurs. Implementing a preventive maintenance system would prevent breakdowns and ensure greater reliability of machinery and equipment.
2. Implementation of a maintenance documentation management system: Currently, maintenance documentation is often managed in a disorganized and inefficient manner. Implementing a maintenance documentation management system would organize the documentation and facilitate access to it.

In the context of the contemporary business environment, where dynamic changes and competition present numerous challenges to companies, there is a growing understanding of the role that internal relationships play in the context of employee engagement and continuous improvement. According to the results of the conducted study, it has been confirmed that good relationships within a company are crucial for increasing employee engagement and reducing their resistance to change.

In the area of "employee engagement," consisting of seven dimensions, the surveyed companies obtained an average rating of 4,10, with a low standard deviation of 0.87. This suggests consistency in the respondents' assessments, which are closely aligned. The practice P1 is most correlated with the other dimensions, and the highest factor loadings are for P1, P3, and P7 (see Table 6).

Table 6.
Employee Engagement

Characteristics	\bar{x}	σ	Standardized Factor Loadings	The average correlations of the component with the remaining variables
The majority of production hall employees are cross-trained (P1)	4,02	0,93	0,599	0,259
Operational employees are actively engaged in continuous improvement activities and have the authority to implement changes (P2)	3,69	0,91	0,323	0,146
The work environment is organized in a way that most tasks are performed in teams (P3)	3,99	0,93	0,593	0,249
Employees regularly submit individual and team ideas for improvement (P4)	3,90	0,80	0,431	0,202
Leadership is involved in quality-related training (P5)	4,42	0,69	0,326	0,163
All employees are encouraged to submit suggestions for problem-solving (P6)	4,55	0,56	0,483	0,253
A structured employee training program is implemented and adhered to (P7)	4,15	0,60	0,506	0,240

Source: Own work.

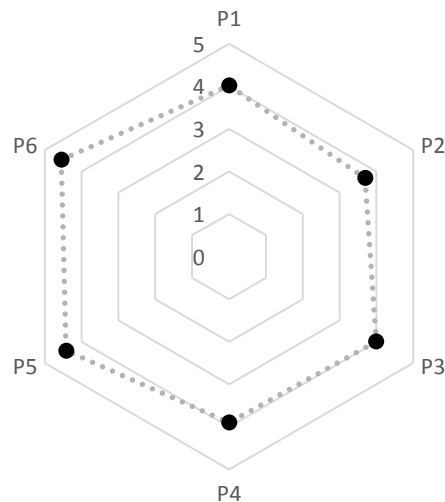


Figure 5. Averages of implementations of practices in the area of "Employee Engagement" in the surveyed companies.

Source: Own work.

In respect to the obtained results, companies, guided by the idea of continuous improvement, are aware of the importance of the right approach to internal relational capital. Introducing new products, maintaining production efficiency in small batches, and minimizing production costs become challenges that companies seek to address by investing in human capital.

Effective employee engagement becomes a key element in achieving the success of a company. Employees who feel like an integral part of the organization are more inclined to actively participate in the process of continuous improvement, translating into improved results. The study results, indicating an average rating of 4,10 in the area of employee engagement, underscore the significant role of this relationship for the effective functioning of an organization.

The research results indicate that companies should focus on further developing employee engagement. Specifically, they should concentrate on the following areas:

- Implementation of a motivational system that rewards employees for their engagement. Currently, most companies rely on a reward-based motivational system. However, there are many other ways to motivate employees, such as recognition, training, and professional development opportunities.
- Creating an organizational culture that supports employee engagement. Organizational culture should promote openness, communication, and collaboration. Employees should feel appreciated for their contributions and have a sense that their opinions are taken into account.
- Involving employees in decision-making processes. Employees should be actively engaged in decision-making processes that affect them. This will allow them to feel that they have an impact on their work and that their opinions matter.

To assess the measurement tool, a reliability evaluation of the model was conducted before proceeding with statistical analyses, utilizing, among others, the Cronbach's Alpha coefficient, which simultaneously serves as an assessment of the internal consistency of the research tool. Measurement scale checks were performed for the following variables: supplier relationships, customer relationships, "pull" and "flow" processes, Total Productive Maintenance (TPM), and employee engagement. The results of the study are presented in Table 7.

Reliability assesses the degree of consistency between multiple measurements of a variable (Hair et al., 1988). In this study, the reliability of the scale is measured in terms of the agreement of results obtained for the observed variables, primarily using the Cronbach's Alpha coefficient. This coefficient is calculated as the average intercorrelations between items measuring the concept (Sekaran, 2003). The closer the coefficient is to unity, the higher the internal consistency and reliability of the study. As observed, not all constructs have α values higher than 0.6, suggesting that the internal consistency and reliability of the study regarding "pull" and "flow" processes and TPM maintenance are questionable.

Table 7.

Reliability Analysis Coefficients of Constructs Examining the Implementation Level of Lean Management

Area	Number of Questions	Cronbach's Alpha	Cronbach's Alpha based on standardized items	Lambda 4	Composite Reliability
Supplier Relationships	7	0,73	0,75	0,84	0,74
Customer Relationships	5	0,68	0,74	0,78	0,75
Processes: "Pull" and "Flow"	5	0,53	0,51	0,61	0,53
Maintenance (TPM)	3	0,58	0,63	0,56	0,67
Employee Engagement	7	0,65	0,66	0,74	0,66

Source: Own work.

The analyzed study was conducted among numerous respondents evaluating various contexts with different interpretations, hence Cronbach's Alpha may not assume the required values. M. Schrepp (2020) suggests providing correlations of individual items (variables of a given construct) whenever possible. This allows for a much better insight into the scale's consistency. Incorrect interpretations of individual items are clearly visible through small correlations with other items of the scale, which can then be considered in the data interpretation.

Therefore, the reliability analysis was supplemented with indicators: Cronbach's Alpha based on standardized items, Lambda 4 - Guttman's split-half coefficient, and the composite reliability coefficient.

It should be stated that the reliability analysis of the developed measurement tool in the area of verifying the implementation status of LM confirms its suitability for empirical verification of the state of lean implementation.

In this study, the second-order latent variable LM was generated using a reflective construct model. This type of modeling is perceived as one in which all first-order latent variables are correlated.

Table 8 illustrates the correlations between first-order latent variables (lean practices). Among the 10 possible correlations, only one is not statistically significant at the assumed significance level of $p < 0,05$, indicating the possibility of the existence of a higher-order latent variable.

Table 8.

Spearman correlation coefficients indicating the degree of dependence between adopted Lean Management constructs

	DS	K	PULL/FLOW	TMP	P
DS	1				
K	0,256 ($p=0,004$)	1			
PF	0,404 ($p < 0,001$)	0,090 ($p=0,314$)	1		
TMP	0,223 ($p=0,011$)	0,414 ($p < 0,001$)	0,248 ($p=0,005$)	1	
P	0,257 ($p=0,003$)	0,240 ($p=0,006$)	0,309 ($p < 0,001$)	0,395 ($p < 0,001$)	1

$0,0 \leq |r| \leq 0,2$ - no correlation

$0,2 < |r| \leq 0,4$ - weak correlation

$0,4 < |r| \leq 0,7$ - moderate correlation

$0,7 < |r| \leq 0,9$ - strong correlation

$0,9 < |r| \leq 1,0$ - very strong correlation

Source: Own work.

The analyzed data simultaneously suggest that the surveyed companies have a narrow view of the Lean Management concept, implementing LM practices in a fragmented manner. This confirms results obtained in other, earlier studies.

5. Summary

Summarizing the research results, it can be concluded that LM is widely implemented in Polish manufacturing companies. Practices in the "Customer Relations" and "Employee Engagement" areas are particularly well-developed. Focusing on building close relationships with customers, involving them in product development processes, and conducting systematic customer satisfaction surveys has yielded positive results.

However, it should be noted that areas such as "Supplier Relations" and "Processes: Pull and Flow" require further action in implementing lean practices. Despite certain areas for development, the research results confirm that LM is an effective management strategy, generating benefits in terms of improving customer relations, employee engagement, and process efficiency.

The conclusions drawn from the conducted research are of significant importance for management practice, suggesting that LM constitutes a solid foundation for manufacturing companies. The achieved goal of the article, i.e., assessing the implementation of Lean Management in Polish firms, provides valuable information for managers and decision-makers, encouraging them to continue their efforts towards effective implementation of this management strategy.

Based on the conducted research, the following conclusions can be drawn:

- The implementation of LM in Polish manufacturing companies is at a relatively high level.
- The areas of "customer relations" and "employee engagement" are the best implemented.
- In the case of the "supplier relations" area, the results are slightly lower, and in the case of the "processes: pull and flow" area, they are the lowest.
- The areas of "supplier relations" and "processes: pull and flow" require further action in the implementation of lean practices.

The significance of the research results for management practice is substantial. The findings indicate that LM is an effective management strategy that can bring tangible benefits to manufacturing companies. The implementation of LM allows for the improvement of customer relations, employee engagement, and process efficiency, which can translate into increased competitiveness for the company.

To further develop Lean Management in Polish manufacturing enterprises, it is necessary to:

- increase managers' awareness of the benefits of LM,
- train employees in the field of LM,
- develop and implement lean development plans in enterprises.

An additional value of the article is the proposal of a measurement tool for diagnosing the state of LM implementation divided into five constitutive areas for LM.

Interpreting the research results, one must consider its limitations. Only one respondent from each company participated in the survey. As a result, it is unknown whether the views of the respondent are shared by other members of the organization. Moreover, bias resulting from the respondent's position, length of employment, or scope of knowledge cannot be ruled out. At the same time, the study is cross-sectional, which does not allow for causal inferences and may be subject to measurement errors. The obtained results may also be affected by systematic error since the same respondent provided indications regarding exogenous and endogenous variables. It should also be noted that the sample selection is not random, as the respondents represented only those companies for which there was certainty about the implementation of the Lean Management concept.

From the limitations, certain future directions for further research can be inferred, which, according to the author, should primarily include the study of barriers to the diffusion of Lean Management strategies and research that would allow explaining the impact of situational factors, especially the SARS-CoV-2 (COVID-19) pandemic, on the adoption of LM methods by companies in the longer time perspective.

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MONITORING FUEL QUALITY IN THE TRANSPORT INDUSTRY

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Purpose: The aim of the article is to check whether there are indications that light waves can be used to monitor fuel quality.

Design/methodology/approach: Tests of deposits released in fuels during long-term storage were carried out. The research involved observing with the unaided eye illuminated samples of fuels stored in glass vials. The research was qualitative in nature. Samples of diesel oil, gasoline were tested. The phenomena occurring in materials under the influence of aging processes were determined and the relationships between the tested material, its quality and the impact of light rays on the sample were explained using physic-chemical phenomena.

Findings: The novelty of the article is to show that fuels after the storage process can significantly differ in quality from the starting material and that it is possible to monitor fuel quality using spectroscopic methods.

Research limitations/implications: The research conducted is qualitative and not quantitative.

Practical implications: It is suggested to use methods of continuous monitoring of stored fuels using light spectroscopy methods.

Originality/value: It is to show that fuels from one manufacturer and stored in the same tank age at different times. Fuels have different properties and significantly differ in quality compared to the input material. Therefore, there is a real need for continuous monitoring of fuel quality.

Keywords: automotive, fuel, quality of gas, quality of oil.

Category of the paper: Research paper.

1. Introduction

Fuel quality testing based on standardized measurement procedures enable the determination of the quality of fuels only in specialized testing laboratories according to appropriate standards (PN-EN 15442:2011, PN-EN 15413:2011, PN-EN 15443:2011). In accordance with the standards, tests of transport fuels require taking samples of material

from tanks located at service stations, transporting appropriately secured samples to a laboratory and then performing tests (UOKIK Report). The information obtained on the quality of the fuel, in accordance with the presented test procedure, is time-consuming and does not give the possibility of an immediate decision on the release of the fuel on the market or its withdrawal (Vasileiadou et al., 2021). Stored fuels undergo ageing processes, which results in a change in their physic-chemical properties and translates into deterioration of their functional properties (He et al, 2021; Matijošius, Sokolovskij, 2009; Stepień, 2015). As a result of chemical reactions taking place in stored fuels, resin deposits or acids are formed (He et al., 2018; Correia et al., 2018; Debe, 2012; Blaabjerg, Teodorescu, Liserre, Timbus, 2006). Improper storage can even accelerate these reactions (Jiang et al., 2024; Jeon et al., 2017; Stepień, 2015; Ukhanov et al., 2022; Sacha, 2020; Silva et al., 2021). Therefore, an important element in the fuel supply chain to the consumer is to check its quality. Due to the lengthy laboratory procedures, new methods are being sought to improve the process of fuel quality assessment (Kalwas, Bukrejewski, 2016).

The article proposes to conduct research and indicate the direction of development of methods for monitoring the quality of fuels in real time.

2. Investigation methods

Visual tests were carried out in accordance with the PB/AS-91 standard as preliminary tests. They consisted of visual inspection of fuel samples placed in glass vials with the naked eye. The tested liquids were characterized by different degrees of degradation related to the changes occurring in them, resulting from the aging process during their long-term storage. Samples for testing non-stored and stored fuels were illuminated from one side. They observed whether individual materials exhibited changes in color and clarity, which could form the basis for inferences about their quality. The aim of the study was also to determine whether the light wave passing through the sample could be used in research on the quality of liquid fuels in order to monitor them. The presented research is preliminary research carried out as part of a broader research project related to the monitoring of the quality of liquid fuels, including biofuels.

3. Results of investigation

Examples of tested samples of liquid fuels are presented in Fig. 1-2. In the case of illumination of unaged samples, some subtle differences can be observed between individual fuel samples. The differences are in the color and turbidity of the liquid. The analysis of the test results allows us to conclude that the material, purchased directly from the manufacturer without the long-term storage process, has a light color and is clear (Fig. 1 a-b). With the naked eye, it is difficult to see significant differences between the starting sample of gasoline and diesel oil, both fuels are characterized by light coloration and volume uniformity. If you move the vial, you will notice that diesel has poorer flow properties, which is due to its higher density and viscosity compared to gasoline. As a result of storage, noticeable changes occur in the observed fuel samples. The samples undergo degradation, which is initially manifested by a slight, but unambiguous and observable change in color.

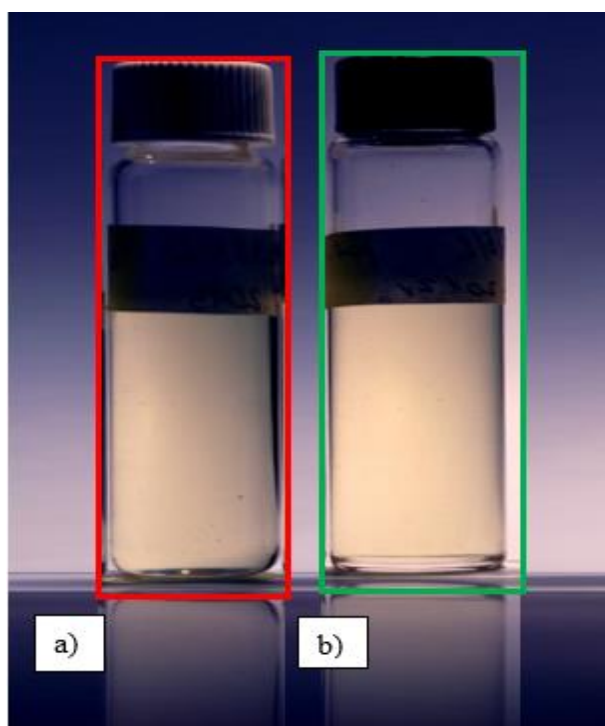


Figure 1. Starting samples: (a) diesel fuel; (b) petrol Pb 95.

First of all, this change is recorded in samples of diesel fuels, which, according to the literature, is related to the process of resin release. As a result of the aging process, the samples acquire a colour of varying intensity of yellow, as shown in Figure 2 – sample (1) and (3). In the initial storage period, the colour is heterogeneous in volume. It is possible to observe the spread of an area of liquid with a more intense color in the test tube with the passage of time and the aging processes taking place. Figure 2a shows samples after two months of storage. In sample (1) – diesel fuel, darker and lighter areas can be clearly distinguished in the tested material. According to the literature analysis, it can be concluded that during the aging process,

small fractions of resins are initially released, which are coagulated over time. The process of combining particles of the dispersed phase of the colloid (resins) into larger aggregates forming a continuous phase with an irregular structure (sample 1, 3 – Fig. 3) results in an increase in the absorbance of light and thus a decrease in its transmittance (which will be explained in more detail later in the article).

Further observations of the sample indicate that the sediments formed as a result of coagulation increase in mass and fall freely to the bottom of the tube. The described phenomena make it possible to observe changes in the form of darker and lighter areas in the tested sample of liquid material. The liquid becomes heterogeneous in its volume.

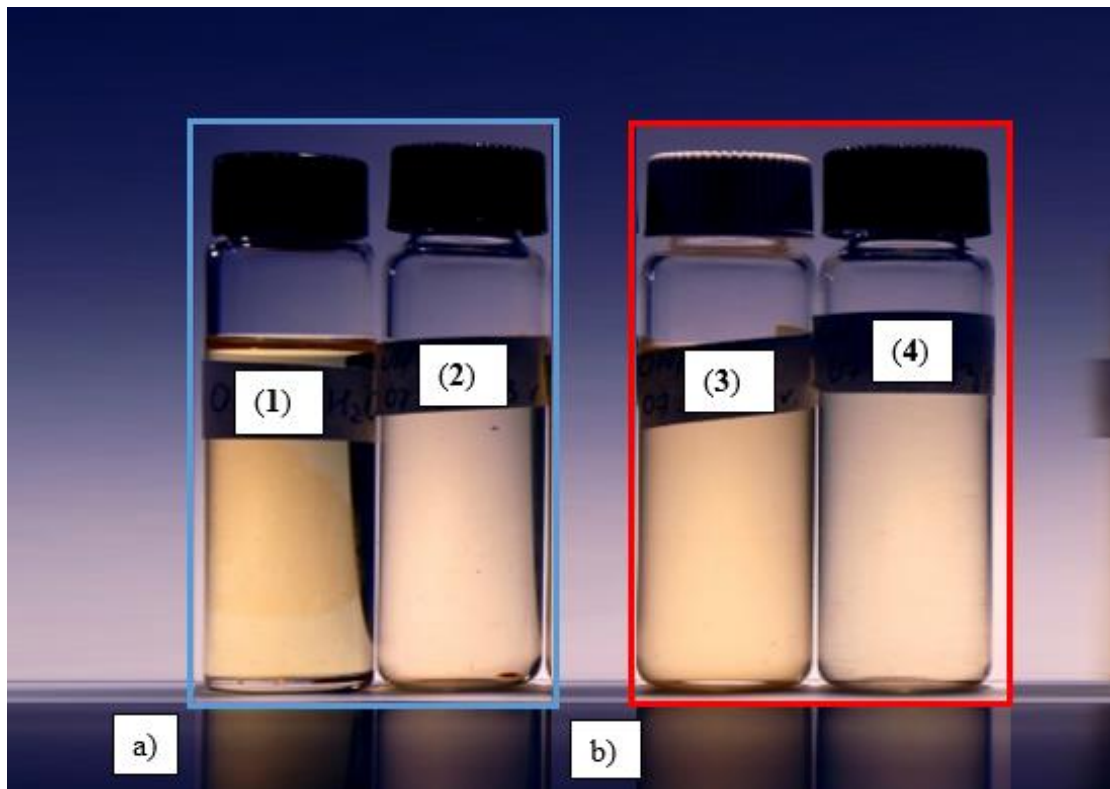


Figure 2. Samples of stored diesel fuel (1) and (3) and unleaded petrol (2) and (4) with different quality parameters (a) samples after 2 months of storage (b) samples after 4 months of storage.

Slightly subtle changes take place in gasoline. During the four-month study, no color changes were observed. The observed changes in the test relate only to the clarity of the fuel. Sample 4 is cloudier compared to the starting material. Although the change is not as characteristic as in the case of the tested diesel fuel, it undoubtedly indicates the beginning of degradation processes in the fuel.

The obtained test results and their analysis allow to clearly state that there is a relationship between the intensity of light falling on the fuel sample, the amount of light intensity passing through the material and the quality of the fuel, its degree of degradation as a result of the aging processes taking place in it. The observed differences in the color and turbidity of liquids between the original and stored samples result from both changes in the chemical structure of the tested liquids and the laws of physics. First of all, it should be noted that the light falling on

the material sample interacts with it. Molecules have different types of energies, m.in kinetic, rotational, oscillatory and electron. Kinetic energy – called translational energy is related to the free movement of the molecule in gases and liquids, while in solids it is the energy of vibration in the crystal lattice. A slow-moving molecule can perform rotational motions, which is a rotational component. On the other hand, the oscillatory part is related to the mutual attraction and repulsion between the atoms of a given molecule. Electron energy is due to the electronic and nuclear structure of the molecule. Atoms combining into molecules lower the total energy of the system. The reduction of this energy depends on the type of bond formed, the distance between the nuclei of atoms, and the degree of electron relocation. A molecule can change its rotational, oscillatory or electronic energy only in certain portions characteristic of its structure – called quanta, which is the basis of spectroscopy. The energy of photons of optical radiation depending on the wavelength is determined with the equation (Cygański, 1993; Paszyc, 1983):

$$E = h\nu = hc / \lambda \quad (1)$$

where:

$h = 6.6256 \cdot 10^{-34}$ [J*s] – means Planck's constant.

ν – frequency of light wave.

$c = 2.9979 \cdot 10^8$ [m/s] – the speed of light in a vacuum.

λ – wavelength of radiation.

Thus, light carries different portions of energy depending on the wavelength. The transition of electrons between individual energy levels requires a strictly defined portion of energy. Infrared radiation is too low energy and does not induce any change in electronic energy. Radiation from the visible range is able to cause 3D- >4p transitions and such photons will absorb atoms. Further passages require radiation in the far UV range, or X-rays. Electron transitions between molecular orbitals in molecules require ultraviolet photon energy, which is used in absorption spectroscopy and photochemistry of organic compounds. Infrared radiation is sufficient to induce oscillatory and rotational transitions (Cygański, 1993; Paszyc, 1983).

On this basis, it should be concluded that light passing through the sample changes its intensity as a result of interaction with it. Samples of the same fuel, with a different degree of material degradation, are characterized by a different concentration of undesirable components (e.g. resins, microorganisms, etc.), which constitute an additional barrier to the light wave. Hence, it should be concluded that the observed subtle differences between the tested materials are related, m.in, to the intensity of the incident light and the light passing through the sample. According to the literature data, the ratio of the passing intensity I to the incident intensity I_0 is called the transmittance T :

$$T = I/I_0 \quad (3)$$

On the other hand, the absorbance A of the sample is defined as:

$$A = \log(1/T) = \log(I_0/I) \quad (4)$$

The Lambert-Beer law determines the relationship between the change in the intensity of radiation passing through the tested sample, by optical route, and the concentration of absorption centers:

$$\log(I_0/I) = e \cdot c \cdot l \quad (5)$$

where:

I_0 – intensity of incident radiation.

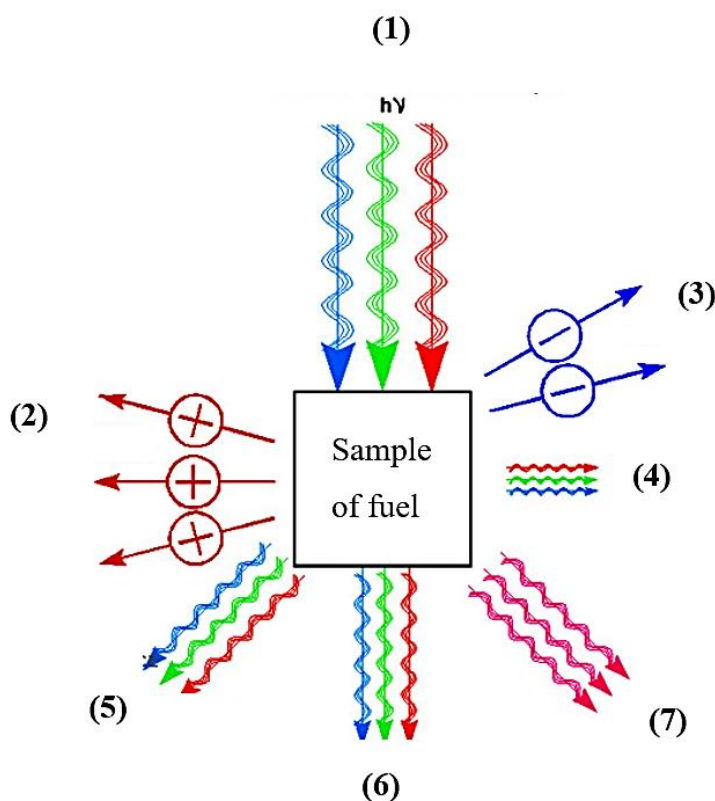
I – the incoming current after passing through the sample.

e – proportionality constant [$l \cdot \text{mol}^{-1} \cdot \text{cm}^{-1}$].

c – concentration of the substance in the solution.

L – optical path [cm].

Based on the above formulas, the observed differences between the samples with the tested fuels can be explained by the mechanism of interaction of light (waves coming from the illumination source of the sample – Figure 3) with the test material placed in the sample, according to Figure 2.



- (1) - incident radiation
- (2) - positive ion emission, MSI mass spectroscopy
- (3) - Electron emission, photoelectron spectroscopy
- (4) - scattered radiation and Raman spectroscopy
- (5) - transmitted radiation with changed polarization, optical rotation dispersion
- (6) - transmitted radiation, UV-VIS absorption spectroscopy, IR, MW, EPR spectroscopy, NMR
- (7) - emission of radiation other than excitation radiation, UV/VIS spectrofluorometric

Figure 3. Mechanisms of light-sample interaction.

Source: own study.

Therefore, it should be concluded that the selection of the right light source, its power and intensity, as well as proper measurements of the intensity of light passing through the tested fuel sample may enable observations to be made, giving the basis for conclusions about the occurring stages of fuel aging. The results of the research indicate that it is possible to develop fuel quality monitoring based on the methods of well-known analytical techniques involving the generation and interpretation of spectra, e.g. spectrophotometry, in order to identify undesirable components in the fuel, e.g. the presence of resins in oils. The interpretation of the research results enabled a qualitative analysis of the fuels, providing the basis for conclusions about the degradation processes taking place in them.

4. Summary and Conclusion

On the basis of the results of the tests presented in Figure 1-2 and their detailed analysis, taking into account the mechanisms of light interaction with the samples, it can be concluded that:

1. light passing through the sample changes its intensity as a result of interaction with it,
2. the amount of radiation passing through the sample depends on its physic-chemical parameters,
3. samples of the same materials, after a different storage time, showed a change in color, so the light reacting with the medium through which it passes changes depending on the mechanisms and processes occurring in the samples during their storage.

On the basis of the results obtained, it can be concluded that it is possible to develop a new method of fuel quality control using spectrometric methods. Due to the fact that the intensity and colour of light changed both when testing samples of different types of fuels and materials after different storage times. It cannot be stated unequivocally that it will be possible to set specific parameters specified in the standards. The obtained results and the recorded changes between the samples of the "fresh" starting fuel and after several months of storage indicate that the observed changes can be related to the ageing processes occurring in the fuel determining the functional properties of the fuels. Therefore, it can be concluded that spectroscopic methods can be used to apply simplified methods for the assessment of the functional quality of fuels.

Acknowledgement

Article is a part of 12/010/BK24/1151 project.

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POLITICAL AND ECONOMIC RATIONALE FOR THE DEVELOPMENT OF RENEWABLE ENERGY IN EUROPEAN UNION COUNTRIES

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Purpose: There are two factors related to the implementation of the Green Deal. The first relates to economic issues and depends on economic development. The second is related to political actions. The aim of this article is to analyze the impact of political and economic factors on the renewable energy sector. Assuming the idea of common priorities in the EU, it can be hypothesized that the action programs for renewable energy implemented by the EU should enable countries to accelerate their efforts to develop this sector of the economy.

Design/methodology/approach: Firstly, k-means analysis will be employed to cluster EU countries based on whether they would achieve the declared target of a 20% share of renewable energy in gross final energy consumption. Secondly, the application of k-means will facilitate the division of countries into groups based on their economic affluence, distinguishing them between richer and poorer nations. Next, the study will utilize the ANOVA, which help determine if the actions carried out by the EU are sufficient to achieve the increasing share of renewable energy. It will consider the diversity of countries in terms of economic and political factors.

Findings: The first hypothesis, regarding the significance of the political factor, was successfully confirmed. The analysis conducted revealed that EU countries vary in their implementation of the EU renewable energy objectives. The second hypothesis regarding the significance of the economic factor has been dismissed. It was not confirmed that the degree of economic development has an impact on the growth of the renewable energy sector.

Originality/value: It can be assumed that all EU countries would support the policy toward the growth of renewable energy. While various factors play a crucial role in shaping the renewable energy market, it is difficult to find an analysis that explains the lack of significant progress in this sector of the economy.

Keywords: renewable energy; economic factors; political factors; Green Deal; European Union; investments.

Category of the paper: Research paper.

1. Introduction

Development of the renewable energy sector requires investments that will yield a profit on the incurred expenditure and additional benefits in the long term. It is widely accepted that investments in this branch of the economy have a multifaceted impact on the environment, the economy, the development of technological innovations, energy independence, and public health (Krozer, 2013, pp. 68-73; Omer, 2012, pp. 561-576). It can be assumed that as long as technology advances and investments develop, the costs of implementation of renewable energy infrastructure will tend to decrease. In addition, these investments may further increase the attractiveness of the venture for both individual and organized consumers (Reuter et al., 2012, pp. 249-254).

Although investment in the renewable energy market seems to be economically valuable, should we consider political factors? According to Wüstenhagen and Menichetti “policy has not only created opportunities, but also posed risks for renewable energy investors” (Wüstenhagen, Menichetti, 2012, p. 1). They note that political factors can influence the renewable energy market. One has to agree with them because it is not a fully free market and there are no free competition rules, e.g. due to technological issues or monopolies.

It seems obvious that the EU member states have recognized the importance of the development of the renewable energy branch, driven by concerns about the scarcity of traditional energy sources as well as environmental challenges at the beginning of the 21st Century. That is why it can be assumed that all EU countries would support the policy toward the growth of renewable energy. While various factors play a crucial role in shaping the renewable energy market, it is difficult to find an analysis that explains the lack of significant progress in this sector of the economy, particularly in terms of achieving the EU goals in this field.

In the available literature, numerous papers address issues related to renewable energy, due to the importance of research in the area of sustainable development, as well as practical implications for the EU’s Green Economy goals.

The primary literature on renewable energy covers technological issues (Turkenburg, Faaij, 2000, pp. 219-272), trends (Bull, 2001, pp. 1216-1226; Gross et al., 2003, pp. 105-122), analyses of renewable energy sources (Twidell, 2021), energy storage (Amrouche et al., 2016, pp. 20914-20927) and many others. Interesting considerations are pursued by Lund, who points out that the plans for the development of the renewable energy sector must encompass strategies for integrating renewable sources into coherent energy systems, with a focus on energy savings and energy efficiency. Using Denmark as an example, the author discusses the challenges and prospects of transforming traditional energy systems into ones that rely on 100% renewable energy sources. He demonstrates that there are no barriers that could prevent energy transformation (Lund, 2007, pp. 912-919).

Dincer stresses that the use of renewable energy sources is one of the most efficient and effective solutions for achieving sustainable goals (Dincer, 2000, pp. 157-175). He mentions that the development of this sector is determined by political factors. On the other hand, in his article “Renewable energy, non-renewable energy and sustainable development”, Güney compares the impact of renewable and non-renewable sources on sustainable development. He observes that renewable energy positively affects both highly developed and developing countries (Güney, 2019, pp. 389-397). This perspective prompts a closer examination of the economic factors that can significantly influence the development of the renewable energy sector.

Many authors also study the impact of renewable energy on sustainable development in individual countries. These papers encompass not only the European market, which is considered the most developed area in available literature (Jagerwaldau, 2007, pp. 1414-1437), but also other countries such as Tanzania (Bishoge et al., 2018, pp. 70-88), India (Naidu, 1996, pp. 575-581), Iran (Rezaei et al., 2013, pp. 320-329), Bangladesh (Ahmed et al., 2014, pp. 223-235), and many others. Besides this field of research, the analysis examines the impact of renewable energy on various economic sectors. For instance, Chel and Kaushik analyze the issues of renewable energy’s impact on sustainable agriculture (Chel, Kaushik, 2011, pp. 91-118) and the construction industry (Chel, Kaushik, 2018, pp. 655-669). Meanwhile, Liczmańska-Kopcewicz and others examine the food market in terms of utilizing renewable energy (Liczmańska-Kopcewicz et al., 2020, pp. 1-20). Green brands play a significant role in this context. The effectiveness of green brands depends on the use of, among other things, renewable energy (Lyeonov et al., 2019; Us et al., 2023; Xin, Long, 2023, pp. 531-538).

The indicated literature demonstrates the multidimensionality of renewable energy management. As shown above, authors from various disciplines highlight different aspects or perspectives of renewable energy management. However, renewable energy studies often do not pay particular attention to the political and economic rationale that determines the effectiveness of its development. What factors determine the growth of the renewable energy sector in EU countries? The available literature does not provide a clear answer to this question.

The aim of this article is to analyze the impact of political and economic factors on the renewable energy sector. Assuming the idea of subsidiarity as one of the overriding priorities for the functioning of the EU, it can be hypothesized that the action programs for renewable energy, implemented by the EU, should contribute to the acceleration of efforts to develop this branch of the economy in the EU.

The article consists of three parts, which will successively analyze the influence of correlation between CO₂ emissions and the percentage of renewable energy in final consumption, and then the political and economic factors on the development of the renewable energy sector. Using the division into two groups of countries, the research will enable an analysis of the relationship between the dependent variable:

Y – share of renewable energy in gross final energy consumption by sector;
and the independent variables:

X₁ – declaration of achieving the renewable energy target in 2020;

X₂ – Gross Domestic Product per capita.

Firstly, k-means analysis will be employed to cluster EU countries based on whether they would achieve the declared target of a 20% share of renewable energy in gross final energy consumption. Secondly, the application of k-means will facilitate the division of countries into groups based on their economic affluence, distinguishing them between richer and poorer nations.

Two specific questions will be posed in the article:

- 1) Is there differentiation among individual groups of countries in terms of share of renewable energy in gross final energy consumption due to the declaration of meeting the EU's goals?
- 2) Is there differentiation among individual groups of EU countries in terms of the share of renewable energy in gross final energy consumption based on their level of affluence?

The study will utilize the ANOVA (Analysis of Variance) method, with the following null hypothesis (H₀):

H₀ - There is no differentiation in terms of share of renewable energy in gross final energy consumption among groups of countries due to political declaration and economic development.

Alternative hypothesis:

H₁ - There is differentiation in terms of share of renewable energy in gross final energy consumption among groups of countries due to political declaration and economic development.

The analysis will help determine whether the actions carried out by the EU are sufficient to achieve the increasing share of renewable energy. It will consider the diversity of countries in terms of economic and political factors.

2. Factors shaping the renewable energy market in the EU

The European Union sets ambitious goals related to environmental protection and combating climate change through its strategy known as the Green Deal. In this strategy, the EU assumes that renewable energy is a key tool that will lead to the achievement of the “zero-emission economy” goal by 2050 and a reduction of up to 55% in CO₂ emissions into the atmosphere by 2030 (European Commission, 2019). Such EU policy is paramount because the EU's member states depend on energy supplies (Poiană et al., 2017, pp. 175-189). Therefore, the governments of the EU's member states should bear in mind that without their energy

resources, they will remain consistently dependent on imports. Russia's invasion of Ukraine has shown that the most strategic goal for European countries should be to increase their independence from Russia, both for humanitarian and economic reasons. It is related to avoiding collaboration with an unstable and irresponsible state, such as Russia has proven to be (Krzykowski, 2022, pp. 93-113; Kuczyńska-Zonik, Sierzputowska, 2023; Tokarski, 2022, pp. 10-16).

The relationship between renewable energy and CO₂ emissions is one of the central aspects of endeavours to mitigate climate change, which is why numerous studies have examined this dependency, pointing out the positive correlation between increasing renewable energy and decreasing CO₂ emissions (Apergis et al., 2010, pp. 2255-2260; Irandoust, 2016, pp. 118-125; Saidi, Mbarek, 2016, pp. 364-374). In the available literature, the results of research in which the authors show the negative impact on these variables can also be found (Jebli, Youssef, 2015, pp. 173-185). On the other hand, Menyah underlined that "renewable energy has not reached a level where it can make a significant contribution to emissions reduction" (Menyah, Wolde-Rufael, 2010, pp. 2911-2915).

In the context of "The Green Deal", renewable energy sources such as solar, wind, hydroelectric, and geothermal power have a pivotal impact on the EU's goals. Fig. 1 presents a comparison between CO₂ emissions and renewable energy usage between 2004 and 2021 in the EU (27).

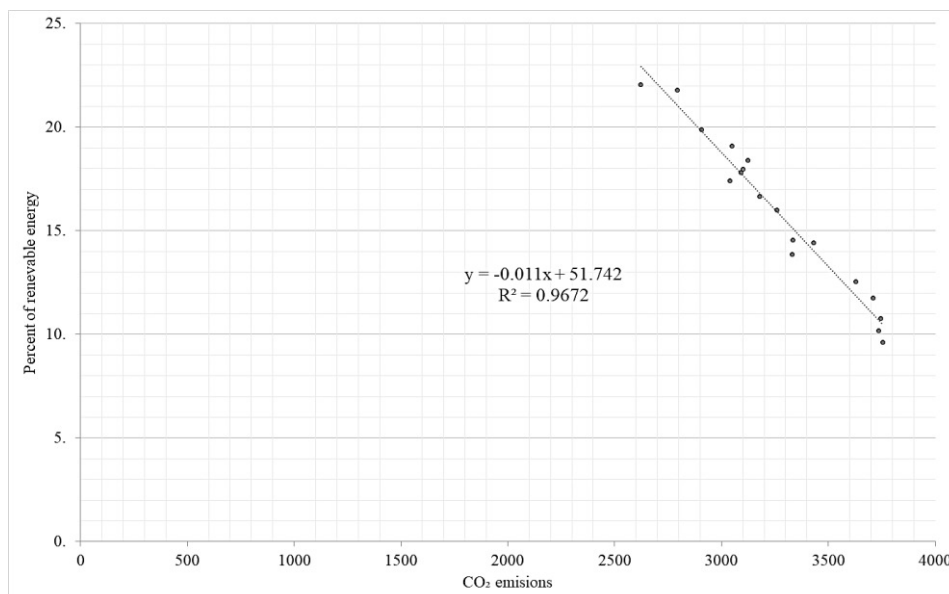


Figure 1. Correlation between CO₂ emissions and percentage of renewable energy in final consumption.

Source: Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; CO₂ emissions, <https://ourworldindata.org/co2-and-greenhouse-gas-emissions>.

It is widely accepted that the EU has made significant efforts to reduce its carbon dioxide emissions and increase renewable energy sources worldwide. As shown in Fig. 1, the EU's commitment to renewable energy plays a critical role in reducing CO₂ emissions within the

region. The dependency between renewable energy and CO₂ emissions in the EU is evident in the progress made towards achieving its climate goals and transitioning to a low-carbon, sustainable energy system. The correlation between variables is significant, since it amounts to -0.98%. The EU has made progress in reducing CO₂ emissions from the highest amount of 3,755 Mt in 2004 to 2,793 Mt in 2021. The trend seems to have been steadily decreasing since then. At the same time, renewable energy in gross final consumption has increased from about 10% to more than 20%. The Union barely achieved its objectives, making it challenging to claim significant progress, especially given that it only aimed for a 10% increase between 2009 and 2020, and the goal has now risen to 45%. Additionally, the success of the EU as a whole organisation cannot be attributed to the success of individual member states belonging to the organisation. Fig. 2 illustrates CO₂ emissions gap by country between 2009 and 2020.

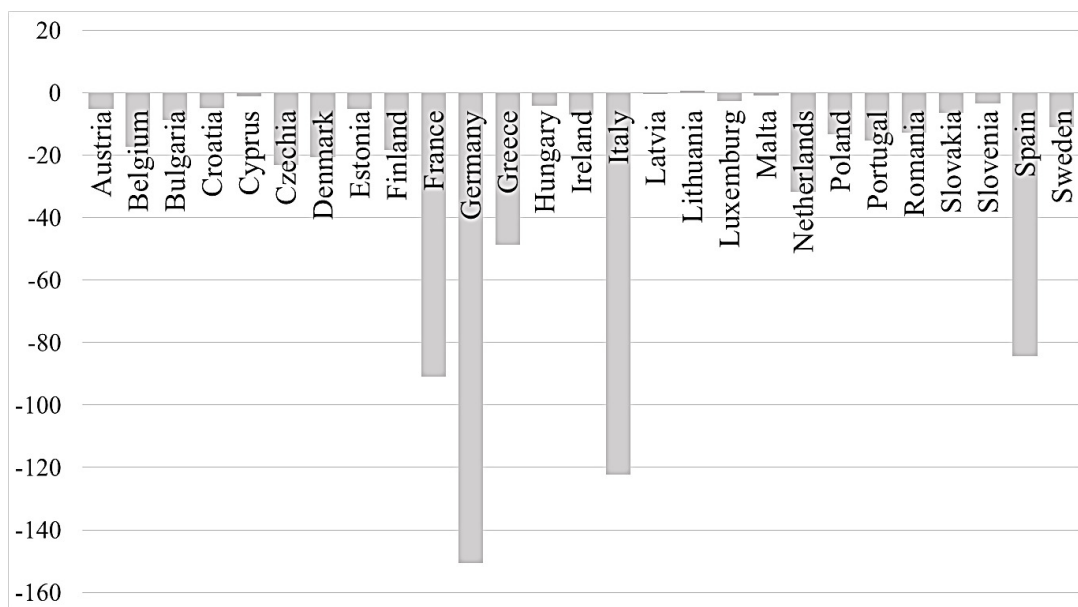


Figure 2. CO₂ emissions gap by country between 2009 and 2020.

Source: *Data on CO₂ and Greenhouse Gas Emissions by Our World in Data*, <https://github.com/owid/co2-data>.

Only four countries visibly reduced their CO₂ emissions over the period, while Poland and Lithuania slightly increased them. Among the countries making relevant progress were Germany, France, Italy and Spain. The graph shows significant differences between countries in terms of CO₂ reductions. This means that, despite a common target, there are features that determine the effectiveness of measures in the area under consideration.

Two factors can be distinguished: political and economic, which are related to the implementation of the Green Deal. Czarny indicated that it is difficult to determine whether decisions made by specific countries are of an exclusively political or economic nature (Czarny, 2018). The first one is directly related to political actions. Here, the response of the countries to the challenge of increasing the share of renewable energy in the energy mix is a major step towards the EU's environmental goals. The lack of appropriate policies could undermine the European concept and reduce the countries' energy security. The second factor relates to

economic issues and depends on economic development. From this perspective, investments in renewable energy can play a crucial role in building a sustainable future for the EU's population. However, they require financial outlays and appropriate policy decisions by Member States to respond to the challenges of the Green Deal. These are dependent on many factors, such as the type of renewable energy, scale of the projects, locations, technology, investment, and operating costs, as well as the country's energy policy.

3. Political factors

In United Europe is a community of values, shared history, culture, and principles. Based on this, countries chart their common path of development. Thus, it is worth examining whether the political factors influence the shaping of the renewable energy growth in the EU countries. Gross perceives that “governments around the world are placing considerable faith in renewable energy as important technologies for reducing energy related environmental problems, particularly CO₂ emissions” (Gross et al., 2003, p. 105). Encouraging the development of the renewable energy market requires a combination of instruments and policies in every EU country, which can play a crucial role in promoting renewable energy adoption. Lu describes three important sustainable energy policies, i.e., Energy-Efficiency Standard (EES), Feed-In-Tariff (FiT), and Building Energy Performance Certification (BEPC) Schemes (Lu et al., 2020). For instance, governments could guarantee feed-in-tariffs above market rates for renewable energy producers, providing a stable income stream and incentives investment in renewable energy projects. Additionally, renewable portfolio standards or tax incentives encourage investors to engage in these types of projects.

These policies vary from one country to another and depend on political regimes, political conditions, and the benefits of political parties, making them subject to change over time. Several empirical studies conclude that governments need to increase the adoption rate of renewable energy and promote effective policy incentives and policy controls to reduce prevalent CO₂ emissions in their countries and regions (Qudrat-Ullah, 2013).

Also, at the EU level, common actions towards the development of renewable energy usage should be promoted. In 2009, EU leaders set a target that 20% of energy consumption in the EU countries should come from renewable energy sources by 2020 (The European Parliament and the Council of the European Union, 2009). Although it had not been achieved by many countries, a new, higher target was set in 2018. At that time, EU countries agreed that 32% of energy consumption would need to come from renewable sources by 2030 (The European Parliament and the Council of the European Union, 2018). The European Parliament directive aimed to maintain global leadership in emissions reductions resulting from the Paris Agreement (UNFCCC, 2016). Three years later, the target was revised again, and in July 2021, in view of

the EU's new climate ambitions, the goal was proposed to be changed to 40% (The European Parliament and the Council of the European Union, 2021). These were not the final solutions that were decided in the EU renewable energy forum. The energy crisis, which was the result of Russia's invasion of Ukraine, contributed to negotiating an initial agreement in March 2023. The document on the binding EU renewable energy target for 2030 sets a new goal of at least 42.5% of renewable energy in gross final energy consumption, with a view to reaching 45%. The target has more than doubled compared to 2020 (European Commission, 2022).

It should be noted that in 2009, when the European Union set the 20% renewable energy goal, each EU country declared how it intended to achieve its individual targets and developed a renewable energy action plan. Not all countries declared their intention to achieve a 20% share of renewable energy in gross final energy consumption. The table below shows the breakdown of countries into two groups based on the EU's target of achieving a 20% share of renewable energy in gross final energy consumption.

Table 1.

Division of countries in terms of meeting the 20% target for the share of renewable energy in final energy consumption

First group – countries that declared achieving 20% renewable energy in gross final consumption	Second group – countries that did not declare achieving 20% renewable energy in gross final consumption
Sweden	Germany
Finland	Slovakia
Latvia	Czechia
Austria	Cyprus
Portugal	Ireland
Denmark	Poland
Croatia	Netherlands
Estonia	Hungary
Lithuania	Belgium
Slovenia	Luxemburg
Romania	Malta
Bulgaria	
Greece	
Spain	
Italy	
France	

Source: Eurostat, EU overachieves 2020 renewable energy target, 19.01.2022, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220119-1>.

The first group of countries includes those that declared reaching the 20% target by 2020. The second group includes those that declared a smaller target than a 20% share of renewable energy in final energy consumption. Among EU Member States, only France failed to meet its target and did not achieve the 20% share of renewable energy required by the EU. Eleven countries did not declare the level of renewable energy indicated by the EU. The EU as a whole succeeded in meeting its goals. This was possible because many countries had declared and invested in the development of the renewable energy sector much more than the required 20%. Notable among these is Sweden, which has a share of over 60% of renewable

energy in gross final energy consumption. Finland and Latvia also achieved very good outcomes (over 40%). The statistical analysis results across the groups of countries surveyed are presented in tab. 2.

Table 2.

Division of countries in terms of meeting the 20% target for the share of renewable energy in final energy consumption

Group	n	Mean	Sd	Median	Min	Max	skew	kurtosis
First - yes	11	35.19	11.87	34.72	19.34	62.57	0.78	0.03
Second - no	16	17.18	4.95	17.21	11.73	31.33	1.25	1.52

Sources: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, EU overachieves 2020 renewable energy target, 19.01.2022, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220119-1>

The averages within the groups differ significantly. In the first group, declaring a desire to achieve a minimum of 20% renewable energy in final energy consumption, the average was 35.19%, while in the group declaring lower targets, the average was only 17.18%. The difference between them is double. When analysing the basic statistics, a very high standard deviation (Sd) is shown in the first group, which may indicate a lack of intergroup variation. Kurtosis (kurtosis) and skewness (skew) are not questionable. It is therefore worth analysing the box plots for the presence of outliers that affect the quality of the ANOVA analysis. Below is a box plot showing the percentage share of renewable energy in gross final energy consumption due to the policy pledge.

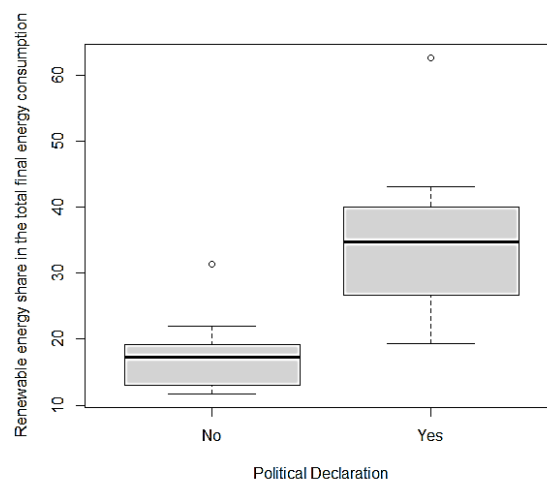


Figure 3. Box plot of percent of renewable energy in gross final consumption due to the policy pledge.

Source: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, EU overachieves 2020 renewable energy target, 19.01.2022, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220119-1>.

The first outlier is noticeable in the graph, pertaining to Lithuania. Although Lithuania did not declare a minimum 20% share of renewable energy in gross final energy consumption in 2009, it succeeded in meeting its targets and even exceeded the EU's indications by 10%.

Interestingly, it is the only country that has achieved such good results despite the lack of a political declaration. It is worth noting that Lithuania is one of the three Baltic states that declare a common Baltic identity with Latvia and Estonia, and one of the communities of the Baltic Sea Region prioritising sustainable development goals. Sweden, Denmark, and Finland are also part of the Baltic Sea Region (Tomala, 2020). The Nordics were mentioned in the first group, as they declared their commitment to meet the EU's renewable energy targets. The second outlier relates to Sweden, which has achieved the best result (62.6%). Sweden is one of the leaders in the EU when it comes to environmental goals, which is why it has achieved the high value of renewable energy in gross final consumption. Other countries within the Baltic Sea Region, such as Poland and Germany, did not achieve results similar to Lithuania.

The assumptions for the ANOVA test in the evaluated example were not confirmed. The results for tests of normality of distribution and homogeneity of variance are shown below.

Table 3.

The assumption for the ANOVA test

Normality test p-value > 0.05	Shapiro-Wilk	Lilliefors (Kolmogorov-Smirnov)	Anderson-Darling
First group - yes	0.367	0.5819	0.4381
Second group - no	0.02151	0.3682	0.09199
Homogeneity of variance	Bartlett test for homogeneity of variances	Levene's Test for Homogeneity of Variance (centre = median: median)	Levene's Test for Homogeneity of Variance (centre = median: mean)
p-value>0.05	0.003083	0.0395	0.0395

Source: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, EU overachieves 2020 renewable energy target, 19.01.2022, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220119-1>

Tests of normal distribution have been performed using three methods. Two of them have confirmed the presence of a normal distribution in both groups. Only the Shapiro-Wilk test in the first group has not confirmed the normality of the distribution (p-value < 0.05). However, none of the three tests for the homogeneity of variance have positively verified the condition for ANOVA (p-value < 0.05). Therefore, a non-parametric Kruskal-Wallis test has been applied to verify whether there is variation regarding the share of renewable energy in gross final energy consumption between groups of countries in terms of political declaration.

The result (p-value = 5.201e-05) is less than 0.05, indicating that the hypothesis H0 should be rejected. There is an inter-group variation between the first and the second group, which measures the share of renewable energy in gross final energy consumption due to the political declaration. Additionally, a post-hoc Dunn test shows that there is a statistically significant difference between the group declaring a 20% or higher share of renewable energy and the group declaring a lower share of renewable energy with 95% confidence.

It can be inferred that a country's appropriate policies affect the efficiency of implemented measures, which leads to the progress of the renewable energy market in countries striving to achieve EU targets. The energy policies of the Nordic countries offer best solutions to this phenomenon. As frontrunners, they employ multiple sustainable energy and climate-related approaches. This signifies that other entities operating in the European market can adopt their management tools and benefit from their experience. It is important to recognize the significance of scientific studies and reports, such as *Towards Enhanced Climate Change Adaptation in the Nordic Region*, in developing recommendations for appropriate actions (Gram-Hanssen et al., 2023). These include synchronising actions at different levels, implementing well-chosen strategies and priorities, aligning climate action, and more.

4. Economic factors

The According to Solaymani "The close and high relationship between production growth and energy consumption growth in the economy refers to the dependence of the economy on energy. Thus, the economy is not only sensitive to energy supply and price shocks, but any initiative to conserve energy can have an impact on the performance of the economy" (Solaymani, 2021).

In 2019, the European Union prioritised achieving climate neutrality by 2050 through the establishment of a renewable energy sector and enhancing energy efficiency (European Commission, 2019). Implementing the Green Deal requires reducing dependence on other countries' energy resources and meeting sustainable development goals. As emphasized by Bórawski et al., renewable energy sources play a significant role in reducing carbon dioxide emissions and pollution (Bórawski et al., 2022, p. 1; Solaun, Cerdá, 2019, p. 1). These socio-political benefits are crucial, but they have required financial investments, which could be a barrier to developing the renewable energy sector for poorer countries. The European Commission recognizes this problem; hence the Fund for Just Transition was established in the EU regulation from 24 June 2021. "It provides support to all Member States. The allocation criteria were based on industrial emissions in carbon-intensive regions, on industrial employment and the extraction of coal and lignite, peat and oil shale production, and on the level of economic development" (The European Parliament and the Council of the European Union, 2021). Is it possible to differentiate countries according to their level of economic development in order to achieve green energy goals? The answer to this question is not straightforward. On the one hand, it can be hypothesized that due to the uneven economic development of European Union countries, richer countries are more effective in implementing investments in the renewable energy sector. On the other hand, taking into account the EU's

aid, European countries should have similar conditions for implementing the green energy strategy.

The first step in the analysis was the grouping of countries by their level of economic development. The diagram below shows a box plot of the GDP per capita for EU countries in 2021.

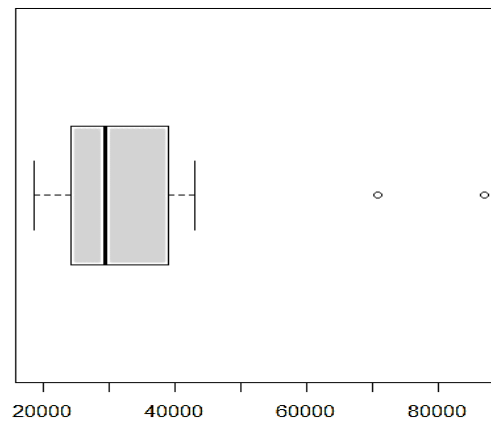


Figure 4. Boxplot of GDP per capita in the EU countries in 2021.

Source: Eurostat, Purchasing power adjusted GDP per capita, https://ec.europa.eu/eurostat/databrowser/view/SDG_10_10/default/table?lang=en&category=sdg.sdg_10.

Two anomalies are noticeable in Fig. 4 concerning Luxembourg and Ireland, whose GDP per capita varies significantly from the rest of the European countries. Since the ANOVA method is sensitive to outliers and based on its assumptions, these countries have been excluded from further analysis.

In the subsequent stage, the EU countries were categorized into two clusters by using the k-means analytical technique. The findings of the analysis are presented below. This method allows for grouping countries into two clusters, with the data in one cluster having a maximum level of similarity and data between clusters having a minimum similarity (Bishop, 1995; Duda, Hart, 1973).

Table 4.
Groups of countries according to GDP per capita

Group	Country	X1	Y
First group Reacher countries	Belgium	39000	13.014
	Denmark	43000	34.715
	Germany	39000	19.168
	France	33800	19.342
	Malta	32400	12.154
	Netherlands	42100	13.003
	Austria	39800	36.445
	Finland	36400	43.096
	Sweden	39800	62.573

Cont. table 4.

Second group Poorer countries	Bulgaria	18600	17.015
	Czechia	29700	17.667
	Estonia	28800	38.010
	Greece	20700	21.928
	Spain	27000	20.729
	Croatia	22600	31.329
	Italy	30900	19.034
	Cyprus	29400	18.419
	Latvia	23300	42.107
	Lithuania	29000	28.230
	Hungary	24300	14.115
	Poland	25000	15.624
	Portugal	24300	33.982
	Romania	23900	23.596
	Slovenia	29200	25.000
	Slovakia	22500	17.412
Outliers	Luxemburg	87100	11.735
	Ireland	70900	12.546

Sources: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, Purchasing power adjusted GDP per capita, https://ec.europa.eu/eurostat/databrowser/view/SDG_10_10/default/table?lang=en&category=sdg.sdg_10

The group of wealthier nations comprises 9 countries that are highly developed. Conversely, the group of less affluent countries comprises 16 nations. Simple statistics were examined for each distinct group regarding the share of renewable energy in gross final energy consumption. The findings of the study are outlined below.

Table 5

Share of renewable energy in gross final energy consumption by sector by groups of countries

Group	n	Mean	Sd	Median	Min	Max	skew	kurtosis
First	9	28.17	17.29	19.34	12.15	62.57	0.7	-0.96
Second	16	24.01	8.44	21.33	14.12	42.11	0.76	-0.77

Sources: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, Purchasing power adjusted GDP per capita, https://ec.europa.eu/eurostat/databrowser/view/SDG_10_10/default/table?lang=en&category=sdg.sdg_10

The averages between the groups exhibit differences, with the group of wealthier countries presenting a comparatively higher share of renewable energy by 4%. However, the averages across both groups are substantially low and do not suffice the target of 45% renewable energy proportion in gross final energy consumption by 2030 and 55% by 2050. Kurtosis and skewness present no objections, whilst the standard deviation value of the wealthier group is twice that of the poorer group and may hint at the lack of intergroup differentiation. It is worth noting that in the first group of more affluent countries, a smaller minimum of renewable energy within their gross final energy consumption can be observed. Luxembourg, Malta, Belgium, Netherlands, and Ireland possess the lowest percentage of renewable energy besides their high level of GDP per capita. However, Sweden is the undisputed EU leader with a remarkable 62.57% renewable energy share. Poorer nations, such as Estonia, Latvia, and Portugal, also exhibit positive outcomes.

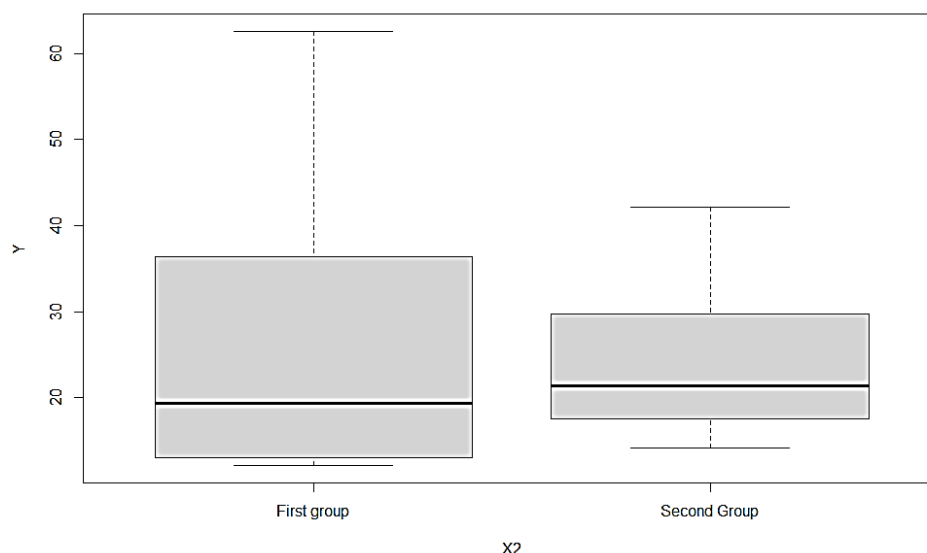


Figure 5. Renewable energy share in the total final energy consumption by group of countries.

Source: Eurostat, Purchasing power adjusted GDP per capita, https://ec.europa.eu/eurostat/databrowser/view/SDG_10_10/default/table?lang=en&category=sdg.sdg_10

In order to perform an ANOVA test, it is necessary to check the assumptions of normal distribution and homogeneity of variance. Tab 6 shows the results of conditions for ANOVA analysis.

Table 6

The assumption for the ANOVA test

Normality test p-value>0.05	Shapiro-Wilk	Lilliefors (Kolmogorov-Smirnov)	Anderson-Darling
First group	0.1155	0.1057	0.1387
Second group	0.07746	0.334	0.007888
Homogeneity of variance	Bartlett test for homogeneity of variances	Levene's Test for Homogeneity of Variance (centre = median: median)	Levene's Test for Homogeneity of Variance (centre = median: mean)
p-value>0.05	0.01943	0.1283	0.1283

Source: Eurostat, Share of renewable energy in gross final energy consumption by sector, https://ec.europa.eu/eurostat/databrowser/view/SDG_07_40/default/table?lang=en; Eurostat, Purchasing power adjusted GDP per capita, https://ec.europa.eu/eurostat/databrowser/view/SDG_10_10/default/table?lang=en&category=sdg.sdg_10

The analysed data are normally distributed both in the first group (p-value > 0.05) and the second one (p-value > 0.05). Bartlett's test negatively indicated the lack of homogeneity of variance (p-value = 0.01943), while two other tests: the Leven test for the median (p-value = 0.0959) and the Leven test for the mean (p-value = 0.0959) responded positively to the conditions of the ANOVA analysis. Hypothesis H₀ of ANOVA was confirmed (p-value = 0.424). This means that there is no variation in the share of renewable energy in gross final energy consumption due to GDP per capita. The above analysis shows that the economic factor does not play a significant role in the development of the renewable energy industry.

5. Conclusions

The development of the renewable energy market in EU countries is driven by a commitment to combat climate change, reduce greenhouse gas emissions, and create a more sustainable energy system. The article has demonstrated that renewable energy capacity has been increasing over the years. Member states have invested in renewable energy infrastructure, resulting in a diversified energy mix. Thanks to the development of the renewable energy market, it has been possible to reduce greenhouse gas emission. Renewable energy sources have played a crucial role in reducing greenhouse gas emissions in the EU. Consequently, by relying less on imported fossil fuels, the EU could improve its energy security and reduced exposure to price volatility in global energy markets.

The effectiveness of developing renewable energy in the EU has been a subject of significant attention and debate. This article aimed to verify two hypotheses concerning the factors that influence the renewable energy market's development.

The first hypothesis, regarding the significance of the political factor, was successfully confirmed. The analysis conducted revealed that EU countries vary in their implementation of the EU renewable energy objectives. Therefore, their political targets diverge from those set at the EU level. It is noteworthy that the 2009 political declaration did not specify the same level of effort required from countries, as compared to the 2022 targets. Nations that were part of the first group and accepted the EU's renewable energy market challenge have an easier task at hand as compared to those who failed to achieve the 20% level by 2020. With the exception of France, most of the countries were able to meet the declared targets, but they were below the EU target. However, the current target has been set much higher, making it challenging for political opportunists to meet the EU's targets in the years ahead. Supplementary policy measures are necessary to facilitate the shift from conventional systems to sustainable energy sources.

The second hypothesis regarding the significance of the economic factor has been dismissed. Unless marked as such, subjective evaluations must be excluded. It was not confirmed that the degree of economic development has an impact on the growth of the renewable energy sector. Therefore, even countries with a lower level of development can benefit from investing in renewable energy. The Baltic States serve as a fascinating illustration in this regard. Lithuania, Latvia, and Estonia are considered to be among the poorer countries, but they have successfully reformed their energy markets based on renewable resources. It is essential to note that not only the economic aspect is crucial in this case. Their security in becoming independent of Russia appears to be more significant. Therefore, by investing in renewable energy sources, they can attain energy security.

The suggestion to enhance political measures supporting renewable energy in nations without a 20% renewable energy target is crucial. Economic factors should not serve as a rationale for authorities shirking their responsibility towards an eco-friendly transition. Therefore, it is vital for the general public to comprehend that political leaders lack justifications to impede progress in this domain.

Despite the successes achieved so far in developing the renewable energy market, it is important to bear in mind the challenges facing the EU in this area, such as:

1. **Intermittency and Grid Integration:** The intermittent nature of some renewable sources, such as solar and wind, poses challenges for grid stability and reliability. Energy storage and grid upgrades are necessary to manage this intermittency effectively. Advances in renewable energy technologies, including improved energy storage solutions and grid management, could address some of the challenges associated with intermittency.
2. **Investment Barriers:** Despite progress, some EU countries still face barriers to investment in renewable energy, such as regulatory hurdles, financing challenges, and uncertain policy frameworks. Increased investment from public and private sectors, as well as access to funding mechanisms like the European Green Deal's Just Transition Fund, can accelerate renewable energy development.
3. **Technological Advancements:** Maintaining a competitive edge in renewable technology development requires continuous innovation and research, which can be resource-intensive.
4. **Political and Economic Variances:** EU member states vary in their commitment to renewable energy, often influenced by political and economic factors. This can hinder harmonized efforts toward sustainable energy goals.
5. **Policy Harmonization:** Closer policy alignment among member states, particularly in areas such as energy subsidies and market regulations, could facilitate the transition to renewables. Collaboration with neighbouring regions and international partners can facilitate the import/export of renewable energy, further increasing energy security and supporting the growth of renewables.

In conclusion, the effectiveness of developing renewable energy in the EU has shown significant progress in reducing emissions, creating jobs, and increasing energy security. However, challenges related to intermittency, investment barriers, and policy differences among member states persist. The EU's commitment to the European Green Deal and ongoing technological advancements offers promising avenues for furthering the development of renewable energy in the region.

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A MODEL APPROACH TO MEDIUM- AND SHORT-TERM PLANNING IN A RESEARCH INSTITUTE

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Purpose: This paper is aimed at presenting the proper significance of the research institute operations' planning, including, but not limited to, the ones relating to the development of tactical and operating plans. It refers to the development of the tactical and operating activity plans in research institutes. Their importance for the effective institute work organization is stressed.

Design/methodology/approach: Its provisions are based primarily on the analysis of reference works and various planning documents developed in different institutes.

Findings: To guarantee that the projects will ensure existence and development of the institute, the plan scope (in particular for the operational ones) should cover the largest scope of the institute operations possible. The applicable legal requirements refer to four different plans, including two operational ones, i.e. the activity and financial plan. Besides them, it is advisable to develop plans "complementing" the implementation scope of the assumptions made in the operational strategy or medium-term plans, e.g. the marketing activity plan or plan to employ the required scientific or technical personnel.

Originality/value: In the article, the authors attempt to adapt universal planning principles to the specific activities of research institutes. This is a new issue and a response to practical needs.

Keywords: research institute; planning in research organization; tactical plan, operating plan, Integrated Management System.

Category of the paper: theoretical paper.

1. Introduction

According to the PWN Encyclopedia, "an institute is a name of various institution types, having legal personality, created to perform tasks stipulated in their statutes. At present, this name refers primarily to research and development or research and educational institutions or the ones within university or scientific corporation structures" (Encyklopedia.pwn.pl).

Based on this definition, the institute can be described as an organization created and operating for a specific purpose. To survive, develop and operate efficiently, every organization needs proper management. Referring to the definition of “management” studied by a separate management science, the reference works contain numerous definitions offered by various researchers. Here are some examples:

- It is an inherent component of every organization, regardless of its size or activity type. It is defined as a process of planning, organizing, coordinating and control of resources and activities to achieve the set objectives (Encyklopedia Zarządzania.pl).
- It is a managerial activity consisting in setting goals and getting them achieved (Pasiczny, 1981).
- It is designing the future that we want and the effective ways to achieve it (Ansoff, 1988).
- It is a set of four functions, including planning, organizing, leading and control, oriented towards the organization’s (human, financial, in-kind and informational) resources, used to achieve the specific objectives of the organization (Griffin, 1998).
- It is a process of planning, organizing, motivating and controlling the work of the organization’s members and using any organization’s resources available to achieve their objectives (Stoner et al., 2001).
- It consists in ensuring (creating on purpose) the conditions for the organization to operate consistently with its assumptions, meaning for it to pursue its mission, achieve objectives stemming from it and retain the consistency level required for continued operations, i.e. the differentiation from other organizations and development or, in other words, the pursuit of its mission and achievement of its goals in the future (Kozmiński, Jemielniak, 2011).

The most important of the four functions of the management process listed in reference works (Griffin, 1998; Stoner et al., 2001) is planning, as it is impossible to organize and control activities or to motivate employees (select the personnel, determine the task performance measures and the salaries and/or extra rewards), unless they have been planned. If there is no plan, the managerial activities will always be ad hoc, chaotic and casual, which makes them relatively ineffective and inefficient.

This paper is aimed at presenting the proper significance of the research institute operations’ planning, including, but not limited to, the ones relating to the development of tactical and operating plans. Its provisions are based primarily on the analysis of reference works and various planning documents developed in different institutes.

2. The basic information on the research institute and its operations

Pursuant to the Research Institutes' Act (the Act, 2010), it is: “an organizational unit, separate in terms of the legal structure, organization, economy and finance, which conducts scientific research and development works aimed at their implementation and application in practice”.

The basic scopes of the research institute activities include:

- conducting scientific R&D works,
- adapting the R&D results to the practical requirements,
- implementing the R&D results.

In Poland, there are various institutes, including the ones belonging to the Polish Academy of Sciences, universities, R&D centers and autonomous, specialist research institutes. Their major operations include research activities with the proviso that the institutes of the Polish Academy of Sciences and universities are oriented primarily towards the development of science, whereas the activities of the R&D centers and autonomous research institutes are targeted mostly at the provision of specific solutions to different entities (Cilak, 2015).

The Act specifies a special institute category, i.e. the “state research institute”. By the decision of the Council of Ministers, this status can be awarded to the institute, which is requested to do tasks of particular importance for planning and implementing the state policy.

The Act (2010) imposes the following obligations on the below-mentioned people and bodies:

- The institute head is obliged to develop the annual activity plan including the most important tasks to be implemented in a calendar year and the directional thematic plan of scientific R&D works.
- The institute scientific board is obliged to determine the prospective directions of the scientific, development and implementation activities.

Another document mentioned in the Act, meaning the mandatory one, is the annual financial plan, which should be considered in the activity plan of the research institute.

3. Significance of planning in management

Similarly to management, reference works provide various definitions of “planning” offered by different scientists. They are highly similar to one another and use analogous statements. Based on them, it is possible to capture the basic essence of planning in the simplest terms as designing future effects, specifying in detail who is to implement what, at what cost and in what time. Such a statement, being the end result of the planning process, is the organization's activity plan, or “a record of future activity simulation” (Trocki, Wyrozębski, 2015).

Planning, referring to various objectives, can (and should) refer to all the areas of the organization's operations, in particular the ones crucial for obtaining the assumed objectives. Proper formulation of goals to be achieved is of key importance for planning. It was most probably best captured by the American scientist G.T. Doran, who formulated the SMART rule of the organization's objective determination, based on which each objective should be: Specific, Measurable, Achievable, Rational and Time bound (Doran, 1981).

For planning to be rational and accurate, it must consider various boundaries, primarily the financial, resource- and time-related. Another important aspect is that the data being the basis for plan development is verified, preferably by its future performers, who should take active part in the planning process.

Depending on the needs, various plan types can be developed. Two basic criteria of this division include the time horizon (period), covered by the plan, and the subject of planning (Figure 1).

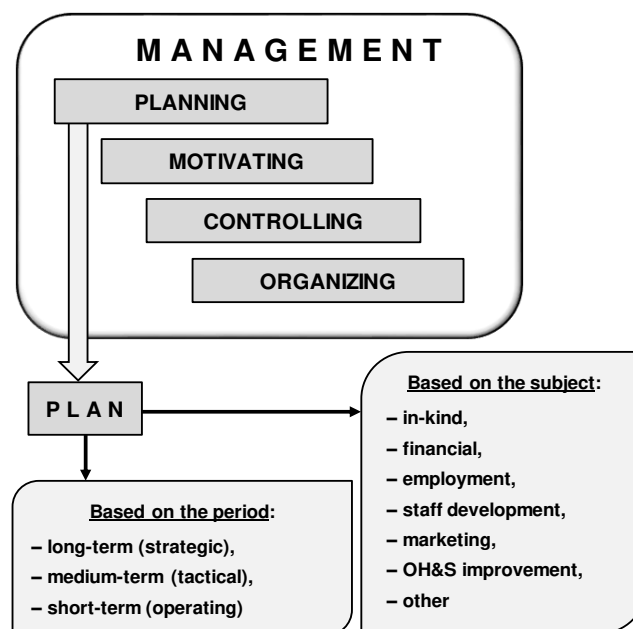


Figure 1. Plan type examples.

Source: own source.

The criterion analyzed in this paper will be the period, for which the objectives are planned. As shown in Figure 1, there are three different plan types, i.e.

- long-term (strategic), for 5 to 10 years of operation, specifying the organization's mission and vision, major operating objectives, the place, where the organization would like to be in the future, together with the resources it would like to use to get there,
- medium-term (tactical), for up to five years, describing more detailed ways to implement the primary, strategic objectives of the organization,
- short-term (operating), specifying the detailed tasks to be performed to implement the adopted assumptions.

The determined operating strategy specifies the major targets and objectives to achieve in general terms. To specify the current activity of the organization, the next step needs to develop more detailed plans, including tactical and operating ones (Table 1).

Table 1.

Planning in an organization – periods and scope

Period	Planning	Problems defined
Long – 5-15 years	Strategic	Why do we exist? What are our mission and vision? What should we deal with? In what direction should we go? What methods should we choose to achieve the goals?
Medium – 2-5 years	Tactical	What goals should we achieve? What activities should we take and what measures should we use? What will the required technical equipment be? Does the employed R&D staff have the required qualifications and is their number sufficient?
Short – 1 year	Operational	What should we do specifically next year? Who should be held accountable for it? At what expense? What results should be obtained?

Source: own study based on (Horvath, 1987).

4. Medium-term planning – tactical one

The effects of scientific works and the implementation works carried out by the research institutes, in particular in the engineering and technical sciences, play highly important role in the contemporary world. Crucial in the aspect of the dynamic changes taking place now in virtually all global economy sectors, they refer primarily to projects aimed at reducing the growing climate changes, which threaten further existence of humans on Earth. Each year, there is a significant growth of the role of activities relating to the effective resource use thanks to the shift to the clean circular economy, reduced energy generation from fossil fuels, including coal, crude oil and gas, with a simultaneous increase in its production from renewable sources.

To meet the challenges faced by the research institute, it is necessary to develop medium-term plans of structured tactical activities first. Tactical plans determine activities required to achieve strategic goals. For the research institute, they include the ones listed in (the Act, 2010), i.e.:

- the list of perspective directions of the scientific, developmental and implementation activity developed by the institute scientific board, sometimes termed a “short-term strategy”. It sometimes contains the provisions on the research institute operations in 3-5 years, referring to the strategic documents shaping the scientific and economic policy of the state and to the needs of the industrial and local government milieus reported by them. The prospective directions are determined by the institute scientific board relating to the fields of science and scientific disciplines, and then grouped into research areas, which the institute is committed to;

- the directional thematic plan of scientific research and development works, developed by the institute head, with more detailed themes of the planned works specified in specific research areas. The plan is developed by the institute head and then subject to the scientific board's evaluation.

As the determined prospective activity directions and thematic research plans translate into the institute operations, both documents should also list the objectives to be achieved, with the measures of their implementation extent.

To stress the interdependencies between the two plans, they are usually included in a single document. The diagram of the way they are developed is presented in Figure 2.

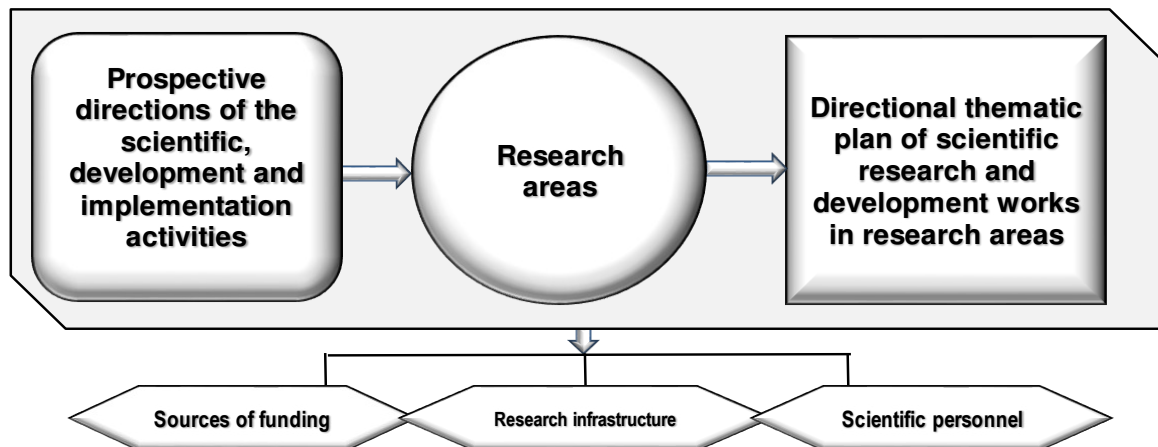


Figure 2. Diagram of tactical operating plans development in a research institute.

Source: own source.

The same document should also contain the provisions specifying the feasibility of the adopted assumptions. They include:

- indication of the available sources of funding,
- characteristics of the institute research potential relating to:
 - the possessed research infrastructure and technical equipment,
 - the scientific and research personnel employed.

The source of funding for the scientific research and development works included in the directional thematic plan may be the funds from the budget of the minister supervising the institute, the National Centre for Research and Development, different special purpose funds, national and EU programs, within which they will be performed, and also from national and foreign business entities, state and local government administration bodies and other entities ordering specific research. The detailed scopes of funding are included in the annual operating financial plans.

The relevant technical infrastructure is grounds for the effective performance of the planned research. For this reason, the subsequent section of the document contains provisions on the possessed, required or modernized testing grounds, laboratories, test stands, specialist instruments, including the computer hardware and the indispensable software.

To implement the planned research and implementation activities, it is also required to employ the suitable number of employees holding the title of the professor, post-doc or PhD. Consequently, it is also necessary to analyze the number of the R&D employees and the activities aimed at maintaining or increasing it.

For many research institutes, which plan to implement the results of the R&D works and innovative solutions in other economic entities in practice to a significant extent, the final section of the document contains general information concerning that activity, which is important from the perspective of earning significant revenues on those grounds.

The scope of tactical targets presented in the horizon of several years is then specified in greater detail in various operating plans, developed usually for one year of the research institute operations.

5. Short-term planning – operational one

Depending on the decisions of the research institute managers, the document may include various short-term plans, including those consistent with the provisions of (the Act, 2010), where two of them, i.e. the financial and activity-based one, are mandatory. Both documents are operational short-term plans relating to the ongoing activity programs.

The annual financial plan evaluated by the institute scientific board is a summary of the anticipated revenues and costs, investment expenditure to develop the research potential and the anticipated employment. The planned revenues are presented in three or four groups as:

- the revenues within funds for science, stemming from the statute subsidy for the maintenance and development of the research potential and within the grants relating to the implementation of the national and international special-purpose projects,
- the revenues from selling own research and service works performed for third parties,
- other operating and financial revenues,
- the revenues from subsidies for the performance of tasks of the state research institute (provided that the institute holds such a status).

Another section of the plan is the summary of the anticipated costs of the institute operations by type, including amortization/depreciation, materials and energy, purchases, services, taxes and levies, payroll, insurance, as well as other benefits and financial costs.

The annual financial plan is summarized by the list of the anticipated revenues and costs depicting the gross financial result to be obtained.

Starting from July 2023, the amendment to (the Act, 2010) imposes the obligation to develop the annual activity plan, evaluated prior by the scientific board, on the research institute head. Because of the period covered by it, it is another operating activity plan. The document should consider the assumptions of the prospective directions of the scientific, developmental

and implementation activities, as well as the directional thematic plan of scientific research and development works. Referring to the assumptions concerning the scientific and organizational activities of the institute, it should contain primarily:

- the list of the most important national and international projects and research to be performed,
- the assumed number of applications for research funds obtained from third-party institutions,
- the assumed number of publications by renowned Polish and foreign publishers,
- the list of training and educational projects implemented for third-party entities,
- planned employment in general or with the number of scientific employees,
- the summary of promotional and informational activities.

The correct development of the assumptions in the above aspects is crucial for the research institute operations and scientific status. The projects for third-party recipients and the special purpose funds for specific research are the basic source of the institute revenues enabling to fund its operations. Besides that, they are an aspect of the institute evaluation in the scientific field, where at least 12 senior scientific employees of the institute operate. The evaluation result translates into the award of the relevant scientific category, which gives the institute prestige and the award of the rights to organize university courses and doctoral schools, to grant degrees and titles, as well as of the financial subsidy, which can be obtained from the state budget. The score is conditional e.g. on (Evaluation – Information from the Ministry of Education and Science):

- evaluation of the scientific level, measured by the number of scientific papers published in scientific journals and peer-reviewed papers from scientific conferences, published monographs and awarded patents for inventions,
- financial effects of scientific research and development works,
- scientific activity impact on the economy and the society.

This means that the correctly planned directions and subjects of the research, number of ranked scientific publications and employment of the appropriate number of highly-qualified scientific personnel are highly important for the research institute operations and development.

Relating to the financial aspects, the annual activity plan should include:

- the assumed financial expenditure on investment activity, specifying the list of modernization and replacement tasks,
- the list of projects reducing the costs to be incurred,
- the initial draft of the financial plan for the budget year.

As already mentioned, the annual financial and activity plans are mandatory. If the institute managers believe that necessary, they may develop also other operational plans, including e.g.:

- a marketing activity plan, based on the strategic objectives included in the long-term strategic plan, which is to advertise the activities, which can be offered to external customers,
- a plan relating to the employment of professionals holding specific skills or licenses,
- a material and financial plan relating to the activities and purchases relating to OH&S,
- a plan relating to the training of employees aimed at improving their professional qualifications.

Because of the period covered by the above plans (starting from the research institute operating strategy), they create a certain cascade of more and more detailed provisions on the activities relating to the operations and development of the research institute (Figure 3).

It can be seen that, although the plans refer to different thematic areas relating to all the operations of the research institute, in many sections they contain provisions referring to the same problems. To avoid any discrepancies between the provisions, they should be developed (which is often done by different organizational units of the institute) in a coordinated way.

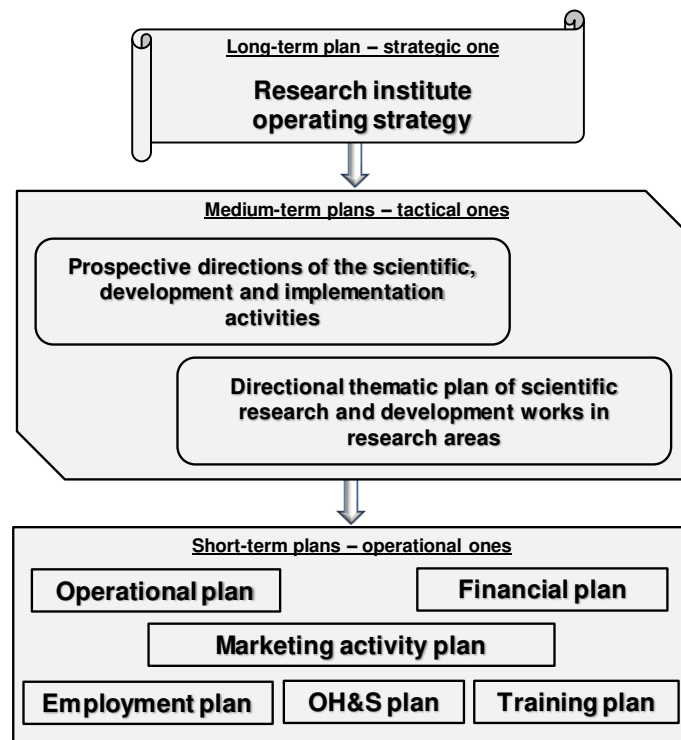


Figure 3. Summary of operational plans developed in the research institute.

Source: own source.

6. Integrated Management System – the planning location in the system

Provisions of various plans developed in the research institute can be coordinated by the implementation of the Integrated Management System (IMS) in it.

Starting from early 1990s, many Polish organizations initiated measures to implement various certified management systems, consistent with the requirements of ISO 9000 standards. Initially, they referred to the quality management systems, and then to the environmental, occupational health and safety management and information security management. As the number of the management systems used grew, the decision was made that, instead of dealing with individual systems separately, it is better to implement a single, comprehensive system to manage them simultaneously. This is how the Integrated Management System was created. Its implementation makes it possible for the organization to manage its operations more efficiently and effectively. It implements positive changes, contributing to the development of and increase in competitive advantage, e.g. by improved quality of the services offered and customer relations, and also to increased accountability of employees for the tasks performed (Olkiewicz, 2012).

All the activities under IMS must follow strict procedures. The basic IMS document is the Book of the Integrated Management System, being a source of information on the system, its requirements, maintenance and improvement. It contains, i.a., the description and map of processes carried out in the organization, with their relationships. Relating to the research institutes, it is usually possible to divide the processes into three groups, i.e. management, basic (business) and auxiliary one. The most important of them is basic processes relating directly to the institute operations, bringing about measurable financial results (revenues) stemming from the obtained subsidies or from revenues from research, designing, educational and training services. They include (Figure 4):

- “Research and service works”,
- “Projects”,
- “Statute works”,
- “Education and training”.

For the activities taken in every process shown in Figure 4, the institute must possess the suitable equipment (infrastructure) and the scientific and research personnel. Implementation of the related works entails expenditure, and their performance should bring about specific financial results.

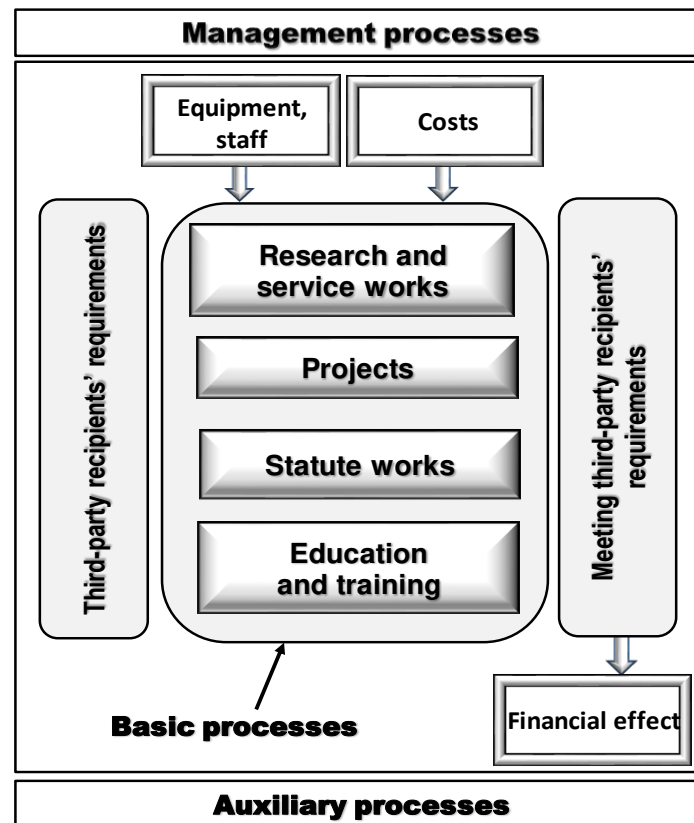


Figure 4. Basic processes carried out in the research institute.

Source: own source.

Based on previous discussion, it can be noticed that all the components specified in the basic processes are covered by different plans developed in the research institutes. Consequently, in IMS, the plan development itself can be covered with relevant procedures, which provide detailed information on who is accountable for the development of specific planning documents and in what scope. This refers, in particular, to the operational plans, including, but not limited to, the two most important ones required by the provisions of (the Act, 2010), i.e. the activity and financial plans. The procedures developed for every plan type separately should specify at least:

- the subject of the procedure,
- the scope of responsibilities and authorizations,
- the detailed plan development method, determining the deadlines for specific work implementation,
- the way to monitor and supervise plan implementation.

It should be emphasized that, if the research institute has the implemented Integrated Management System, its procedures also comprise the detailed provisions on the mutual cooperation of its organizational units. Thanks to that, it is possible to determine the way to inform one another about the works on the development of individual plans, which will eliminate the danger of discrepancies between their provisions.

7. Conclusions

The thorough development of tactical and operational plans of actions in the research institute based on realistic assumptions is crucial for its effective operations. To guarantee that the projects will ensure existence and development of the institute, the plan scope (in particular for the operational ones) should cover the largest scope of the institute operations possible. The applicable legal requirements refer to four different plans, including two operational ones, i.e. the activity and financial plan. Besides them, it is advisable to develop plans “complementing” the implementation scope of the assumptions made in the operational strategy or medium-term plans, e.g. the marketing activity plan or plan to employ the required scientific or technical personnel. The precise allocation of the scopes of authorizations and obligations during plan development, resulting from the implementation of the Integrated Management System in the institute and covering the planning activities with the system procedures, should contribute to its improved quality.

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PLANNING IN A RESEARCH INSTITUTE

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Purpose: As with any organisation, one of the most important prerequisites for the effective operation of a research institute is proper planning of its functioning – that is, accurately defining the future and establishing all the resources necessary for scientific, financial and economic activities. This paper is an attempt to illustrate the importance of planning the activities of a research institute over different time horizons for its proper functioning.

Design/methodology/approach: To solve the research problem posed in this way, the following was used: (1) a method of analysing and critiquing the literature through literature studies leading to a possibly multifaceted presentation of the issue of planning the functioning of a research institute and (2) a document examination method involving the collection of source materials, which were: financial plans, prospective directions of scientific, development and implementation activities, thematic directional plans for scientific research and development work, the institute's strategy and the procedures and practices used to prepare the plans.

Findings: The research shows that the planning process at the research institute is subject to the requirements of the applicable regulations. This implies the necessity to draw up four types of plans in terms of: prospective directions of scientific, development and implementation activities, directional thematic plans of scientific research and development works and annual activity and financial plans.

Originality/value: In the article, the authors attempt to adapt universal planning principles to the specific activities of research institutes. This is a new issue and a response to practical needs.

Keywords: research institute; planning in research organization; science organization in Poland.

Category of the paper: theoretical paper.

1. Introduction

As with any organisation, one of the most important prerequisites for the effective operation of a research institute is proper planning of its functioning – that is, accurately defining the future and establishing all the resources necessary for scientific, financial and economic activities. Properly constructed plans, prioritised in terms of time (when?), subject (what?) and

execution (how?), preceded by a detailed analysis of the environment, identification of both the positive and negative sides of the institute and all realistically available opportunities for action under specific financial conditions, significantly increase the likelihood of proper operation and development.

This paper is an attempt to illustrate the importance of planning the activities of a research institute over different time horizons for its proper functioning. To solve the research problem posed in this way, the following was used:

- a method of analysing and critiquing the literature through literature studies leading to a possibly multifaceted presentation of the issue of planning the functioning of a research institute,
- document examination method involving the collection of source materials, which were: financial plans, prospective directions of scientific, development and implementation activities, thematic directional plans for scientific research and development work, the institute's strategy and the procedures and practices used to prepare the plans.

In this way, descriptive as well as quantitative information about the subject of the research was collected. In the course of it, the following activities were carried out:

- documents were collected and a preliminary selection was carried out,
- the authenticity of the documents collected was established and their reliability checked,
- document analysis was carried out.

The method used was complementary to the analysis of literature sources. Due to the necessity of ensuring an accurate, unambiguous and reliable analysis, it was necessary due to doubts arising in the course of interpreting the examined documents. The key condition, fulfilled at each stage of the research, was to demonstrate the reliability of the documents analysed. Another important aspect of the conducted research was that it concerned not only the material obtained in the process of anonymised research, but also as a result of activities unrelated to the research process undertaken.

2. The place of the research institute in the economy and science

A research institute is a legally and economically distinct organisation (system), with legal personality, comprising structured elements (subsystems), between which there are specific links for the realisation of set objectives. There are various institutes – scientific institutes belonging to the Polish Academy of Sciences (Polska Akademia Nauk – PAN), institutes of higher education, institutes that are science and development centres and independent, specialised research institutes (Figure 1).

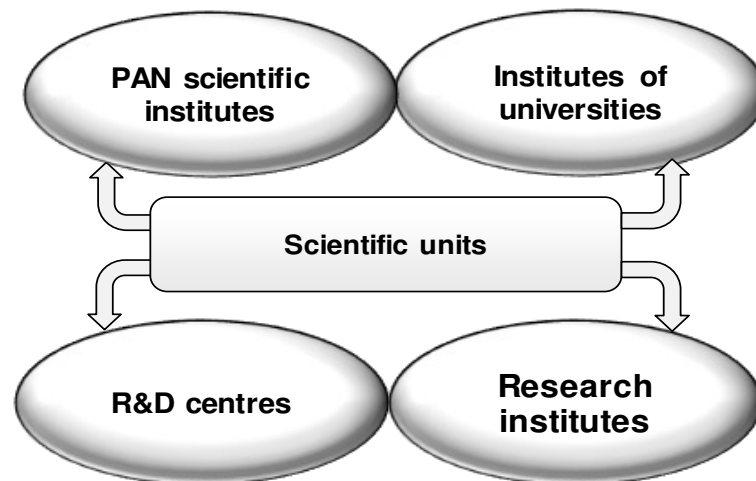


Figure 1. Research institutes among scientific units.

Source: own work based on (Gryzik, 2017).

Their main domain is to carry out research and scientific activities, but the institutes of the Polish Academy of Sciences and universities are primarily oriented towards the development of science per se, while the activities of research and development centres and independent research institutes are mainly directed towards the commercial provision of specific solutions for the needs of various entities (Cilak, 2015).

According to the provisions of the Research Institutes Act (Law, 2010a):

- a) a research institute is a state organisational unit with legal personality, legally, organisationally, economically and financially separate, which conducts research and development work aimed at their implementation and application in practice,
- b) the core activities of the institute include:
 - carrying out research and development work,
 - adapting the results of scientific research and development work to the needs of practice, – implementation of research and development results.

The Act also distinguishes a special category of institute, which is a state research institute. By a decision of the Council of Ministers, such status may be granted to an institute which is commissioned to perform tasks of particular importance for the planning and implementation of state policy.

The main documents underpinning the operation of the institute are its statutes and organisational rules, which define the subject matter and scope of the institute's activities and the working procedures of its bodies.

In addition to this, the institute operates on the basis of an activity plan established for the period of a calendar year, specifying the most important tasks to be carried out during the period covered by the plan. The Act stipulates that the tasks included in the developed activity plan should be correlated with the provisions of the directional thematic plans of scientific research and development works, annual financial plans and established perspective directions of scientific, development and implementation activities.

Research institutes are responsible for their own liabilities and trade in their own name and on their own account. What is important here is the fact that institutes not belonging to the Polish Academy of Sciences or universities operate outside the public finance sector. This exclusion results in the fact that they have to cover the costs of their activities from the revenues they receive – they should therefore conduct activities aimed at self-financing (Wyszomirska, 2022). This is an intermediate form between non-economic activities (as in the case of budgetary units) and commercial activities – they operate at the interface between the scientific and economic sectors (Cilak, 2015; Gryzik, 2017).

According to the provisions of (Law, 2010a), a research institute derives its revenue from subsidies and grants and in connection with its basic and other activities, including the sale of the results of scientific research and development work, patents, protective rights and licences, implementation work, production of equipment and apparatus, certification, issuance of qualification certificates and other production or services. Subsidies and grants may only be granted for "financing activities for the implementation of the state's scientific, scientific-technical and innovation policy, in particular scientific research, development work and the implementation of other tasks of particular importance for civilisational progress, economic and cultural development of the state" (Law, 2010b).

It is clear from this that they can be commercially active – the institutes provide a specific 'good' 'to the market', finding buyers to purchase it. From this point of view, they should be regarded as organisations operating in the market. Consequently, an institute that conducts research and commercially disseminates knowledge is an enterprise to the extent that it carries out economic activities. However, unlike 'typical' businesses, the main purpose of institutes is not to carry out commercial activities, but scientific and research activities serving the needs of the state or the economy, because that is what they were established for (Cilak, 2015). It follows that, the product offered is primarily newly developed technologies and innovative solutions. The optimal solution for a research institute is to license them, which allows it to retain control over the result of the development work and share in future profits. It is possible to contribute the results of the work to a special-purpose commercial company – the establishment of capital companies and the taking up of shares in them is allowed by the provisions of the (Laws, 2010a). However, it is important to bear in mind that, as a result of the restructuring processes that industry is undergoing, including in particular in industries defined as 'heavy industry', due to the liquidation, merger or sale of many enterprises, the number of potential recipients of the results of scientific research and development work has significantly decreased (Gryzik, 2017). This puts the onus on research institutes to carefully plan their work so that the results meet the actual needs of future buyers.

In order to better coordinate and plan research and development, networks of research institutes are being established in Western European countries (Barcikowska, 2018). They mainly deal with applied research conducted in cooperation with industry. They are financed by the beneficiaries of the solutions developed, which are state-owned and private companies. In the case of planning and achieving results that are also of significant social importance, it is also possible to obtain, often substantial, public funding.

The managers of a research institute cannot assume that its primary income will be the subsidies received from the state. In order to function on the market, institutes should operate efficiently, and this requires good management. Hence the importance of the two most important management functions, in particular planning. The proper determination of the activities carried out in all areas of planning is a prerequisite for generating revenues sufficient to allow the institute to function. This is because it must be borne in mind that, according to the provisions of the (Law, 2010a), if it continues to make financial losses, the institute may be liquidated or declared bankrupt by the decision of the supervising minister (with the exception of an institute participating in the health care system).

With regard to the need for proper planning, in addition to the financial aspects, there is another thing that must be borne in mind and concerns scientific staff and their publication activities. It is extremely important for every research institute to obtain an appropriate scientific status. If it employs at least 12 independent researchers active in a particular scientific discipline, it is subject to mandatory evaluation (assessment) in that discipline. The result of this is, among other things, the award of an appropriate scientific category. In addition to being largely decisive for the prestige of the institute, the rights to conduct studies, doctoral schools, award degrees and titles and the amount of financial subsidy it may receive from the state budget depend on it. The size, type and scientific profile of the institute are taken into account in the evaluation process, and the parameters of the evaluations vary depending on the specifics of the fields of science being evaluated. The grade obtained depends, *inter alia*, on (the Ministry of National Education information):

- evaluation of scientific level, measured by the number of scientific papers published in scientific journals and peer-reviewed proceedings of scientific conferences, monographs published, patents granted for inventions,
- financial impact of the research and development work carried out,
- impact of scientific activity on the functioning of the economy and society.

The prerequisite for obtaining a high rating is first and foremost the proper planning of the directions and topics of the research carried out, the number of scored scientific publications, employing an appropriate number of highly qualified scientific staff, undertaking cooperation with renowned national and foreign research centres.

3. The essence of planning in organisational management

In today's economic and business realities, the main conditions for the existence of any organisation, including a research institute, should be its development and the efficiency of its functioning. And these mainly depend on the quality of management (Bąk, 2018; Jonek-Kowalska, Turek, 2016).

There are a number of different definitions of the term 'management' developed by management scientists. In this paper, the best one to use will be the definition developed by the American scholar R.W. Griffin. He defined management as a set of four functions – organising, planning, motivating, controlling – directed at an organisation's resources (human, financial, physical, information), used with the intention of achieving specific organisational goals (Griffin, 1998). Within each of these functions, organisational managers use specific methods and approaches to achieve them. The different management functions, which cover the whole area of the organisation's activities, are interrelated and interdependent (Figure 2).

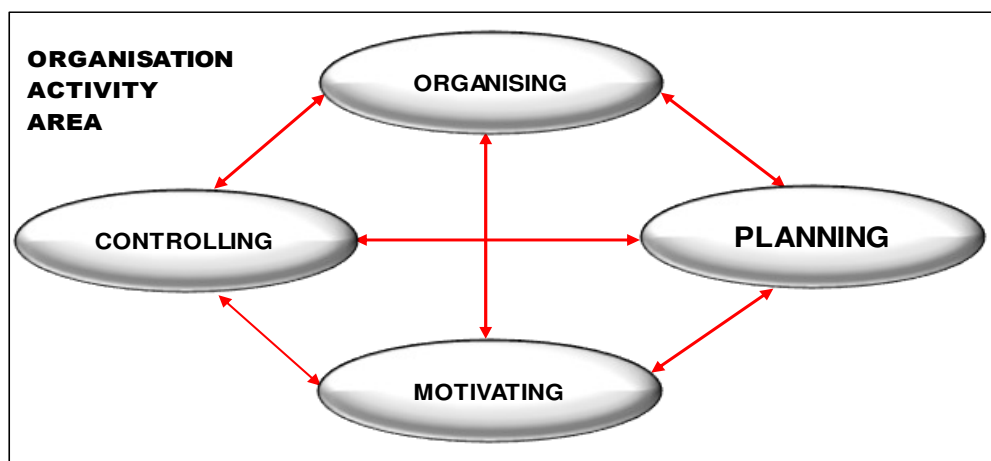


Figure 2. Planning considerations at a research institute.

Source: (Bąk, 2018).

In this interdependence, the two most important functions are organising and planning. Primacy should be given in particular to planning, which establishes the objectives of the organisation's activities and the ways and undertakings to achieve the objectives set. This results in the creation of different types of plans, which may differ in the length of time they cover or the objectives they address. However, they will always form the basis for the other functions: unplanned activities cannot be organised, monitored or motivated. This is particularly true for the monitoring function, which mainly consists of identifying deviations from, the plan's findings (Bąk, 2012; Jonek-Kowalska, 2017).

The end result of planning is a plan, which is a record of a simulation of the course of future activities (Trocki, Wyrozębski, 2015). A properly developed plan is a document that defines the directions, ways and goals envisaged to be achieved, with the necessary tasks of work and activities given. The planning of the functioning of each organisation should take into account

the conditions of the environment in which it operates, including, first of all, those of a legal nature (applicable laws, regulations, provisions) and of an economic nature (the possibility of carrying out effective activities ensuring existence and development in a competitive market). It should also cover different time horizons. Depending on their length, plans can be distinguished:

- long-term – strategic, concerning the development programme,
- medium-term – tactical,
- short-term – operational, concerning programmes of ongoing activities.

The interrelationship of these factors, and their interactions, is illustrated in the diagram shown in Figure 3.



Figure 3. Planning considerations at a research institute.

Source: own work based on (Griffin, 1998).

4. Planning in a research institute

4.1. Long-term planning – research institute strategy

In the most general terms, strategy can be defined as a combination of the objectives that an organisation is pursuing and the activities and means by which it intends to achieve them. In an organisation operating on the basis of the adopted strategy, strategic management is implemented, aiming to solve the key problems of the activity in a way that ensures its survival and development, with maximum use of its potential to reduce the threats coming from the environment in which it exists. Adopting the general model of strategic management, which

assumes the necessity of four stages – strategic analysis, strategy formulation, strategy implementation, strategic control – it can be concluded that a research institute should implement a sequence of activities (Figure 4).

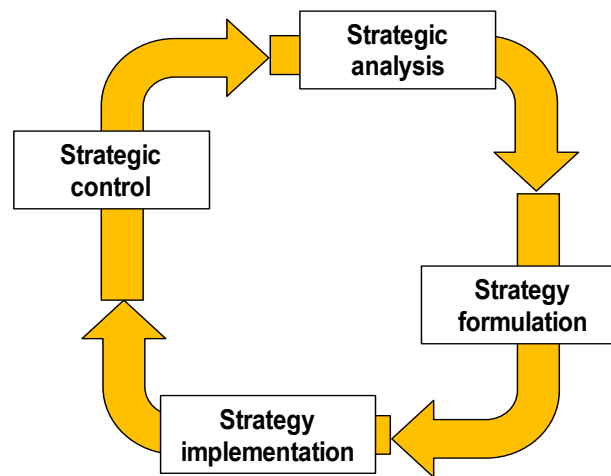


Figure 4. Stages of the strategic management model.

Source: own work.

The starting point in the strategic management process is to carry out a strategic analysis including a diagnosis of the distant, proximate and internal environment. The strategic analysis of the situation of the research institute is about the fullest possible assessment of its condition and its current and future opportunities in the market, taking particular account of its resources and the likely directions of development of its environment. Obtaining information on the expectations of the environment and the capabilities of the research institute makes it possible to formulate:

- mission, defining the specific reason for its existence, giving an answer to the question of what distinguishes it from other institutes, what it is, what it does and where it is going,
- vision, indicating the situation in which the institute wishes to and may find itself in the future.

The organisation's system of objectives, defined at a relatively general level in the form of a mission and vision, and the analyses carried out of its interior and environment, form the starting point for defining key success factors. The constructed set of key success factors indicating the future desired states of the organisation is transformed into the form of a strategic objectives tree, assuming a simple mapping of lower-order objectives into higher-order objectives, or a strategic objectives map appreciating the cause-and-effect relationships occurring between the individual objectives.

The defined strategic objectives provide an ideal picture of the institute's intentions, a picture that does not in itself create any added value without specifying how the objectives are to be achieved and how they are to be measured. In order to ensure the applicability of the strategy, the goals must be translated into a system of strategic initiatives, each of which should

be broken down to the level of specific actions, to which responsible persons should be assigned, and timetables for their implementation.

Strategic initiatives can be implemented in the form of strategic processes (which are a set of cyclical activities related to the core business of the institute linked or interacting, transforming input resources into products or services), as well as strategic projects (defined as unique, one-off undertakings with a well-defined objective, set in a specific timeframe, for the implementation of which specific resources are allocated). The system of strategic objectives should be correlated with a system of metrics including key performance indicators.

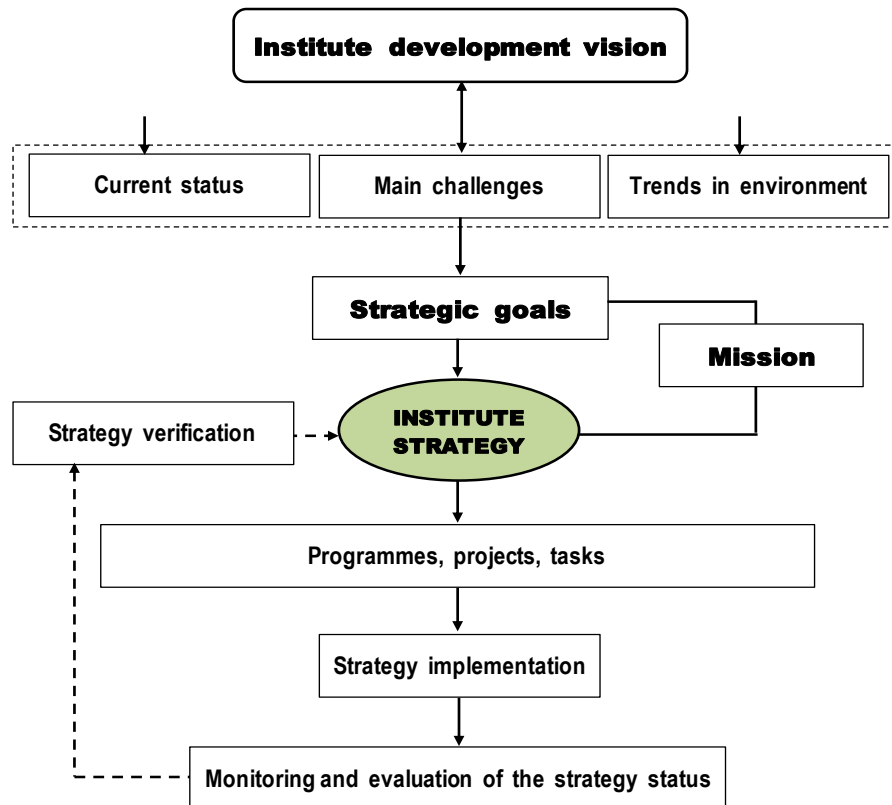


Figure 5. A model for strategy work at a research institute.

Source: own work.

The next stage, the implementation of the strategy, is linked to the need for action on two levels:

- the first – covering activities related to building mechanisms to implement and improve the strategy,
- the second, which includes projects aimed at aligning the organisation's components – systems, organisational structure, management styles, skills, competences, its organisational culture – with the adopted strategy.

The activities undertaken at the strategic control stage closing the strategic management cycle relate to monitoring the correctness of the implemented strategy and changes occurring in the environment. Dysfunctions identified in the strategy implementation process, or specific changes occurring in the environment, are the basis for returning to the beginning of the cycle and restarting the strategic analysis process (Figure 5).

4.2. Medium-term planning – future orientations of research, development and implementation activities

In a period of dynamic change currently taking place in virtually all sectors of the global economy, resulting from intensive efforts to use resources efficiently through the transition to a clean, closed-loop economy and to counteract the loss of biodiversity and reduce the levels of pollution contributing to increasing climate change, the role of research and implementation work carried out by research institutes is increasing significantly. To meet such a challenge, it is necessary to develop a medium-term plan for the institute's structured tactical activities. This is a compilation of forward-looking directions for scientific, development and implementation activities, set by the institute's scientific council and sometimes referred to as a 'short-term strategy'. It usually contains provisions on the functioning of the research institute, most often in a 3-5 year perspective, referring in its content to the strategic documents shaping the state's scientific and economic policy and the signalled needs of the industrial and local government communities.

The prospective directions are defined with reference to the scientific fields and scientific disciplines which are the domain of the institute concerned. They are detailed in the next part of the document, called the directional thematic plan of scientific research and development works, established by the director of the institute. The individual lines of activity are most often grouped into specific research areas, and then, within a given area, the more detailed subject matter of the planned work is established. A diagram of how the plan is constructed is shown in Figure 6.

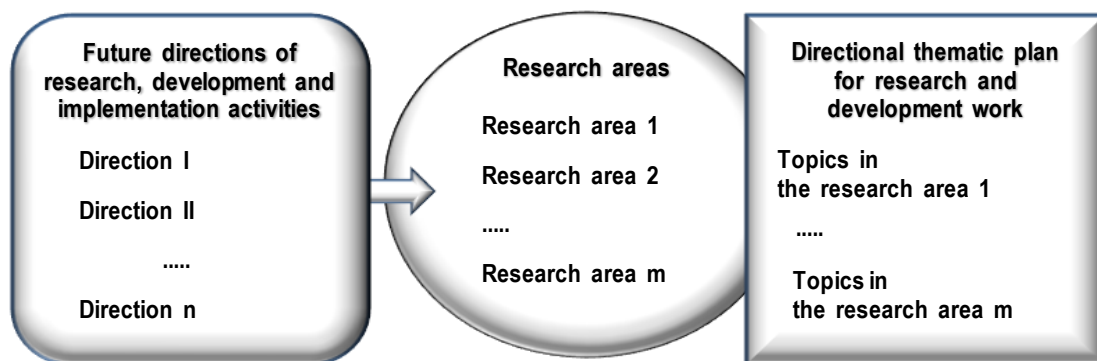


Figure 6. Diagram for constructing a tactical action plan at a research institute.

Source: own work.

In order to demonstrate the feasibility of the adopted assumptions, an important part of the plan is also to indicate the available sources of funding for the work and to present the institute's research potential in terms of its material resources (laboratories, research equipment) and intellectual resources (number and competence of scientific and research staff, possibility and ability to cooperate with the economic sector, technologies).

With regard to many research institutes, it is possible to assume that the implementation of scientific research and development works included in the directional thematic plan will be financed from the budgets of the Ministry, the National Centre for Research and Development, various special purpose funds and national and EU programmes under which they will be conducted. In many cases, it is assumed that funds will be obtained from domestic and foreign economic entities, state and local government offices and other entities commissioning specific scientific research and development works.

As an adequate research infrastructure is the basis for the successful implementation of the adopted assumptions, the next section of the document usually contains provisions concerning this issue. With regard to the existing research stations and the necessary apparatus and computer equipment and the necessary software, the plan presents the possible needs for their supplementation, together with an indication of the potential sources of funding for the necessary purchases and modernisation.

Bearing in mind that it is also necessary to employ an adequate number of staff with professorial titles and degrees at the institute in order to carry out the planned research and implementation activities, an analysis of the number of research staff and measures to maintain or increase it is necessary in the next section of the document.

4.3. Short-term planning – annual activity and financial plans

As required by the (Law, 2010a), the director of the research institute establishes an annual plan concerning:

- finances,
- activities of the institute.

Both documents are operational short-term plans for ongoing action programmes.

The annual financial plan, which is the basis for the management of the institute's resources, is a statement of anticipated costs and revenues, the amount of capital expenditure allocated to the development of research potential and anticipated employment. Planned revenues are presented in three groups, as:

- revenue under science funding from the statutory subvention for the maintenance and development of research potential and funding from national and international targeted projects,
- revenue from the sale of own research and service work carried out for external parties,
- other operating and financial income.

The next item in the plan is a breakdown of the Institute's anticipated operating costs by type, including: depreciation, materials and energy, purchases, services, taxes and charges, salaries, insurance and other benefits, and finance costs.

The final summary of the document is a combined statement of planned income and expenses, showing the gross financial result expected to be achieved.

The necessity to draw up an annual plan of the institute's activities was introduced by the amendment of the (Law, 2010a) effective from July 2023. It is assumed that this document will be prepared primarily on the basis of the provisions on the forward-looking directions of scientific, development and implementation activities and the directional thematic plan of scientific research and development works. The directions of scientific and development and implementation activities included therein, defined in a time horizon of several years, should be defined in more detail in the annual operational activities plan. In the case of a research institute, the document should primarily include:

- a compilation of major projects and national and international studies scheduled for implementation,
- an assumed number of publications in renowned national and international publishing houses,
- the assumed number of applications for research funding from external institutions,
- a summary of promotional and information activities,
- the amount of financial outlay for investment activities, with a list of modernisation and replacement tasks,
- the size of the planned workforce – in total and specifying the number of researchers,
- a list of cost-cutting measures,
- preliminary draft financial plan for the financial year.

The planning documents presented relate to the substantive and financial aspects of the research institute's activities and can be referred to as strategic, tactical and operational plans (Figure 7).

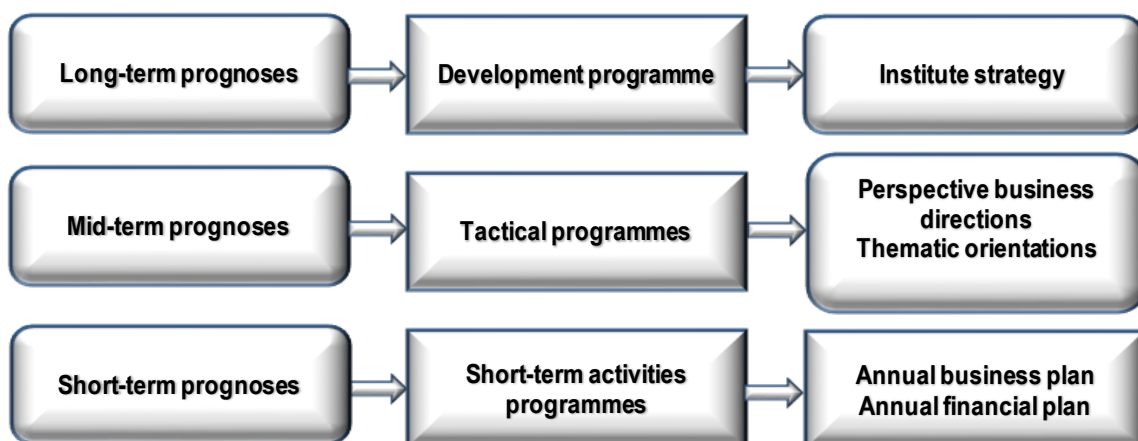


Figure 7. Summary of plans being developed at the research institute.

Source: own work.

To summarise the considerations of the different objectives and scopes of planning carried out at research institutes, a summary can be drawn up, directly indicating the differences that occur (Table 1).

Table 1.

Features of strategic, tactical and operational planning in a research institute

Strategic planning	Tactical planning	Operational planning
Institute strategy.	Prospective lines of business. Directional thematic plan.	Business plan. Financial plan.
Developed by the institute's management, reviewed by the scientific council.	The forward-looking lines of activity are set by the Scientific Council. The thematic directional plan is set by the director of the institute, the scientific council gives its opinion.	Determined by the director of the institute, opinion of the scientific council.
Defined over a horizon of at least five years, with an indication of prospects over a horizon of up to ten years.	Most often a three-year time horizon, no more than five years.	Annual time horizon.
Indicates actions to be taken to ensure the future sustainability of the institute's functioning and development. Defines the general lines of the plans and actions to be undertaken by the units and organisational units.	It sets out the specific objectives and directions of the activities included in the strategic plan. Often refers directly to 'single product' issues, e.g. a specific research area.	In conjunction with specific financial resources, it sets specific, detailed objectives to achieve strategic goals. It applies to both research and marketing activities to strengthen the institute's brand and position.

Source: own work.

5. Conclusions

The research shows that the planning process at the research institute is subject to the requirements of the applicable regulations. This implies the necessity to draw up four types of plans in terms of: prospective directions of scientific, development and implementation activities, directional thematic plans of scientific research and development works and annual activity and financial plans. In research institutes, there is no formal obligation to develop a functional strategy. The development of any type of plan is of vital, multi-faceted importance for the activities of a research institute. The proper selection of research directions that result in significant results, finding buyers interested in their implementation, and the employment of highly competent scientific staff, allow work to be carried out that provides significant support for the state economy and yields measurable financial results. It is also a prerequisite for the effective functioning of the institute and the building of its scientific prestige. There is a need for in-depth research on how to improve the planning process at the research institute.

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RESPONSIBLE RESEARCH AND INNOVATION IN ACADEMIA – CONTEXT OF REGIONAL SMART SPECIALIZATIONS

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Purpose: The paper aims to discover the challenges of implementing the Responsible Research and Innovation (RRI) concept in higher education institutions.

Design/methodology/approach: The approach included several steps. First, the necessary literature review was conducted to present RRI concept. Then, the information was gathered to present the lodzkie region in the area of R&D and economy. The last (empirical) part was the study in the form of workshops being organized to obtain information on factors influencing the implementation of RRI concept.

Findings: Implementing RRI approach encounters barriers, in particular, the idea needs wider popularization, especially in terms of the benefits of its application. There is also insufficient social trust in science. This emphasizes a need to promote reliable scientific knowledge and to strengthen social awareness of its role in the development of the world. The role of internal and external stakeholders is important here. Communication between participants in innovation processes can improve the efficiency of activity in the sphere of RRI, including mechanisms of inclusive decision-making. The channels and models of communication have to take into consideration the heterogeneity of the recipients. This requires human resources with relevant competencies to execute efficient communication patterns.

Research limitations/implications: The workshop was conducted on a relatively small sample and the attendants were already involved in socially/economically/environmentally responsible activity. Although it was possible to capture the main ideas on how to foster RRI concept, it is important to execute wider research on a sample representative for a whole quadruple helix population, including scientists not yet interested in “responsible science”.

Practical implications: Findings are important for entities interested in promoting responsible research, e.g. public (e.g. regional) bodies.

Social implications: A better understanding of the factors influencing RRI concept implementation can result in fostering the process which in turn would be beneficial for the society as RRI concept promotes research oriented on public interest.

Originality/value: The paper presents publicly important findings that (with awareness of their limitations) can entail a commitment to achieving sustainable, ethically acceptable, and socially desirable results of research conducted within universities.

Keywords: Responsible Research and Innovation (RRI), R&D, university, knowledge commercialization, quadruple helix.

Category of the paper: Research paper.

1. Introduction

The role of universities has evolved over the centuries. Contemporary universities not only teach or perform science but also engage in the economic and social world. They also consider the natural environment aiming at sustainable development and the preservation or restoration of natural resources. Policymakers as well as scientists actively promote responsible research and innovation (RRI) referring to a research and development process integrating research into a broader social context (Owen, 2013; von Schomberg, 2013). von Schomberg (2013) defined RRI as "a transparent and interactive process in which social actors and innovators respond to each other about the acceptance, sustainability and social needs of innovation processes and their commercial products, to properly integrate scientific and technological advances into our society" (von Schomberg, 2013). This concept has gained importance in the European Union over the past decade. It is therefore essential to understand the factors that can enable the implementation of the concept within higher education institutions and to be aware of the barriers that limit the approach. The paper aims to understand these circumstances with the use of a literature review, retrieved statistical data, and empirical study. The approach included several steps. First, the necessary literature review was conducted to present RRI concept. Then, the information was gathered to present the lodzkie region in the area of R&D and economy. The last (empirical) part was the study in the form of workshops being organized to obtain information on factors influencing the implementation of RRI concept. The paper aims to answer the following research questions:

1. Do researchers and other R&D process stakeholders have any experience with RRI concept?
2. Did implementing RRI concept in research meet any obstacles?
3. Are there any factors fostering RRI?
4. How could we avoid the barriers?

Based on the above-mentioned research questions, the following hypotheses were formulated:

1. Researchers as well as stakeholders of R&D processes have experience with RRI or related approaches.
2. RRI implementation is limited by internal or external factors.
3. Efficient communication between stakeholders can foster RRI implementation.
4. The barriers can be limited or avoided mostly through a better understanding of the idea.

Although scientific research on RRI has been conducted within the last decade (12 years of reference count the average h index 60), there are still some blind fields and the concept as an object of the research loses attractiveness. There are also publications from earlier period of time (Hellstrom, 2003; Gustom, 2004) that refer to responsible innovation, but until then the full term RRI was not used. Five of the most quoted publications concentrate on 2011-2013,

but in recent years the field of study is still present, although not as important as before in quantity. Perhaps now it is generally agreed that responsible forms of innovation must be adapted to the needs of society (de Saille, 2015). The paper brings some important insight into the mechanisms of RRI concept implementation which is important for all stakeholders of R&D and innovation processes (e.g. public bodies and academia management bodies, policy makers) to support research beneficial for the present and future society.

2. Methods

The approach included several steps. First, the necessary literature review was conducted to present RRI concept. Then, the information was gathered to present the lodzkie region in the area of R&D and economy. Statistical data as well as analysis prepared for the public bodies for the purpose of strategic plans preparation were exploited here. The last (empirical) part was the study in the form of workshops being organized to gather information on factors influencing the RRI concept. The workshops aimed to stimulate discussion (in inter-disciplinary groups) about the possibility of including the approach of RRI in R&D projects and university development processes. A detailed description of this last step is presented later in the paper.

3. Responsible Research and Innovation concept

Responsible Research and Innovation (RRI) is a concept that has gained special significance in the last decade in the European Union (EU), referring to a research and development process integrating research into a broader social context (Owen, 2013; von Schomberg, 2013). Google Scholar literature research on “responsible research and innovation” conducted for the period 2000-2023 reveals that such research has been carried out since 2011 and that these 12 years of reference count the average h index 60. There are also publications from earlier period of time (Hellstrom, 2003; Gustom, 2004) that refer to responsible innovation, but until then the full term RRI was not used. Five of the most quoted publications concentrate on 2011-2013, but in recent years the field of study is still present, although not as important as before in quantity. Perhaps now it is generally agreed that responsible forms of innovation must be adapted to the needs of society (de Saille, 2015), and such research as a separate field has lost such an attractiveness. This hypothesis should probably be studied in another paper leading to discoveries of directions of interest in scientific research. As in De Saille (de Saille, 2015), the declaration of the of European Research Area Board in 2009 suggesting a “paradigm change” in the European Research Areas reflects the long journey from the “republic of

science” model (Polanyi, 1962), which perceives science as a neutral space that is not affected by political, social and ethical issues, to the more recent constructivism model, which assumes that science and scientists are intrinsically connected to the world of society, economy and politics (Sturgis and Allen, 2004), and simultaneously constructs science and society (Jasanoff, 2006). This is in line with the development of contemporary universities. RRI promotes open multilateral cooperation with scientists, citizens, policy makers, enterprises and third-party organizations to discuss how science and technology should be best formed, not only to solve today's problems but also to create a desirable world for future generations. More specifically, von Schomberg (2013) defined RRI as "a transparent and interactive process in which social actors and innovators respond to each other with regard to the acceptance, sustainability and social needs of innovation processes and their commercial products, in order to properly integrate scientific and technological advances into our society" (von Schomberg, 2013). The process of RRI can be described in four clusters (Table 1).

Table 1.
Four clusters of RRI process requirements

Cluster	Description
Diversity and inclusion	Diverse and integrated RRI processes must involve a wide range of stakeholders in the early development of science and technology, as well as broaden and diversify sources of expertise, disciplines and perspectives, for reasons of normative democracy. In this regard, inclusive practices should lead to a variety of practices. In contrast, different practices are more likely to include everyone.
Openness and transparency	Openness and transparency are conditions for accountability, liability and thus responsibility. This is an important aspect of establishing public trust in science and politics. However, more openness does not automatically lead to greater trust: information must be adapted to the needs of the stakeholders to make sense to them.
Anticipation and reflexivity	Anticipation involves understanding how the present dynamics of research and innovation practices shape the future and envisioning the future. Thus, one can act on future challenges. To act appropriately and to be open to changes in direction, there is also a need for reflection. This reflection means learning about the definitions of the problem, commitments, practices and individual and institutional values, assumptions and routines.
Responsiveness and adaptive change	Responsiveness means responding to new knowledge, perspectives, views and standards. Responsiveness is a condition for adaptive change. RRI requires the ability to change or shape existing practices and organizational structures and systems in response to changing circumstances, new insights and stakeholders and public values.

Source: Kupper, Klaassen, Rijnen, Vermeulen, Broerse, 2015.

The RRI aims to create a society in which the practices and results of R&I (research and innovation) are committed to achieving sustainable, ethically acceptable and socially desirable results. According to the RRI approach, all people and institutions influencing and devoted to research and innovation are responsible for our future. RRI is interested in predicting the future results of research and innovation processes. Results are not determined individually, but are from and/or present in the description of process requirements. Consequently, attention should be paid to the integrated nature of processes and results in the implementation of the RRI.

4. Regional economy and intelligent specializations in the lodzkie region

The lodzkie region is located in the central part of Poland and covers an area of 18,219 km² (9th place among voivodeships). According to data from the Lodzkie Statistical Office (*Rocznik...*, 2022), in June 2020, lodzkie region was inhabited by 2,448,713 people (6th place in Poland). The population density was higher than the average in Poland and amounted to 135 people/km² (Poland 123 people/km²), in cities it reached 1320 people/km², and in rural areas 54 people/km². The urbanization rate was 62.4%, which gave the lodzkie region 7th place in Poland.

The lodzkie region is quite well developed economically. In 2021, almost 60% of people aged 15 and over in the region were professionally active. In 2021, according to the Lodzkie Statistical Office (*Rocznik...*, 2022), the voivodeship generated 6.1% of gross domestic product, which gave it 6th place in the country. It is worth noting that this share has been almost unchanged for several years (2000 - 6.1%, 2010 - 6%, 2014 - 6.1%, 2018 - 6.0%). In terms of GDP per capita, the voivodeship ranked 5th in the country with regional GDP constituting 95.9% of the national average.

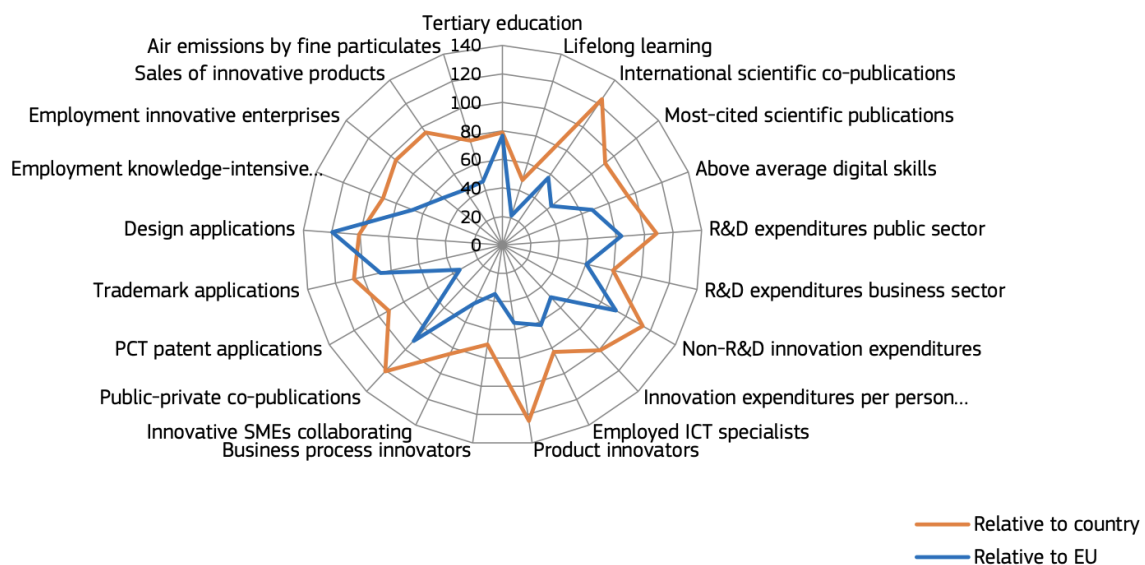


Figure 1. Indicators of the innovation scoreboard – lodzkie region with relation to the country and EU.

Source: Regional Innovation Scoreboard 2023. Regional profiles. Poland. European Commission (2023). Retrieved from: https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-poland.pdf

With accordance to Regional Innovation Scoreboard 2023 Regional... (2023), the lodzkie region is an emerging innovator +. Innovation performance has increased over time. The radar diagram (Figure 1) presents relative strengths compared to Poland (orange line) and the EU (blue line), showing relative strengths (e.g. design applications) and weaknesses (e.g. lifelong learning).

According to the operational program for EU funds for the lodzkie region (*Program regionalny...*, 2022), the reasons for the voivodeship's low innovativeness can be found in its outdated economic profile, uncompetitive industrial processing and the predominance of micro-enterprises, usually characterized by low innovation potential. According to the provisions of this document, the challenge in the coming years is the industrial transformation of the region through the development of more technologically advanced sectors and departments, which will enable the inclusion of regional companies in international chains of producing innovative products.

In 2019, internal expenditure on R&D in the voivodeship accounted for 4.49% of national expenditure, and the enterprise sector is responsible for only approximately 1/3 of them. As stated in the operational program (*Program regionalny...*, 2022) it is necessary to increase the involvement of companies in the implementation of research projects and support cooperation between the science sector and the business area to create lasting relationships. In 2019, in the lodzkie region, only 33.4% of entities operating in the R&D area were equipped with scientific and research equipment, and its consumption rate was one of the highest in Poland (nearly 86%, 15th position in the country). The low level of entrepreneurship among residents and the use of the region's potential in terms of services (including innovative and logistics) were also considered a challenge.

In Regional Innovation Strategy for the Lodzkie Region LORIS 2030 (*Regional...*, 2013) industries with the greatest potential for growth in the lodzkie region have been selected. They include:

- Modern textile and fashion industry (including design).
- Advanced building materials.
- Medicine, pharmacy, cosmetics.
- Energy, including generation of energy from renewable sources;
- Innovative agriculture and food processing.
- IT and telecommunications.

Smart regional specializations are a concept for implementing innovation policy, which involves the effective and synergistic use of public support to strengthen innovative capabilities by focusing on the most promising areas of comparative advantage. Smart specialization can be defined as "the entrepreneurial process of identifying areas of science and technology that can benefit a selected region from specialization" (Foray, 2009). It is currently assumed that in order to effectively use the funds invested in science, research and development, regions should strive to position themselves on the regional "market" rather than fragment investments in areas where they will remain catching-up regions anyway. This approach is intended to ensure an increase in the impact of individual European Union policies on regional economies. The result would be a more efficient use of public funds, while simultaneous stimulation of grassroots activities. Scientific projects that comply with regional smart strategies can be perceived as reflecting the RRI perspective as they respond to economic needs and challenges of the regional environment.

5. Academy and R&D in lodzkie region – main data

The lodzkie voivodship is a significant academic centre in Poland, where, according to the Lodzkie Statistical Office (*Rocznik...*, 2022), in the academic year 2021/22 there were 19 higher education institutions with 71038 students with a staff of 5953. In terms of positions in the *Ranking Perspektywy 2023 – ranking of Polish universities (Ranking...*, 2023), in 2020 the positions of public universities in Łódź ranged from 9th (Łódź University of Technology) through 11th (Medical University of Łódź) to 25th (University of Łódź) out of approximately 90 universities in the country.

According to the Lodzkie Statistical Office (*Rocznik...*, 2022), in 2021 412 entities conducted research and development activities in the lodzkie voivodship compared to 299 in 2019 which means an increase of 37% (*Rocznik...*, 2023). In 2019, intramural expenditure on research and development (GERD) amounted to 1360 000 000 PLN (at current prices) and rose by 11.4% per year and 58.4% compared to 2017 (*Nauka...*, 2020). The R&D intensity indicator (GERD/GDP) for 2018 reached 0.94%, and was 0.22% higher than for 2017. Current expenditure dominated intramural R&D expenditure structure – 86.2%, while capital expenditure accounted for 13.8%. In the lodzkie region, intra-mural expenditures on R&D were financed mainly from government sectors and corporate funds. The resources of these sectors accounted for 41.7% and 32.8% of intra-mural expenditure in R&D. The structure of intra-mural expenditure on R&D projects is dominated by basic research, which accounts for 794.6 million PLN, or 58.4% of total expenditure. Funds of 428.0 billion PLN have been allocated for experimental development and 137.4 billion PLN for applied research. As in previous years, the largest expenditures on research and development activities were devoted to engineering (34.1%), medical and health (26.7%) and natural sciences (14.5%). The share of other research and development areas in intra-mural research and development expenditure was 24.7%. In 2019, research and development personnel numbered 13.9 thousand, i.e. 10.1% more than the previous year and 5.2% more than 2017. The actual involvement of research and development personnel in scientific research and experimental development was 7.2 thousand full-time equivalents in 2019. Researchers accounted for 74.2% of internal research and development staff, measured as full-time equivalents (2018 72.4% and 2017 80.4%). More than one quarter of R&D personnel had at least a Ph.D. degree, and the personnel structure was dominated by people with master's, bachelor's or equivalent degrees (41.0% in 2019).

According to *The Development Strategy of the Lodzkie Region 2030 (The Development Strategy...*, 2021), Research and Development Centers provide additional technical and scientific support for specific industries and specializations. These are scientific units or entrepreneurs that are not research institutes but conduct research or development work. In 2020, 41 entities in Poland had the CBR status, including 445 from the lodzkie region.

The problem, however, is the insufficient level of cooperation between the R&D sphere and enterprises - in the lodzkie region, less than 4.5% of enterprises cooperated in the field of innovative activities, compared to 5.1% on average in the country.

6. Factors affecting the implementation of Responsible Research and Innovation concept in scientific projects –workshop study approach

As part of the activities of the University of Lodz in RiEcoLab project, a participatory approach of various stakeholders (internal and external) was applied to the process of integrating the concept of RRI into higher education. RiEcoLab stands for *Responsible Innovation-led Entrepreneurial University Transformation Centres (Ecosystem Integration Labs)*. The project was developed under Horizon 2020 and was supported by EIT (European Institute of Innovation & Technology) within HEI Initiative: Innovation Capacity Building for Higher Education. The main aim and an overall joint vision of the RiEcoLab project (<https://riecolab.eu>) is to develop a novel way R&D is being performed in universities to ensure immediate commercialization (spinoffs) and involvement of a large number of internal stakeholders (academic and non-academic staff, students).

For the purpose of gathering information on factors affecting the RRI implementation process, the workshop was conducted. The workshop aimed to stimulate discussion (in interdisciplinary groups) about the possibility of including principles of responsible research and innovation in R&D projects and university development processes.

It was assumed that the research interests of the scientific team applying for the workshop must be reliant on the smart specializations of the lodzkie region. Smart specializations reflect the publicly important research areas from a regional point of view. The recruitment process was open and finally, the workshop involved researchers of 8 scientific projects which complied with the smart specialization of the lodzkie region:

- 1 project in compliance with “IT and personalized design”,
- 2 project in compliance with sustainable agriculture and agri-food industry,
- 5 projects in compliance with “innovative medical industry, pharmaceuticals and cosmetics”.

The workshop was also addressed to internal and external stakeholders of University of Lodz. They were recruited mainly via networking, already existing links with the university and faculty’s partners and stakeholders. During the workshop the following stakeholders took part:

1. Academia.
2. NGO.
3. Industry.

4. Public sector.
5. Internal.

A total of 31 participants took part in this workshop.

The agenda of Responsible Research and Innovation workshop included presentation of the project RiEcoLab, presentations of the scientific projects, presentations of the participants, presentation of Responsible Research and Innovation concept, workshop on embedding Responsible Research and Innovation in university R&D processes.

During the main part of the workshop, participants worked in groups consisting in 6-7 people. They were provided with sheets of paper and worked on the following issues:

1. The past, which is behind us:
 - a. What is behind us, i.e. what we have already implemented?
 - b. What we have achieved, i.e. examples of good practices (adopted solutions).
 - c. What could have gone better, or where we went wrong. How could we avoid them? What actions have been taken (i.e. how have we managed the risk)?
 - d. Who did we include in the research process to meet the requirements consistent with RRI? Who was the key partner from this point of view? What was his contribution? At what stages of the research/project was it involved?
 - e. Which of the previously used solutions was valuable, and we can already use it due to, for example, system solutions?
2. The present, which is here and now:
 - a. Do we find the RRI principles valuable? Why?
 - b. What are our strengths?
 - c. What are our weaknesses?
 - d. What drives us, i.e. what motivates us?
 - e. What drives us to follow RRI principles?
 - f. What is the greatest value of our research/project?
 - g. What do we still not know?
 - h. Have our attitudes changed or are we just following the system?
3. The future is what lies ahead:
 - a. What are we planning for the future?
 - b. What about the RRI principles, or how will we apply them?
 - c. What is the biggest challenge/limitation? (including gender balance, data access and management, open access publication, ethics).
 - d. What are the biggest risks and how can we counteract them?
 - e. What do we need (what resources) to comply with RRI principles?
 - f. What kind of partners do we need to meet the RRI principles? In what areas can they play a key role? Do they want to get involved? How do we want to engage them?
 - g. What role could the university play?
 - h. What role could co-operating units play?

- i. What changes should take place in your institution?
- j. How to make the results of works/research "responsive", "market oriented", "user friendly". What will this mean in practice?

Above listed questions were not closed list and motivated participants to brainstorming, vivid discussions and ideas and experiences sharing. 4 moderators assisted participants helping to generate ideas and clarify or collect them. Ideas were noted on the small adhesive stickers. This enabled the broader discussion while presenting the results of brainstorming in groups.

7. Results

The RRI workshop revealed some important factors present in the concept implementation processes and possibilities of embedding. The study confirmed hypotheses which were formulated. Some factors are supporting, other limiting the R&D processes in universities to become more responsible and environment/stakeholders oriented. Key lessons learned are:

1. Science already has some experience in implementing this approach, although these activities are not free of barriers and limitations.
2. The principles of RRI require wider popularization, especially in terms of the benefits of their application.
3. There is no doubt about the important role of internal and external stakeholders of the activities carried out, although, as noted, universities encounter certain problems here, such as insufficient social trust in science, which was, for example revealed during Covid 19 pandemic.
4. There is a need to promote reliable scientific knowledge, to strengthen social awareness of its role in the development of the world. The channels and models of communication have to take into consideration heterogeneity of the recipients.
5. It is necessary to strengthen the understanding of the seemingly different points of view of different stakeholders on expected values.
6. Communication between participants in innovation processes is important in order to improve the efficiency of activity in the sphere of RRI, including mechanisms of inclusive decision-making.
7. Not all scientific projects are successful right away and need support.
8. The scope of political or policy interference in science seems to be oversized.
9. Universities need well-qualified administrative structures enabling RRI to be vertically and horizontally implemented in higher education institutions.
10. Not all scientists are interested in achieving wider impact of their scientific achievements. There is a need of broader dissemination of the 3rd role of contemporary universities.

8. Discussion

The presented research has many shortcomings. First, it would be recommended to deeply investigate in what directions international research has evolved in terms of fields related to the RRI concept. Knowing these trends, the analysis of internal and external mechanisms influencing the possibility of RRI concept implementation in academia would be more precious. Secondly, the study provides insight based on one study with a relatively small sample. What is more, the attendants were already involved in socially/economically/environmentally responsible activity as researchers represented projects that complied with regional specializations. Also, the stakeholders were reached through channels of contacts related to entities already involved in some relations with academia. Although it was possible to capture the main ideas on how to foster the RRI concept, it is important to execute wider research on a sample representative for a whole quadruple helix population, including scientists not interested in “responsible science”. Thirdly, it should be investigated if and which stakeholders still need to be familiarized with the necessity of involving science in positive change in the world. It would also be worth confirming whether the academic society is widely in such an agreement. The analysis of the practical dimension of the use of RRI concepts should involve various research methods.

9. Summary

The concept of Responsible Research and Innovation enables a broader view of university research and development activities. It is an approach that allows for a new perspective on the impact of academia on the external environment. From a regional perspective, such support can be executed within projects in compliance with regional smart specializations. This is why for the purpose of the study, representatives of scientific projects responding for the needs of such smart specializations have been selected. The study confirmed the hypotheses which were formulated. It confirmed that science already has some experience in implementing RRI approach, although these activities are not free of barriers and limitations. The principles of RRI require wider popularization, especially in terms of the benefits of their application. There is no doubt about the important role of internal and external stakeholders of the activities carried out. However, as noted, universities encounter certain problems here, such as insufficient social trust in science. The research revealed some important factors affecting the ability to implement the RRI concept. One of the most important findings is that there is a need to promote reliable scientific knowledge, to strengthen social awareness of its role in the socio-economic system. What is more, it is necessary to strengthen the understanding of the apparent

different views of different stakeholders on the expected values. Finally, communication between participants in innovation processes and cooperation is important in order to improve the efficiency of activity in the sphere of responsible research and innovation, including mechanisms of inclusive decision-making.

Generalization of the results is yet limited. The literature study needs to be deepened and include other than RRI but similar concepts. Secondly, the study provides insight based on one study with a relatively small sample, and the choice of participants was oriented toward those who engage themselves in wider participation (with various stakeholders of R&D processes). Thirdly, it should be investigated if and which stakeholders still need to be familiarized with the necessity of involving science in positive change in the world. It would also be worth confirming whether the academic society is widely in such an agreement. Further research should be based on more differential study methods.

Nevertheless, the paper has some practical and theoretical implications. From the practical point of view, the results are useful for R&D practitioners as well as bodies supporting R&D processes as they help optimize innovation and research processes in the field of their public value. From the theoretical point of view, it should be noticed, that regarding the limitations of the study, more advanced research should be conducted to wider and deepen the knowledge on limitations and drivers of RRI.

Acknowledgements

I would like to thank the team from the Faculty of Management of the University of Lodz implementing the project RiEcoLab – RESPONSIBLE INNOVATION-LED ENTREPRENEURIAL UNIVERSITY TRANSFORMATION CENTRES (ECOSYSTEM INTEGRATION LABS), financed by HORIZONT 2020, for our joint work, thanks to which this article was created.

For more information about a project, please refer to the following website:
<https://riecolab.eu>

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THE USAGE OF POKA-YOKA IN INDUSTRY 4.0 CONDITIONS

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Purpose: The purpose of this publication is to present the usage of Poka-Yoka 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 Poka-Yoke with Industry 4.0 signifies a transformative leap in error prevention methodologies, aligning seamlessly with the objectives of advanced manufacturing. By merging the principles of Poka-Yoke with smart technologies like sensors, IoT devices, and real-time data analytics, a dynamic and sophisticated approach to error prevention emerges in the era of Industry 4.0. With applications ranging from simple visual cues to complex technological solutions, Poka-Yoke finds resonance across various industries, particularly in the automotive sector, where sensors and devices on assembly lines swiftly detect and rectify deviations, elevating both product quality and operational efficiency. The incorporation of artificial intelligence and machine learning in Industry 4.0 augments Poka-Yoke, enabling systems not only to identify errors but also to learn from them, fostering continuous improvement and adaptability in response to evolving production scenarios. Emphasizing proactive error prevention at the source, continuous improvement, and a commitment to training and education, the key principles outlined in Table 1 contribute to creating resilient, reliable processes delivering consistently high-quality outputs. Table 2 demonstrates the seamless integration of Poka-Yoke with Industry 4.0, showcasing technological advancements that collectively form an adaptive approach to error prevention and quality management. Additionally, Table 3 highlights the advantages of this integration, emphasizing improved quality control, operational efficiency, and adaptability in modern manufacturing environments. However, challenges outlined in Table 4, including complex implementation, data security concerns, high initial costs, interoperability issues, and skill gaps, necessitate strategic planning and investment in overcoming obstacles. In conclusion, the integration of Poka-Yoke with Industry 4.0 signifies a strategic evolution, where technology-driven error prevention, continuous improvement, and a commitment to quality converge to create resilient, adaptive, and highly efficient manufacturing systems, positioning this integration as a cornerstone for excellence in the evolving landscape of industrial production.

Originality/value: Detailed analysis of all subjects related to the problems connected with the usage of Poka-Yoka in Industry 4.0 conditions.

Keywords: Industry 4.0; Quality 4.0, quality management; quality methods, Poka-Yoka.

Category of the paper: literature review.

1. Introduction

Poka-yoke principles align seamlessly with the goals of Industry 4.0 by addressing the challenges and opportunities presented in this era of advanced manufacturing. The use of sensors, Internet of Things (IoT) devices, and real-time data analytics enables a more sophisticated and dynamic approach to error prevention. In smart factories, these technologies play a pivotal role in monitoring and controlling processes, offering the capability to detect deviations from the norm instantly.

One notable aspect of poka-yoke in Industry 4.0 is the integration of artificial intelligence (AI) and machine learning algorithms. These technologies empower systems to not only identify errors but also learn from them, continuously improving and adapting to evolving production scenarios. Predictive analytics, powered by AI, contribute to a preemptive approach, allowing for the anticipation and elimination of potential issues before they escalate (Barsalou, 2023; Maganga, Taifa, 2023).

The purpose of this publication is to present the usage of Poka-Yoka approach in Industry 4.0 condition.

2. The basics of Poka-Yoka approach

Poka-yoke, a term originating from Japan, translates to "mistake-proofing" or "error prevention" in English. It refers to a method or approach employed in various industries to eliminate or reduce errors in processes by designing systems that prevent mistakes or make them immediately apparent. The concept of poka-yoke revolves around the idea that human errors are inevitable, but their consequences can be mitigated through thoughtful design. By incorporating fail-safes and intuitive mechanisms into workflows, businesses aim to minimize the occurrence and impact of mistakes (Gajdzik et al., 2023).

Poka-yoke techniques can take various forms, ranging from simple visual cues to sophisticated technological solutions. For instance, using color-coding, shape differentiation, or specific labeling can help operators identify correct components or steps in a process (Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). Additionally, physical constraints or mechanisms can be implemented to prevent improper actions, ensuring that processes unfold seamlessly (Jokovic et al., 2023).

The automotive industry is one sector where poka-yoke is extensively applied. Assembly lines are equipped with sensors and devices that detect deviations from the standard procedures, instantly alerting operators to rectify the issue. This not only enhances product quality but also contributes to overall efficiency by reducing the need for rework.

Poka-yoke aligns with the broader philosophy of continuous improvement and lean manufacturing. It emphasizes the importance of preventing errors at the source rather than relying solely on inspections or corrections downstream. This proactive approach not only reduces the likelihood of defects but also fosters a culture of accountability and attention to detail within organizations. As industries continue to evolve and embrace automation, the principles of poka-yoke remain relevant. By integrating error-proofing measures into processes, businesses can enhance reliability, customer satisfaction, and ultimately, their bottom line (Alrabadi et al., 2023).

Automation, a cornerstone of Industry 4.0, synergizes effectively with poka-yoke strategies. Automated systems can be designed with inherent error-proofing mechanisms, ensuring that tasks are executed accurately and consistently. Robots and autonomous machines equipped with sensors can navigate complex workflows with precision, minimizing the risk of errors and enhancing overall operational efficiency. Furthermore, the connectivity fostered by Industry 4.0 facilitates the seamless communication of data across the entire production ecosystem. This interconnectedness enables a holistic view of the manufacturing process, allowing for a comprehensive poka-yoke strategy that spans the entire value chain (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; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021).

The usage of poka-yoke in Industry 4.0 conditions represents a strategic evolution of error prevention methodologies. By leveraging the capabilities of advanced technologies, industries can create resilient, adaptive, and highly efficient manufacturing systems. The integration of poka-yoke in the era of Industry 4.0 reflects a commitment to quality, innovation, and the continuous pursuit of excellence in the ever-evolving landscape of industrial production (Singh et al., 2023).

Table 1 contains description of Poka-Yoka key principles. These principles collectively contribute to the overarching goal of Poka-Yoke, which is to create processes and systems that are robust, reliable, and capable of consistently delivering high-quality outputs.

Table 1.
Key principles of Poka-Yoka

Key principle	Description
Elimination of Defects	Poka-Yoke focuses on preventing defects and errors at the source rather than detecting them later in the process. The goal is to eliminate the possibility of mistakes before they occur.
Simplicity	Poka-Yoke systems should be simple and easy to understand. Complex systems can be prone to failure or may not be used effectively by operators. Simplicity encourages widespread adoption and success.
Fail-Safe Mechanisms	Incorporate fail-safe mechanisms that automatically correct or highlight errors. This ensures that even if a mistake occurs, it is quickly identified and rectified before it leads to a defect.
Feedback and Alarms	Provide immediate feedback to operators when an error is made. This could be visual or auditory alarms that alert the operator to the mistake, allowing for prompt correction.
Preventive (Anticipatory) Design	Design processes and systems with anticipation of potential errors. By understanding where mistakes are likely to occur, preventive measures can be implemented to avoid those errors altogether.
Source Inspection	Shift the focus from inspection at the end of the process to inspection at the source. By inspecting components or inputs as early as possible, defects can be identified and corrected before they propagate through the entire process.
100% Inspection	Aim for 100% inspection or verification to ensure that no defects escape undetected. This involves checking every unit or output for errors, leaving no room for defective products to reach the customer.
Autonomation (Jidoka)	Incorporate automation to detect and stop the production process when a defect is identified. This prevents the production of defective items and allows for timely correction.
Training and Education	Provide comprehensive training to operators to ensure they understand the importance of error prevention and are equipped with the knowledge and skills to use Poka-Yoke effectively.
Continuous Improvement	Implement a culture of continuous improvement where the Poka-Yoke system is regularly reviewed and updated. This ensures that it remains effective in preventing errors in the evolving production environment.

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 Poka-Yoka method can be integrated with Industry 4.0 and Quality 4.0 concept

The integration of the Poka-Yoke method with the Industry 4.0 framework and the concept of Quality 4.0 represents a synergistic approach toward enhancing manufacturing processes in the digital era. Industry 4.0, characterized by the use of smart technologies and interconnected systems, aligns seamlessly with the principles of Poka-Yoke, contributing to a more sophisticated and adaptive quality management system (Maganga, Taifa, 2023).

In the context of Industry 4.0, the deployment of advanced sensors, IoT devices, and real-time data analytics facilitates the early detection of deviations or errors in production processes (Sulkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Gajdzik, Wolniak, 2023; Swarnakar et al., 2023). Poka-Yoke principles can

be applied in conjunction with these technologies to create intelligent, self-correcting systems. For instance, sensors can monitor various aspects of production, and if a deviation from the norm is detected, automated corrective actions can be initiated, preventing the production of defective goods (Bousdekis et al., 2023).

The concept of Quality 4.0, which leverages digital technologies for comprehensive quality management, aligns with Poka-Yoke's emphasis on error prevention. Integrating Poka-Yoke into a Quality 4.0 framework means incorporating mistake-proofing mechanisms at every stage of the value chain. This includes not only the prevention of defects in the manufacturing phase but also extends to aspects such as supply chain management, logistics, and customer interactions (Jonek Kowalska, Wolniak, 2021; Jonek-Kowalska, Wolniak, 2022).

Furthermore, the data generated by Industry 4.0 technologies can be utilized to continuously improve Poka-Yoke systems. Machine learning algorithms can analyze historical data to identify patterns and root causes of errors, allowing for the refinement of error-prevention strategies. This dynamic feedback loop enables organizations to adapt and optimize their processes in real-time, fostering a culture of continuous improvement.

Integrating the Poka-Yoke method with Industry 4.0 and Quality 4.0 enhances the effectiveness of error prevention by leveraging digital technologies, real-time data analytics, and automation. This holistic approach not only ensures the production of high-quality goods but also contributes to the overall agility and resilience of manufacturing systems in the rapidly evolving landscape of the Fourth Industrial Revolution.

Table 2 is listing examples of integration of Poka-Yoka method with Industry 4.0. These aspects collectively contribute to the integration of Poka-Yoke with Industry 4.0, fostering a technologically advanced and adaptive approach to error prevention and quality management in manufacturing processes (Antony et al., 2023; Escobar et al., 2023; Antony et al., 2023; Salimbeni, Redchuk, 2023).

Table 2.

Poka-Yoka integration with industry 4.0

Aspect	Description
Sensors and IoT Devices	Integration of advanced sensors and Internet of Things (IoT) devices to monitor and collect real-time data from production processes. Sensors can detect deviations, abnormalities, or potential errors, enabling proactive error prevention.
Automation and Robotics	Leveraging automated systems and robotics for the implementation of Poka-Yoke mechanisms. Automated processes can quickly identify errors and take corrective actions, minimizing the need for human intervention and reducing the risk of human error in repetitive tasks.
Data Analytics	Utilizing data analytics tools to analyze large datasets generated by sensors and other sources. This allows for the identification of patterns, trends, and root causes of errors, enabling organizations to make data-driven decisions for continuous improvement and optimization of Poka-Yoke systems.
Artificial Intelligence	Incorporating artificial intelligence (AI) algorithms for advanced error detection and prediction. AI can learn from historical data to anticipate potential issues, enhance the accuracy of error prevention measures, and adapt to evolving production environments for improved overall system efficiency.

Cont. table 2.

Connectivity and Interoperability	Ensuring seamless connectivity and interoperability between different components of the production ecosystem. Integration with Industry 4.0 involves creating a network where devices, systems, and processes can communicate and share information in real-time, facilitating a cohesive and responsive production environment.
Cyber-Physical Systems	Integrating cyber-physical systems where physical processes are connected with digital systems. This integration enables the synchronization of physical actions with digital information, allowing for real-time monitoring, control, and coordination of production processes in line with Poka-Yoke principles.
Predictive Maintenance	Implementing predictive maintenance strategies based on data analytics to anticipate and address potential issues before they lead to equipment failures or errors in the production process. This proactive approach aligns with Poka-Yoke principles to prevent defects and disruptions in manufacturing operations.
Cloud Computing	Utilizing cloud computing for storage, processing, and analysis of large volumes of data generated by integrated systems. Cloud-based solutions provide scalability, accessibility, and collaborative capabilities, supporting the effective implementation and management of Poka-Yoke measures across diverse manufacturing facilities.

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 visual management approach usage in industry 4.0. These advantages highlight how the synergy between Poka-Yoke and Industry 4.0 technologies contributes to improved quality control, operational efficiency, and adaptability in modern manufacturing environments.

Table 3.

The advantages of Poka-Yoka integration with industry 4.0

Advantage	Description
Real-time Error Detection	Integration with Industry 4.0 enables real-time monitoring through sensors and IoT devices. This results in the immediate detection of errors or abnormalities in production processes, allowing for prompt corrective actions and minimizing the likelihood of defective products reaching the end of the line.
Increased Automation and Efficiency	By combining Poka-Yoke with automation and robotics in an Industry 4.0 setting, there is a significant increase in process efficiency. Automated systems can quickly identify and rectify errors, reducing manual intervention, streamlining workflows, and optimizing overall production efficiency.
Data-Driven Decision Making	The integration facilitates the collection and analysis of large datasets through data analytics tools. This data-driven approach allows organizations to make informed decisions, identify root causes of errors, and continuously improve Poka-Yoke systems based on insights derived from real-time and historical data.
Adaptability to Dynamic Environments	The use of artificial intelligence (AI) in Poka-Yoke integration with Industry 4.0 enhances adaptability. AI algorithms can learn from evolving production environments, adjusting error prevention strategies accordingly. This adaptability is crucial in today's fast-paced manufacturing landscape, ensuring the resilience of quality control measures.
Enhanced Connectivity and Communication	Integration with Industry 4.0 promotes seamless connectivity and interoperability between various components of the production ecosystem. This facilitates efficient communication between devices and systems, fostering a collaborative and responsive manufacturing environment that aligns with the principles of Poka-Yoke.

Cont. table 3.

Proactive Predictive Maintenance	The integration allows for predictive maintenance strategies based on data analytics. By anticipating equipment issues before they lead to errors, organizations can implement timely maintenance, preventing disruptions and ensuring the continuous functionality of the production systems in line with Poka-Yoke objectives.
Scalability and Accessibility	Cloud computing in Industry 4.0 provides scalability and accessibility benefits. Organizations can easily scale their Poka-Yoke systems across multiple facilities, and cloud-based solutions enable remote access and collaboration, enhancing the manageability and effectiveness of error prevention measures.

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 Poka-Yoka approach usage in Industry 4.0 and methods to overcome them. Addressing these problems requires a comprehensive approach that combines technological solutions, organizational strategies, and a commitment to change management principles. By proactively tackling these challenges, organizations can maximize the benefits of visual management integration with Industry 4.0.

Table 4.

The problems of Poka-Yoka integration with industry 4.0

Problems	Description of Problem	Overcoming Strategies
Complex Implementation Challenges	The integration of Poka-Yoke with Industry 4.0 may face challenges due to the complexity of implementing advanced technologies, such as sensors, AI, and IoT devices, in existing manufacturing systems. Integrating these technologies seamlessly can be a complex and resource-intensive process.	Conduct thorough planning and feasibility studies before implementation. Collaborate with experienced technology providers. Provide comprehensive training to personnel. Gradual implementation phases to minimize disruptions. Ensure strong communication and collaboration between IT and operational teams.
Data Security and Privacy Concerns	The increased connectivity and data exchange in Industry 4.0 raise concerns about data security and privacy. The integration of Poka-Yoke with sensitive data may expose vulnerabilities, leading to potential breaches or unauthorized access, which could compromise the effectiveness and reliability of error prevention systems.	Implement robust cybersecurity measures, including encryption and access controls. Comply with relevant data protection regulations. Regularly update and patch security systems. Conduct regular audits and assessments of cybersecurity protocols. Establish clear data governance policies and educate personnel on security best practices.
High Initial Costs and Resource Investments	The adoption of Industry 4.0 technologies and the integration of Poka-Yoke can entail significant initial costs, including the acquisition of advanced hardware, software, and personnel training. Organizations may face financial challenges in justifying and allocating resources for the integration.	Develop a comprehensive cost-benefit analysis to showcase long-term savings and benefits. Explore potential funding or financing options. Consider phased implementation to spread costs over time. Leverage government incentives or grants for technology adoption. Collaborate with technology vendors for cost-sharing or flexible payment plans.

Cont. table 4.

Interoperability Issues with Legacy Systems	Existing legacy systems in manufacturing environments may not seamlessly integrate with modern Industry 4.0 technologies. Interoperability challenges between legacy systems and new components can lead to data inconsistencies, communication breakdowns, and hinder the smooth functioning of integrated Poka-Yoke systems.	Prioritize compatibility when selecting new technologies. Invest in middleware solutions to bridge the gap between legacy and modern systems. Develop a roadmap for gradual legacy system upgrades. Collaborate with vendors to ensure compatibility. Establish clear communication protocols and standards for data exchange.
Skill Gaps and Workforce Training Needs	The integration of advanced technologies requires a skilled workforce capable of managing and maintaining these systems. Skill gaps may arise, leading to challenges in effectively utilizing Industry 4.0 tools and Poka-Yoke integration. Workforce training and upskilling become crucial to maximize the benefits of the integrated system.	Invest in comprehensive training programs for existing staff. Collaborate with educational institutions to develop tailored training modules. Recruit or hire personnel with the necessary skills. Foster a culture of continuous learning and development. Provide ongoing training and support as technology evolves.

Source: (Almeida, Abreu, 2023; Jokovic et al., 2023; Khoureshed, 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 Poka-Yoke with Industry 4.0 represents a strategic evolution in error prevention methodologies, aligning seamlessly with the goals of advanced manufacturing. The marriage of Poka-Yoke principles with smart technologies, such as sensors, IoT devices, and real-time data analytics, offers a dynamic and sophisticated approach to error prevention in the era of Industry 4.0.

Poka-Yoke's foundation in eliminating or reducing errors through thoughtful design finds resonance in various industries, with applications ranging from simple visual cues to complex technological solutions. The automotive industry stands out as a notable example, employing sensors and devices on assembly lines to detect and rectify deviations promptly, enhancing both product quality and operational efficiency.

In the context of Industry 4.0, the integration of artificial intelligence and machine learning brings a transformative dimension to Poka-Yoke. These technologies empower systems not only to identify errors but also to learn from them, leading to continuous improvement and adaptability in response to evolving production scenarios. Predictive analytics, fueled by AI, contributes to a preemptive approach, allowing organizations to anticipate and eliminate potential issues before they escalate. Table 1 outlines key principles of Poka-Yoke, emphasizing the proactive nature of error prevention at the source, continuous improvement,

and a commitment to training and education. These principles collectively contribute to creating robust, reliable processes capable of consistently delivering high-quality outputs.

The seamless integration of Poka-Yoke with Industry 4.0 is evident in Table 2, showcasing aspects such as sensors, automation, data analytics, artificial intelligence, and connectivity. These elements collectively form a technologically advanced and adaptive approach to error prevention and quality management, fostering efficiency and reliability in manufacturing processes.

Furthermore, Table 3 highlights the advantages of this integration, emphasizing real-time error detection, increased automation, data-driven decision-making, adaptability to dynamic environments, enhanced connectivity, proactive predictive maintenance, and scalability. These advantages underscore how the synergy between Poka-Yoke and Industry 4.0 technologies contributes to improved quality control, operational efficiency, and adaptability in modern manufacturing environments. However, as presented in Table 4, challenges arise during the integration of Poka-Yoke with Industry 4.0, including complex implementation, data security concerns, high initial costs, interoperability issues with legacy systems, and skill gaps. Overcoming these challenges requires meticulous planning, cybersecurity measures, cost-benefit analyses, prioritizing compatibility, and investing in workforce training and development.

The integration of Poka-Yoke with Industry 4.0 signifies a strategic evolution in manufacturing practices, where technology-driven error prevention, continuous improvement, and a commitment to quality converge to create resilient, adaptive, and highly efficient manufacturing systems. The collaborative efforts of stakeholders, coupled with technological advancements, position this integration as a cornerstone for excellence in the ever-evolving landscape of industrial production.

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THE USAGE OF SMART LOCKS IN SMART HOME

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Purpose: The purpose of this publication is to present the usage of smart doorbells in smart locks.

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 smart locks into the fabric of smart homes represents a groundbreaking advancement, reshaping the dynamics of security and convenience. These intelligent locks have surpassed traditional mechanisms, ushering in an era where digital authentication and advanced features redefine how individuals secure and engage with their living spaces. Smart locks empower homeowners with unparalleled control and accessibility, eliminating the need for physical keys and introducing heightened security through encryption and biometric identification. Emphasizing their pivotal role in smart homes, the publication highlights the ability of smart locks to remotely monitor and control access, providing unprecedented flexibility, especially in scenarios involving trusted individuals. The seamless integration of smart locks within the broader smart home ecosystem fosters an interconnected environment, enabling holistic automation and enhancing user experience and energy efficiency. While acknowledging challenges such as vulnerabilities and power dependency, the publication underscores the vast advantages of smart locks, ranging from enhanced security to increased home resale value. Tables 1, 2, and 3 provide a comprehensive overview of key features, advantages, and challenges, serving as a valuable guide for navigating the evolving landscape of smart home security. As technology advances, smart locks continue to shape the future of residential living, fortifying the boundaries between physical and digital security.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of smart locks in smart home.

Keywords: Smart City, energy efficiency, smart home, smart house, digitalization, smart locks.

Category of the paper: literature review.

1. Introduction

The integration of smart locks within the framework of smart homes has emerged as a pivotal advancement, reshaping the landscape of modern home security and convenience.

In an era characterized by rapid technological evolution, these intelligent locks have transcended traditional locking mechanisms, offering a myriad of features that redefine the way individuals interact with and secure their living spaces.

At its core, the primary function of smart locks is to provide homeowners with enhanced control and accessibility to their properties. The conventional use of physical keys has given way to more sophisticated methods of entry, with smart locks often relying on digital authentication mechanisms. This shift not only eliminates the need for cumbersome key management but also introduces a new level of security through encrypted protocols and biometric identification (Chen et al., 2023).

The purpose of this publication is to present the usage of smart window blinds in smart locks.

2. Smart locks in smart home

One of the most prominent features of smart locks is the ability to remotely monitor and control access to one's home. Through dedicated mobile applications, users can lock or unlock doors from virtually anywhere, granting unprecedented flexibility in managing entry points. This capability proves invaluable in scenarios where homeowners need to provide access to trusted individuals, such as guests, service providers, or even family members, without the necessity of physical keys or on-site presence (Dhaou, 2023).

Furthermore, the integration of smart locks into the broader ecosystem of smart homes fosters a seamless interconnectedness. These locks often synergize with other smart devices, enabling a holistic automation of household tasks. For instance, unlocking the front door may trigger the lights to turn on, the thermostat to adjust to a preferred temperature, and security cameras to temporarily deactivate. This level of automation not only enhances the overall user experience but also contributes to energy efficiency and the optimization of daily routines.

In terms of security, smart locks offer an array of advanced features that surpass traditional lock-and-key systems (Gajdzik et al., 2023; Jonek-Kowalska, Wolniak, 2021; Jonek-Kowalska, Wolniak, 2022). Real-time alerts and notifications keep homeowners informed about any suspicious activities or unauthorized attempts at entry. Additionally, the ability to audit and track access history provides a comprehensive overview of who has entered or exited the premises, instilling a sense of accountability and transparency (Olabode et al., 2023).

The utilization of biometric authentication methods, such as fingerprint scanning or facial recognition, adds an extra layer of security, ensuring that only authorized individuals gain access. Moreover, many smart locks employ robust encryption protocols, safeguarding against hacking attempts and unauthorized digital breaches (Patheja et al., 2023).

While the adoption of smart locks undoubtedly enhances security and convenience, it is not without its challenges (Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). Concerns about potential vulnerabilities, system reliability, and the reliance on power sources for electronic components necessitate careful consideration during implementation. Moreover, the interoperability of various smart home devices remains a critical aspect that requires standardization to ensure seamless integration and optimal performance (Ameur et al., 2023; Bsarir-Ozel et al., 2023).

The usage of smart locks in smart homes represents a transformative paradigm in the realm of residential security and convenience (Tong et al., 2023). The amalgamation of digital authentication, remote access control, and integration with other smart devices redefines the traditional concept of home security. As technology continues to advance, the evolution of smart locks is likely to persist, shaping the future of residential living and fortifying the boundaries between physical and digital security (Valencia-Arias et al., 2023).

Table 1 contains descriptions of key features of smart locks usage.

Table 1.

Key features of smart locks usage

Key Features of smart locks	Description
Remote Access Control	Enables users to lock or unlock doors from anywhere via a mobile app, enhancing convenience and flexibility.
Digital Authentication	Replaces traditional keys with digital methods such as PIN codes, fingerprint scanning, or facial recognition for heightened security.
Integration with Smart Home Devices	Synergizes with other smart devices, triggering automation sequences upon door entry or exit for enhanced home efficiency.
Real-time Alerts and Notifications	Sends immediate notifications about any suspicious activities, providing homeowners with instant awareness and peace of mind.
Access History Tracking	Maintains a detailed log of who enters or exits the premises, contributing to accountability and transparency in home security.
Biometric Authentication	Utilizes biometric data (fingerprint, facial features) for access, offering an additional layer of secure and personalized entry.
User-Specific Access Control	Allows homeowners to grant temporary or specific access to guests, service providers, or family members without physical keys.
Auto-Locking Feature	Automatically locks the door after a specified period, reducing the risk of accidental or negligent security lapses.
Voice Activation	Permits users to control the lock through voice commands, enhancing accessibility and hands-free operation.
Geo-fencing Technology	Utilizes location-based services to trigger lock actions, ensuring doors automatically lock or unlock when users enter predefined zones.
Emergency Access Options	Provides alternative entry methods (e.g., backup codes or physical keys) in case of technological malfunctions or emergencies.
Tamper Alerts	Notifies users if the lock detects any tampering or unauthorized attempts, further bolstering security measures.
Battery Status Monitoring	Keeps users informed about the status of the lock's power source, preventing unexpected lockouts due to depleted batteries.
Temporary Access Codes	Generates one-time or time-limited codes for specific individuals, enhancing security during short-term access requirements.
Smartphone Compatibility	Ensures compatibility with a wide range of smartphones, accommodating different operating systems and device preferences.

Cont. table 1.

Weather Resistance	Designed to withstand various weather conditions, ensuring optimal performance and durability regardless of external elements.
Manual Override	Incorporates a manual key override as a failsafe in situations where electronic components may fail or during power outages.
Multi-User Management	Facilitates the management of multiple users with distinct access privileges, catering to diverse household and occupancy scenarios.
Secure Encryption Protocols	Implements robust encryption to safeguard against hacking attempts and unauthorized digital breaches, ensuring data integrity.
Easy Installation and Setup	Streamlines the installation process and user setup, making smart lock adoption accessible to a wide range of homeowners.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

3. The advantages and problems of using smart locks

The adoption of smart locks presents a myriad of advantages that transcend traditional locking mechanisms. Foremost among these advantages is the enhanced security they offer. With features like digital authentication and real-time alerts, smart locks minimize the risk of unauthorized access, providing homeowners with a heightened sense of safety. Remote access control stands out as another key benefit, allowing users to monitor and manage their locks from virtually anywhere using dedicated mobile applications (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; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021). This capability not only enhances convenience but also offers flexibility in controlling access to one's home (Douha et al., 2023).

The integration of smart locks with other smart devices within the home ecosystem is a pivotal advantage. This synergy enables seamless automation, such as adjusting lighting or thermostat settings upon door entry, contributing to a more efficient and connected living environment. User-specific access control is a feature that resonates with homeowners seeking flexibility in managing access permissions. The ability to grant temporary or customized access to guests or service providers without relying on physical keys adds an extra layer of convenience and security (Huda et al., 2024).

The maintenance of access history is a valuable aspect, providing homeowners with a comprehensive record of who has entered or exited their property (Raff et al., 2024). This feature enhances accountability and transparency in home security. Biometric authentication, a hallmark of many smart locks, ensures secure access by utilizing unique biometric data such as fingerprints or facial recognition. This adds an additional layer of protection against unauthorized entry (Chaudhari et al., 2023).

Real-time notification alerts contribute to immediate awareness by keeping users informed about any suspicious activities or unauthorized attempts at entry. This proactive approach to security enhances peace of mind for homeowners (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Gajdzik, Wolniak, 2023; Swarnakar et al., 2023). Energy efficiency is a noteworthy advantage, as smart locks seamlessly integrate with other smart home systems. This integration allows for energy-efficient automation, such as adjusting temperature settings or turning off lights when the door is locked, contributing to overall energy savings (Sobhani et al., 2023).

The convenience and flexibility offered by smart locks are further underscored by features like remote unlocking, the sharing of virtual keys, and task automation (Wu et al., 2023). These aspects empower homeowners with greater control over their living spaces. Geo-fencing technology adds an extra layer of automation and security by leveraging location-based services. Smart locks can automatically lock or unlock doors as users enter or leave predefined zones, enhancing both convenience and safety (Alsaedi et al., 2023).

Finally, the integration of smart locks can contribute to increased resale value for homes. The appeal of modern security features and technological conveniences often resonates with prospective buyers, positioning homes with smart locks at the forefront of the real estate market (Ramanujam et al., 2024).

Table 2 highlighting the advantages of using smart locks in smart home.

Table 2.

Advantages of using smart locks

Advantage	Description
Enhanced Security	Smart locks provide advanced security features, such as digital authentication and real-time alerts, minimizing the risk of unauthorized access and enhancing overall home safety.
Remote Access Control	Users can remotely monitor and control their locks, allowing for convenient management of access to their homes from anywhere using a mobile app, enhancing flexibility and control.
Integration with Smart Devices	Integration with other smart home devices enables seamless automation, such as adjusting lighting or thermostat settings upon door entry, contributing to a more efficient and connected home.
User-Specific Access Control	Homeowners can grant temporary or customized access to guests or service providers without physical keys, offering greater flexibility and security in managing access permissions.
Access History Tracking	Smart locks maintain a detailed log of entry and exit activity, providing homeowners with a comprehensive record of who has accessed their property, enhancing accountability and transparency.
Biometric Authentication	Utilizing biometric data for access, such as fingerprints or facial recognition, adds an extra layer of security by ensuring that only authorized individuals gain entry to the home.
Notification Alerts	Real-time alerts and notifications keep users informed about any suspicious activities or unauthorized attempts at entry, providing immediate awareness and peace of mind.
Energy Efficiency	Integration with smart home systems allows for energy-efficient automation, such as adjusting temperature settings or turning off lights when the door is locked, contributing to overall energy savings.

Cont. table 2.

Convenience and Flexibility	The ability to unlock doors remotely, share virtual keys, and automate tasks enhances overall convenience, providing homeowners with greater flexibility and control over their living spaces.
Geo-fencing Technology	Leveraging location-based services, smart locks can automatically lock or unlock doors as users enter or leave predefined zones, adding an extra layer of automation and security to the home.
Increased Resale Value	Homes equipped with smart locks often appeal to tech-savvy buyers, potentially increasing the resale value of the property due to the added security and modern conveniences they provide.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

Table 3 highlighting some of the common problems and challenges associated with the problems of using smart locks in smart homes.

Table 3.
Problems of using smart locks

Problem	Description	Methods of Overcoming
Vulnerability to Hacking	Smart locks, being connected to the internet, may be susceptible to hacking attempts, potentially compromising home security.	Implementing robust cybersecurity measures, such as regular software updates, strong encryption, and using reputable smart lock brands, can enhance resistance to hacking.
Power Dependency	Smart locks rely on power sources, and in the event of a power outage or device malfunction, there's a risk of being locked out or compromising security.	Installing smart locks with backup power options, such as battery backup or manual override keys, ensures continued functionality during power interruptions.
Initial Cost	The upfront cost of purchasing and installing smart locks can be higher compared to traditional locks, potentially deterring budget-conscious homeowners.	Exploring budget-friendly options, waiting for sales or discounts, and considering long-term savings in terms of enhanced security and convenience can justify the initial investment.
Compatibility Issues	Compatibility challenges may arise, especially in older homes or with other smart home devices, potentially limiting the seamless integration of the smart lock.	Thoroughly researching and selecting smart locks that are compatible with existing systems and devices, and checking for firmware updates, can help address compatibility issues.
Connectivity Reliability	Reliance on internet connectivity or Bluetooth may pose challenges in areas with unstable or weak signals, leading to delays or failures in remote access.	Using smart locks with alternative connectivity options, such as Z-Wave or Zigbee, can provide more reliable connections, and having a backup physical key ensures access in connectivity issues.
Privacy Concerns	The collection of user data by smart lock manufacturers may raise privacy concerns, as personal information could be vulnerable to misuse or unauthorized access.	Researching and selecting smart locks from reputable manufacturers with transparent privacy policies and understanding how data is handled can help alleviate privacy concerns.
Technological Obsolescence	Rapid advancements in technology may result in smart locks becoming obsolete or incompatible with newer devices, potentially requiring frequent upgrades.	Choosing smart locks with upgradable firmware and staying informed about industry standards can prolong the lifespan of the technology and mitigate the impact of technological obsolescence.

Cont. table 3.

Physical Vulnerabilities	Mechanical components of smart locks may still be susceptible to physical tampering or forced entry, compromising the overall security of the lock.	Installing additional physical security measures, such as reinforced strike plates or deadbolts, alongside the smart lock can bolster overall resistance to physical attacks.
Learning Curve	Users unfamiliar with technology may experience a learning curve in understanding and effectively using the features of smart locks, potentially leading to user errors.	Providing comprehensive user manuals, instructional guides, and customer support can assist users in overcoming the learning curve, ensuring proper utilization of the smart lock.
Limited Aesthetics Choices	The design and aesthetic choices for smart locks may be limited compared to traditional locks, potentially impacting the visual harmony of certain architectural styles.	Exploring various smart lock models and brands to find designs that complement the aesthetics of the home, or considering smart lock retrofit options, can address limitations in aesthetics.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

4. Conclusion

The integration of smart locks into the fabric of smart homes marks a transformative leap in the realms of security and convenience. The evolution of these intelligent locks has transcended traditional locking mechanisms, ushering in an era where digital authentication mechanisms and advanced features redefine the way individuals secure and interact with their living spaces.

Smart locks, at their core, empower homeowners with unprecedented control and accessibility to their properties. The shift from conventional physical keys to digital authentication not only eliminates the burdens of key management but also introduces a heightened level of security through encrypted protocols and biometric identification. The publication emphasizes the pivotal role of smart locks in the broader landscape of smart homes, highlighting their ability to remotely monitor and control access. This capability, facilitated through dedicated mobile applications, offers unparalleled flexibility in managing entry points, especially in scenarios involving trusted individuals like guests, service providers, or family members.

Furthermore, the seamless integration of smart locks within the broader ecosystem of smart homes fosters an interconnected environment. This synergy enables holistic automation, where unlocking the front door can trigger a cascade of actions, such as adjusting the thermostat and activating security cameras, enhancing both user experience and energy efficiency. In terms of security, smart locks boast advanced features, including real-time alerts, access history tracking, and biometric authentication methods. These features contribute to a comprehensive security framework, instilling a sense of accountability and transparency within residential spaces.

However, it is essential to acknowledge the challenges associated with smart lock adoption, including potential vulnerabilities, power dependency, and compatibility issues. Overcoming these challenges requires robust cybersecurity measures, backup power options, thorough research on compatibility, and staying informed about technological advancements. The advantages of using smart locks are vast, ranging from enhanced security and remote access control to energy efficiency and increased resale value for homes. The convenience and flexibility offered by smart locks, coupled with their integration capabilities, redefine the traditional concept of home security.

Table 1 provides a detailed overview of key features crucial to understanding the functionality and benefits of smart locks, while Table 2 highlights the myriad advantages of incorporating smart locks into smart homes. Additionally, Table 3 identifies and addresses potential problems and challenges associated with smart lock usage, presenting methods to overcome these issues. As technology continues to advance, the trajectory of smart locks remains promising, shaping the future of residential living and fortifying the boundaries between physical and digital security. The comprehensive understanding of both the advantages and challenges presented in this publication serves as a valuable guide for homeowners and stakeholders navigating the evolving landscape of smart home security.

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THE USAGE OF SMART SPRINKLER SYSTEM IN SMART HOME

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Purpose: The purpose of this publication is to present the usage of smart sprinkler system in smart homes.

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 a Smart Sprinkler System within the context of a Smart Home represents a groundbreaking convergence of technology and water management, reshaping conventional approaches to lawn care and irrigation. This innovative system epitomizes a seamless fusion of convenience, efficiency, and sustainability in the modern landscape of home automation. Operating on real-time data and intelligent algorithms, the Smart Sprinkler System ensures precise water usage by dynamically adapting to environmental changes, avoiding over-watering or under-watering, and aligning with conservation efforts. The publication emphasizes the system's connectivity, leveraging the Internet of Things (IoT) for remote control and integration into smart home ecosystems. Notable features include energy efficiency, aesthetics enhancement, and integration with other devices. While the advantages are evident, the accompanying tables comprehensively detail key features, advantages, and potential challenges, providing a nuanced perspective for homeowners and highlighting the ongoing evolution of these systems in advancing sustainable, efficient, and connected living experiences.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of smart sprinkler system in smart home.

Keywords: Smart City, energy efficiency, smart home, smart house, digitalization, smart sprinkler system.

Category of the paper: literature review.

1. Introduction

A Smart Sprinkler System in the context of a Smart Home represents a pioneering integration of technology and water management, revolutionizing the traditional approach to lawn care and irrigation. In the contemporary era of home automation, this system stands out

as a testament to the seamless fusion of convenience, efficiency, and sustainability (Wu et al., 2023).

At its core, the Smart Sprinkler System is designed to cater to the specific needs of a lawn or garden by leveraging real-time data and intelligent algorithms. This level of precision ensures that water is utilized judiciously, avoiding over-watering or under-watering, thereby contributing to water conservation efforts. Through the integration of weather data, soil moisture levels, and even local watering restrictions, the system adapts dynamically to the ever-changing environmental conditions (Chaudhari et al., 2023).

The purpose of this publication is to present the usage of smart sprinkler system in smart home.

2. Smart sprinkler system in smart home

One of the standout features of this innovative system lies in its connectivity. Harnessing the power of the Internet of Things (IoT), the Smart Sprinkler System can be controlled remotely through dedicated smartphone applications or integrated into existing smart home ecosystems (Patheja et al., 2023). This connectivity not only provides homeowners with the flexibility to manage their irrigation system from anywhere in the world but also facilitates real-time monitoring and adjustment. Moreover, the system often incorporates advanced sensors and moisture detectors strategically placed throughout the landscape (Douha et al., 2023). These sensors continuously gather data, enabling the Smart Sprinkler System to make informed decisions about when and where to water. The ability to create custom watering schedules based on specific plant types or landscaping zones further enhances the system's adaptability and efficiency (Alsaedi et al., 2023).

Energy efficiency is another critical aspect of the Smart Sprinkler System (Afroz et al., 2024). With the integration of smart sensors, the system optimizes water distribution, minimizing wastage and promoting a sustainable approach to lawn care. This not only aligns with the broader environmental goals of smart home technologies but also translates into cost savings for homeowners over the long term (Raff et al., 2024).

In addition to the environmental and economic benefits, the Smart Sprinkler System contributes to the overall aesthetics of the smart home landscape. The automation of the irrigation process eliminates the need for manual intervention, reducing the burden on homeowners and allowing them to enjoy a well-maintained and lush garden effortlessly (Sobhani et al., 2023).

As technology continues to evolve, the Smart Sprinkler System represents a glimpse into the future of smart home landscaping (Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022). Its ability to seamlessly integrate with other smart devices, learn from user behaviors, and adapt to environmental variables positions it as a cornerstone of modern, connected living (Ramanujam et al., 2024). Ultimately, this innovation not only elevates the efficiency of traditional irrigation methods but also underscores the potential of smart home technology to enhance the quality of life for homeowners (Ameur et al., 2023).

Table 1 contains descriptions of key features of smart sprinkler system usage.

Table 1.

Key features of smart sprinkler system usage

Key Features of System Sprinkler	Description
Precision Watering	The smart sprinkler system utilizes real-time data, including weather conditions and soil moisture levels, to deliver precise and efficient watering. This minimizes water wastage by avoiding over-watering or under-watering, promoting water conservation.
Remote Control	Through the integration of IoT technology, users can control and monitor the sprinkler system remotely using dedicated smartphone applications. This feature provides homeowners with the flexibility to manage their irrigation system from anywhere, enhancing convenience and adaptability.
Dynamic Adaptation	The system dynamically adapts to changing environmental conditions, adjusting watering schedules based on factors such as temperature, humidity, and local watering restrictions. This ensures that the irrigation process remains responsive and optimized for the specific needs of the lawn or garden.
Customized Watering Schedules	Homeowners can create customized watering schedules tailored to the unique requirements of different plant types or landscaping zones. This feature allows for a personalized approach to lawn care, optimizing water distribution based on specific characteristics and preferences.
Sensor Integration	Advanced sensors and moisture detectors strategically placed throughout the landscape continuously collect data. This data informs the system's decision-making process, enabling it to make informed choices about when and where to water. Sensor integration enhances the overall efficiency of the sprinkler system.
Energy Efficiency	The smart sprinkler system optimizes water distribution, reducing energy consumption and promoting sustainable lawn care practices. By minimizing water wastage, homeowners not only contribute to environmental conservation efforts but also benefit from long-term cost savings associated with efficient water usage.
Integration with Smart Home	The system seamlessly integrates with other smart home devices and ecosystems, allowing for a cohesive and interconnected home automation experience. Integration capabilities enable users to manage the sprinkler system alongside other smart technologies, streamlining overall home maintenance and control.
Automated Operation	Automation eliminates the need for manual intervention in the irrigation process. The system operates autonomously based on predefined schedules, environmental data, and user preferences. This automated operation reduces the workload on homeowners, providing them with a hands-free and effortlessly maintained garden or lawn.

Cont. table 1.

Learning Capabilities	Some smart sprinkler systems incorporate machine learning algorithms to analyze user behavior and adapt the watering patterns accordingly. Over time, the system learns from usage patterns, optimizing its performance to align with the specific needs and preferences of the homeowner and the landscape.
Enhanced Aesthetics	Beyond functionality, the smart sprinkler system contributes to the overall aesthetics of the smart home landscape. The automation of irrigation processes ensures a consistently well-maintained and lush garden, enhancing the visual appeal of the outdoor space and complementing the modern, connected living experience.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

3. The advantages and problems of using smart sprinkler system

Implementing a smart sprinkler system offers a myriad of advantages, revolutionizing the conventional approach to lawn care and irrigation. One significant benefit lies in water conservation, as these systems employ precision watering based on real-time data, mitigating over-watering and under-watering (Valencia-Arias et al., 2023). This not only contributes to environmental sustainability but also results in cost savings for homeowners by optimizing water usage and minimizing energy consumption (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 convenience and flexibility afforded by smart sprinkler systems are unparalleled. With remote control capabilities through dedicated smartphone applications, users can effortlessly manage and monitor their sprinkler systems from anywhere. This adaptability allows for real-time adjustments to settings, schedules, and responses to changing weather conditions without requiring physical presence (Dhaou, 2023).

Efficient lawn care is another notable advantage. Customized watering schedules, dynamic adaptation to environmental changes, and sensor integration ensure that each part of the landscape receives the appropriate amount of water (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Gajdzik, Wolniak, 2023). This promotes healthy plant growth and maintains an aesthetically pleasing lawn without the need for constant manual intervention. The integration of smart sprinkler systems with other devices and ecosystems within a smart home further enhances their utility. This interconnectedness enables users to coordinate and control their sprinkler system alongside other smart technologies, fostering a unified and efficient smart home experience (Hussain et al., 2023; Chen et al., 2023).

The automated operation of smart sprinkler systems eliminates the need for manual intervention, making lawn care a hands-free experience. Operating autonomously based on predefined schedules, weather data, and user preferences, these systems reduce the time and effort homeowners need to dedicate to maintaining their outdoor spaces (Hussain et al., 2023). Beyond the immediate benefits, smart sprinkler systems contribute to environmental conservation by promoting responsible water usage and reducing the ecological footprint associated with traditional irrigation methods (Tong et al., 2023; Rhode et al., 2023). Additionally, a well-maintained, lush lawn enhances the curb appeal of a property, potentially increasing its value (Gajdzik et al., 2023; Jonek-Kowalska, Wolniak, 2021; Jonek-Kowalska, Wolniak, 2022).

Some smart sprinkler systems go a step further with learning capabilities, analyzing user behavior to adapt watering patterns over time. This adaptive learning optimizes the system's efficiency by tailoring watering schedules to the specific needs and preferences of the homeowner and the unique characteristics of the lawn or garden (Bsarir-Ozel et al., 2023; Olabode et al., 2023).

Smart sprinkler systems provide a time-saving, cost-effective, and environmentally conscious solution to lawn care, offering homeowners an effortless way to maintain a beautiful and sustainable outdoor space.

Table 2 highlighting the advantages of using smart sprinkler system in smart home.

Table 2.

Advantages of using smart sprinkler system

Advantage	Description
Water Conservation	Smart sprinkler systems employ precision watering based on real-time data, reducing water wastage by avoiding over-watering or under-watering. This contributes to water conservation efforts and aligns with sustainable practices, promoting responsible use of this valuable resource.
Cost Savings	By optimizing water usage and minimizing energy consumption, smart sprinkler systems lead to long-term cost savings for homeowners. Efficient irrigation reduces water bills and lowers energy costs, providing an economic benefit alongside environmental conservation.
Convenience and Flexibility	Remote control capabilities via smartphone applications offer unparalleled convenience. Homeowners can manage and monitor their sprinkler system from anywhere, providing flexibility in adjusting settings, creating schedules, and responding to changing weather conditions without the need for physical presence.
Efficient Lawn Care	Customized watering schedules, dynamic adaptation to environmental changes, and sensor integration contribute to efficient lawn care. The system ensures that each part of the landscape receives the appropriate amount of water, promoting healthy plant growth and maintaining an aesthetically pleasing lawn without manual intervention.
Integration with Smart Homes	Smart sprinkler systems seamlessly integrate with other smart home devices and ecosystems. This integration allows users to control and coordinate their sprinkler system alongside other smart technologies, fostering a unified and interconnected smart home experience that enhances overall efficiency and management.

Cont. table 2.

Automated Operation	Automation eliminates the need for manual intervention, making lawn care a hands-free experience. The system operates autonomously based on predefined schedules, weather data, and user preferences, reducing the time and effort homeowners need to dedicate to maintaining their outdoor spaces.
Environmental Impact	Smart sprinkler systems contribute to environmental conservation by promoting responsible water usage. Precision watering and efficient irrigation practices align with eco-friendly principles, reducing the ecological footprint associated with traditional, less controlled irrigation methods.
Enhanced Property Value	A well-maintained, lush lawn enhances the curb appeal of a property. Smart sprinkler systems contribute to the overall aesthetic appeal of the landscape, potentially increasing property value. A beautifully manicured lawn adds to the visual attractiveness of the home, making it more appealing to potential buyers or tenants.
Learning and Adaptation	Systems with learning capabilities analyze user behavior and adapt watering patterns over time. This adaptive learning enhances the system's efficiency by tailoring watering schedules to the specific needs and preferences of the homeowner and the unique characteristics of the lawn or garden, further optimizing water usage.
Time-Saving and Effortless	The combination of automation, remote control, and efficient operation reduces the time and effort homeowners need to invest in lawn care. Smart sprinkler systems streamline the irrigation process, allowing users to enjoy a beautifully maintained garden without the manual labor traditionally associated with watering and maintaining outdoor spaces.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

Table 3 highlighting some of the common problems and challenges associated with the problems of using smart sprinkler system in smart homes.

Table 3.
Problems of using smart sprinkler system

Problem	Description	Methods of Overcoming
Initial Cost	The upfront cost of installing a smart sprinkler system, including the purchase of devices, sensors, and controllers, can be a barrier for some homeowners. This initial investment may discourage adoption, especially for those on a tight budget.	Research and Comparison: Conduct thorough research to identify cost-effective options and compare different smart sprinkler systems. DIY Installation: Some systems offer straightforward DIY installation, reducing installation costs. Government Rebates: Explore potential rebates or incentives offered by local governments for the installation of water-saving devices, which may offset initial costs.
Technical Complexity	The technical complexity of smart sprinkler systems may pose a challenge for users who are not tech-savvy. Setting up the system, configuring settings, and troubleshooting technical issues may be intimidating for some homeowners.	User-Friendly Interfaces: Choose a system with a user-friendly interface and clear instructions for installation and configuration. Professional Installation: Opt for professional installation services if available, ensuring that the system is set up correctly. Customer Support: Select a system with robust customer support to assist users with any technical challenges they may encounter.

Cont. table 3.

<p>Dependency on Connectivity</p>	<p>Smart sprinkler systems heavily rely on a stable internet connection and may face challenges if connectivity issues arise. Interruptions in connectivity can hinder remote control functionality and the ability to receive real-time weather updates, impacting the system's performance.</p>	<p>Backup Systems: Some smart sprinkler systems come with backup options, such as offline schedules or local control via Bluetooth. Stable Internet: Ensure a reliable internet connection, and consider implementing redundancies such as a secondary internet service provider or a backup power source for routers. Offline Operation: Choose a system that can operate offline based on pre-set schedules without constant reliance on internet connectivity.</p>
<p>Compatibility with Existing Setup</p>	<p>Compatibility issues may arise when integrating a smart sprinkler system with an existing irrigation setup. Incompatibility with current wiring, valves, or irrigation infrastructure may require additional modifications, adding complexity to the installation process.</p>	<p>Compatibility Checks: Before purchasing, verify compatibility with existing irrigation components. Professional Assessment: Seek advice from irrigation professionals to assess compatibility and identify necessary modifications. Consult Manufacturer Support: Contact the manufacturer's support for guidance on integration and potential challenges with existing setups.</p>
<p>Power Source Dependency</p>	<p>Smart sprinkler systems rely on a stable power source to operate efficiently. Power outages or disruptions may affect the system's functionality, leading to missed watering schedules and potential issues with the automated operation.</p>	<p>Battery Backup: Choose a system with battery backup capabilities to ensure continued operation during power outages. Uninterruptible Power Supply (UPS): Consider using a UPS to provide temporary power during outages. Solar-Powered Options: Explore solar-powered smart sprinkler systems that reduce dependency on traditional power sources and enhance resilience during power interruptions.</p>
<p>Limited Compatibility with Landscaping Features</p>	<p>Some smart sprinkler systems may not be compatible with certain landscaping features such as drip irrigation systems, specialized plants, or complex garden layouts. This limitation can hinder the system's ability to cater to the diverse needs of different landscapes.</p>	<p>1. Compatibility Research: Prior to installation, research the system's compatibility with various irrigation methods and landscaping features. 2. Customization Options: Choose systems that offer customization features to adapt to different landscaping needs. 3. Consultation with Experts: Seek advice from landscaping professionals to assess compatibility and explore workarounds for specialized features.</p>
<p>Weather Prediction Inaccuracy</p>	<p>Smart sprinkler systems rely on weather data for efficient watering schedules. However, inaccuracies in weather predictions can lead to suboptimal watering, with the system either over-watering or under-watering based on inaccurate forecasts.</p>	<p>1. Multiple Data Sources: Integrate the system with multiple weather data sources to improve accuracy. 2. Sensor-Based Adjustment: Utilize soil moisture sensors to supplement weather data, allowing the system to adapt in real-time based on current conditions. 3. Regular Calibration: Periodically calibrate the system and adjust settings based on observed weather patterns rather than solely relying on predictive data.</p>
<p>Security and Privacy Concerns</p>	<p>The connectivity of smart sprinkler systems to the internet raises security and privacy concerns. Unauthorized access to the system could lead to tampering with watering schedules or the potential exposure of personal data.</p>	<p>Secure Network Configuration: Ensure that the network used by the smart sprinkler system is secure, with strong passwords and encryption. Regular Software Updates: Keep the system's firmware and software up to date to address potential security vulnerabilities. Privacy Settings: Review and adjust privacy settings within the system's application to limit data sharing and access permissions.</p>

Cont. table 3.

Dependency on External Services	Some smart sprinkler systems rely on external cloud services for functionality. If these services experience downtime or discontinuation, it may impact the system's ability to receive updates, operate remotely, or access certain features.	Offline Functionality: Choose systems that offer offline functionality for essential features, allowing the system to operate independently of external services. Vendor Reliability: Select reputable vendors with a history of reliable service and a commitment to maintaining infrastructure. Data Backup: Regularly back up system settings and configurations to mitigate potential data loss in the event of service disruptions.
Maintenance and Upkeep	Regular maintenance is crucial for the optimal performance of smart sprinkler systems. Issues such as clogged nozzles, sensor malfunctions, or wear and tear on components can arise over time, requiring attention and potential replacements.	Scheduled Maintenance: Implement a routine maintenance schedule to inspect and clean nozzles, sensors, and other components. System Health Monitoring: Choose systems with built-in diagnostic features that alert users to potential issues, facilitating proactive maintenance. Professional Services: Consider professional maintenance services to ensure thorough inspections and address potential problems before they escalate.
Limited Local Watering Regulations Integration	Smart sprinkler systems may not seamlessly integrate with local watering regulations, leading to unintentional violations. This lack of synchronization can result in penalties or restrictions imposed by local authorities.	Manual Schedule Adjustments: Regularly check and adjust watering schedules to align with local regulations, even if not directly integrated. Regular Updates: Keep the system's software up to date to ensure compatibility with any changes or updates to local watering regulations. Communication with Authorities: Stay informed about local watering regulations and proactively communicate with local water authorities to address any concerns or seek guidance on compliance.

Source: (Gøthesen et al., 2023; Alsaedi et al., 2023; Chaudhari et al., 2023; Huda et al., 2024; Husain et al., 2023; Rhode et al., 2023; Basarir-Ozel et al., 2023; Tong et al., 2023; Chen et al., 2023; Douha et al., 2023; Sobhani et al., 2023).

4. Conclusion

The integration of a Smart Sprinkler System within the framework of a Smart Home signifies a groundbreaking fusion of technology and water management, reshaping traditional approaches to lawn care and irrigation. This system epitomizes a harmonious blend of convenience, efficiency, and sustainability in the contemporary landscape of home automation. At its essence, the Smart Sprinkler System operates on real-time data and intelligent algorithms, meticulously tailored to the specific requirements of a lawn or garden. The precision in watering ensures judicious use of water, aligning with conservation efforts by avoiding over-watering or under-watering. By dynamically adapting to environmental changes through the integration of weather data, soil moisture levels, and local watering restrictions, the system stands as an innovative solution for modern landscape management.

The publication aims to shed light on the utilization of smart sprinkler systems in smart homes. Noteworthy is the system's connectivity, leveraging the Internet of Things (IoT) to enable remote control through dedicated smartphone applications and integration into existing smart home ecosystems. This connectivity, coupled with advanced sensors and moisture detectors, empowers the system to make informed decisions, creating custom watering schedules tailored to specific plant types or landscaping zones. Energy efficiency is a pivotal aspect, with smart sensors optimizing water distribution, minimizing waste, and fostering sustainable lawn care. The resulting cost savings align with environmental goals while enhancing economic viability for homeowners. Beyond functionality, the system's automation contributes to the aesthetic appeal of the smart home landscape, eliminating the need for manual intervention and providing homeowners with a consistently well-maintained garden.

As a beacon of future smart home landscaping, the Smart Sprinkler System exemplifies seamless integration with other devices, learning capabilities, and adaptability to environmental variables. Its role extends beyond improving traditional irrigation methods, showcasing the potential of smart home technology to elevate homeowners' quality of life. With advancements continuing to unfold, the system promises a glimpse into the evolving landscape of modern, connected living. Table 1 details key features of smart sprinkler system usage, highlighting its precision watering, remote control capabilities, dynamic adaptation, customized schedules, sensor integration, energy efficiency, integration with smart homes, automated operation, learning capabilities, and its contribution to enhanced aesthetics.

Table 2 outlines the advantages of using a smart sprinkler system, emphasizing water conservation, cost savings, convenience, efficient lawn care, integration with smart homes, automated operation, environmental impact, enhanced property value, learning capabilities, and the time-saving, effortless nature of its operation. However, Table 3 delves into the potential challenges and problems associated with smart sprinkler systems, offering detailed descriptions of each issue and suggesting methods for overcoming or mitigating these challenges. These include considerations such as initial costs, technical complexity, dependency on connectivity, compatibility with existing setups, power source dependency, landscaping feature compatibility, weather prediction inaccuracies, security and privacy concerns, reliance on external services, maintenance and upkeep, and integration with local watering regulations.

While smart sprinkler systems present unparalleled advantages, acknowledging and addressing potential challenges ensures a holistic understanding of their implementation in smart homes. The ongoing evolution of these systems reflects a commitment to advancing sustainable, efficient, and connected living experiences for homeowners.

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ADJUSTING THE LENS – QUALITY MANAGEMENT IN V4 COUNTRIES THROUGH TIMES OF CRISES

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Purpose: The idea of the study is to understand fluctuation in quality management depending on organizational context. The primary purpose of this article is to analyze changes in quality management in four countries grouped in V4 (The Visegrad Group) in the prism of macroeconomic crises, over the last five years. The following research question was formulated: What influences market saturation with a formal approach to quality management (ISO 9001 certificates), and when?

Design/methodology/approach: The considerations are based on a systematic literature review (SLR) and an analysis of the long-term data of ISO survey – certifications. The data was compared among V4 countries and an attempt was made to relate the results to economy-wide indicators, especially in turbulent environments.

Findings: The results show no clear and unidirectional relationships between the number of ISO 9001 certifications and macroeconomic data. This was identified for the V4 group as a whole and for individual countries, as well. Implementation of the QMS is an individual decision of each organization, depending on closely related microeconomic factors.

Research limitations/implications: Research findings always represent a slice of a larger reality. In that research paper limitations concern: the period of analysis, literature review in English and supplemented locally in the native languages, focusing on the V4 area. Findings implicate quality management's perceptions need to adjust the lens to understand macro numbers of certificates by the circumstances and adjust micro decisions in organizations in the QM area depending on the crisis phase on the market.

¹ This article was produced with the support of a Visegrad Fellowship #62310004 awarded by the International Visegrad Fund.

Originality/value: The article analyses certification data in previously unrepresented form. Results were compared between V4 countries in the prism of times of crisis with an indication of certificate saturation rates and an attempt to explain macroeconomic fluctuations. The research results are helpful for researchers exploring quality management issues, and all organizations that can relativize the importance of quality management.

Keywords: quality, quality management, V4 countries, crisis management.

Category of the paper: research paper.

1. Introduction – connecting the dots

The quality of products (commodities and services) is the basis for the functioning of any organization in the market. Adequate quality (tailored to customers) is the result of repeatable processes as a result of effective process ownership and the role of employees, notably process owners (Danilova, 2019), which cannot be overestimated. Quality Management has become a mainstream managerial approach for improving products, services, and business processes in order to generate superior customer satisfaction and pursue competitive advantage (Dahlgaard-Park et al., 2018). Product Quality in the field of business has been explored from different perspectives and Rosillo-díaz et al. (2022) indicated (after a bibliometric analysis of 3484 documents published between 1989-2019) the timeliness of this topic over the years. It can be noted that price has become a sign of basic quality, that is, a variable essential in determining a product's perceived quality (Rosillo-díaz et al., 2022). Of course, individually, the price-quality relationship is not always directly proportional, which is connected with different business practices (and marketing strategies) of individual organizations. The same is true of having an "ISO 9001 certificate", an organization that has implemented a Quality Management System (QMS) does not necessarily carry out its processes in a repetitive manner and thus the products resulting from them are not always of adequate quality. Although all consumer categories perceive products, services, and organizations certified to international management system standards favourably, the inclination towards certification is greater among developing economies than in developed economies (Yadav et al., 2022). In general, there is a positive relationship between quality management system (QMS) certification and employee- and customer-related company performance (Milovanović et al., 2023). But the cause-effect relation is not so obvious, in individual cases. Dick et al. (2008) concluded that quality management system certification has an influence on business performance but also there is an opposite relationship – whereby better-performing firms self-select to adopt ISO 9001 certification. What on the micro-scale can be considered in individual circumstances takes on a more general shape on the macro scale. Carnerud & Bäckström (2019) identified and depicted the key areas around which quality research has orbited during the past 37 years. They identified seven central topics around which quality research has centred during this period: Service

Quality & Customer Satisfaction; Process Design & Control; ISO Certification & Standards; TQM – Implementation, Performance & Culture; QM – Practices & Performance; Reliability, Costs, Failure & Problems and Excellence – BEMs, Quality Awards & Excellence in Higher Education (Carnerud, Bäckström, 2019). Research on quality is still vibrant and relevant but thematic concentration is variable and dependent on the external conditions of a particular organization, at a given time.

Time and space influence the economic conditions in individual organizations. Repeatable processes are disrupted from both internal sources (the organization – its resources, including employees) and external sources (the near and far environment). Control systems are used by organizations to detect internal and external changes in order to gain business goals but they may not be sufficient in turbulent environment, thus there is a need to develop capabilities to be responsive to disruptions (Madani, Parast, 2023). It means to enhance organizational resilience which is defined as the “ability of an organization to absorb and adapt in a changing environment” (ISO 22316, 2017, point 3.4, p. 1). The main purpose of organizational resilience is to boost effective reactions against crises with the view to assure business continuity during disruptions. The understanding of crisis management is diverse in the literature and depends on the characteristics of the organization (Khodarahmi, 2009). Organizational crisis (a crisis that affects the organization, regardless of the source) is described as “a disruptive, unstable event that requires decisions to be made quickly to avert the threat to survival” (Andres, Heo, 2023). The CRISIS framework guides crisis management in six steps: Coping, Rethinking, Initiating, Sensing, Intervening, and Sandbagging (Chong, 2004). But this is the sequence of actions in the crisis phase, activities grouped in a reaction set. In business, it is important to take preventive measures and anticipate and prevent crises, including learning from previous ones. This means that crisis management consists of actions taken in three phases according to the most common Smith’s model (Bhaduri, 2019): pre-crisis, crisis response, and post-crisis. One possible way to take preventive action is to use the “Risk-based thinking” that is promoted in ISO 9001 standard. “Risk-based thinking enables an organization to determine the factors that could cause its processes and its quality management system to deviate from the planned results, to put in place preventive controls to minimize negative effects and to make maximum use of opportunities as they arise” (ISO 9001, 2015, p. vi).

Product quality is the basis for the organization's existence in the market. Quality management system influences the repeatability of quality and "ISO 9001 certification" influences the perception in the market. The result of operations is influenced by proper process management, within which “risk-based thinking” is taken into account. So the question arises – Can an “ISO 9001 system” strengthen organizational resilience and support an organization in crisis? Zapłata & Wiśniewski (2022) indicated in a case-study that a certified quality management system can be a tool to assure business continuity in a crisis. But there is a need to identify that relation in the macro view.

Two areas of research emerge from the above: the importance of product quality, the role of the ISO 9000 system, and the importance of QMS in a changing environment (during crisis time).

1.1. Research area – 5W: what, which way, when, where, why

In theory, certified quality management system ISO 9001 can be a tool to assure business continuity in crisis, because of the “risk-based thinking” internal mechanism. The question is – is it possible to take this observation to the macro scale? In the literature, there is no research about the number of ISO 9001 certificates depending on the crisis macroeconomic situation. There is a scientific gap and identification that relation could help in raising awareness of the role of quality management systems in business continuity.

Description of the research area contains five elements – 5W:

1. **What.** Analysis of fluctuation in “ISO 9001 certificates” in time of macroeconomic crisis – Covid-19 pandemic. This worldwide crisis was unprecedented and affected essentially every organization in the world. This is one of the recent macroeconomic crises so obtaining this data affects its timeliness and usefulness. Also, another crisis (war in Ukraine) affects the issues analyzed. The main goal is to find answer on question: What and when influences on market saturation with a formal approach to quality management (ISO 9001 certificates)?
2. **Which way.** The road to gain the goal contains three analyses. First is systematic literature review in area of “ISO 9001” to identify factors of (re)certification (mainly macro). Second is comparing literature findings with data on the number of ISO 9001 certificates. Third is national analysis (within V4 countries) comparison to macroeconomic data.
3. **When.** The analysis period covers 2018-2022 due to two issues. Firstly, the latest ISO 9001 was published in 2015, and as of 2018, only certificates confirming QMS compliance with this standard are valid. Secondly, Covid-19 in various locations started in late 2019/early 2020.
4. **Where.** The analysis covers four countries: Czech Republic, Hungary, Poland, and Slovakia. Those four countries are grouped in V4 (The Visegrad Group) because of similar economic and territorial conditions and history. Such profiling will allow macro dependencies to emerge, but with detailed analysis and the emergence of dependencies and conclusions at the national level.
5. **Why.** Madani and Parast (2023) analyzed subject of organizational resilience on the SLR basis at the time preceding between 2000-2018. Because of the turbulent environment, there is a need to look at that relationship in the newest time. Results will allow business improvement by addressing issues affecting business continuity in the most common “ISO 9001 system”.

1.2. Research protocol and basic material

A literature review article provides an overview of literature related to some subject and there are many methods and tools to achieve the planned goal (Paul, Rialp, 2020). “Selecting the right database like Web of Science (WoS) and/or Scopus is the first step usually for developing a review article” (Paul et al., 2023). Scopus most often provides a database of literature research in the area of both "quality management" (Camango, Cândido, 2023a) (Fonseca et al., 2022) and "business continuity/organizational resilience" (Corrales-Estrada et al., 2021; Conz, Magnani, 2020; Rahman et al., 2022). The SCOPUS database was selected for this study as the most inclusive database to identify relevant studies. The identification of the literature was carried out using the term/number “9001” only in the title, because of finding articles exactly about the standard. According to the process delineated by the SLR method (Kushwah et al., 2019) in research protocol was defined, and applied strict inclusion criteria. To be included in the study, the articles had to meet five criteria: (1) published between 2018-2023, (2) studies in English, (3) in scientific journal, (4) peer-reviewed journal, (5) full-text article. A systematic literature review was adopted as the method of study, due to the thematically specific scope of the review and the relatively small number of articles, facilitating manual analysis of their content (Donthu et al., 2021, Table 1, p. 287). As a result of the above criteria, 120 articles were identified in the Scopus database (status as of November 17, 2023). After analysis, 8 articles were removed (repetitions and written in another language – only the abstract in English). 112 articles, listed in the appendix (Tables 11-16), were accepted for further analysis. These articles were published in a total of 56 topical journals, and the most common ones (without single items – 41) are presented in Table 1.

Table 1.

Journals with the majority of “ISO 9001 articles” in the sample

No.	Journal title	No. of articles
1.	Total Quality Management & Business Excellence	18
2.	The TQM Journal	12
3.	International Journal of Quality & Reliability Management	9
4.	International Journal for Quality Research	5
5.	International Journal of Productivity and Performance Management	5
6.	South African Journal of Industrial Engineering	3
7.	Sustainability	3
8.	Gestão & Produção	2
9.	IEEE Access	2
10.	International Journal of Production Economics	2
11.	International Journal of Quality and Service Sciences	2
12.	Production Engineering Archives	2
13.	Production Planning & Control	2
14.	Quality - Access to Success	2
15.	Systematic Reviews in Pharmacy	2

Source: own elaboration.

In 15 journals, articles were published more than once. In total, these articles account for more than 63% of all those analyzed. Almost 35% of the articles were published in three journals, which by their title direct the reader to quality management issues.

An analysis of articles by type shows a split between the traditional two groups – empirical and theoretical studies (shown in Table 2).

Table 2.

Breakdown of articles by type and territorial scope of empirical studies

Year	No. of articles	Research papers (Europe sample/V4)	Theory papers
2018	18	16 (8/2)	2
2019	13	11 (5/0)	2
2020	26	22 (13/4)	4
2021	22	16 (9/2)	6
2022	16	14 (5/1)	2
2023	17	15 (7/1)	2
Total:	112	94 (47/10)	18

Source: own elaboration.

Most of the articles (84%) have “Research paper” status, contain primary data from mainly surveys (Idris, Durmuşoğlu, 2023; Siougle et al., 2023) and sometimes case-studies (Czódorová, Gnap, 2023; Georgiev, Georgiev, 2023) or Delphi-method (Bastas, Liyanage, 2018; Chiarini, 2019). The 47 articles in the group of 94 empirical ones present area-based studies realized in European countries. While ten of them deal directly with the countries of the V4 group, and they were referred to in the following section. Theory papers, which contain secondary data, describe mostly literature review (Cândido, 2023; Abuazza et al., 2020) as well as proposals for different models (Ikram et al., 2021a; Marra da Silva Ribeiro et al., 2022).

2. ISO 9001 – literature review

The analysis of the collected articles focused on three issues. First, there is a general description of the topics covered in the analyzed articles. Second, the purpose of the analysis was to identify factors influencing ISO 9001 certification and abandonment of QMS maintenance. Third, on the analysis of the subject matter in the V4 countries. The elements identified in this way will then serve as criteria for a detailed analysis – systemic quality management in V4 countries through the prism of data on the number of “ISO 9001 certifications”.

2.1. Literature review results – general approach

Content analysis of the 112 articles indicates that the vast majority of the articles deal with quality management at the micro level, in relation to the functioning of individual organizations. Most often, the conclusions concern the positive impact of QMS on the functioning of the

organization (Ibtissam et al., 2023; Aldabbas et al., 2020) and, consequently, on the financial results of running the business (Idris, Durmuşoğlu, 2023; Vanichchinchai, 2022; Slakey et al., 2021; Zimon et al., 2018) and even on the stock price – as a result of the publicity about obtaining “ISO 9001 certification” (Kiryanto et al., 2022). But of course, the detailed results depend on the specifics of each organization (Damic, 2022). For example QMS according to ISO 9001 is more important for stakeholders than customers – this confirms that certification is more important in the B2B market than in B2C (Neves et al., 2023). Also in the case of international functioning the adoption of ISO 9001 certification is positively associated with exports (Yang et al., 2023). In another article, the authors indicated ambivalent behavior toward the ISO 9001 standard’s formal requirements (Georgiev, Georgiev, 2023). In turn, included in the latest version of the standard “risk-based thinking” was analyzed overall in QMS (Popova et al., 2019) or through an onsite management system audit (Naveen et al., 2022). Strangely enough, the seven publications in the period under review were based on research conducted several years earlier – on a sample of “old QMS ISO 9001:2008” (Georgiev, Georgiev, 2023; Nedra et al., 2022; Zayas-Mateo, Martínez-Lorente, 2021; Kebede Adem, Viridi, 2021; Castello et al., 2020; Tomic, Spasojevic Brkic, 2019; Rodríguez-Mantilla et al., 2019).

2.2. Literature review results – factors of (re/de)certification

Grounds for the decision to implement and certify a quality management system are diverse and linked to the individual goals of a given organization as has been described many times in the literature. In the group of articles analyzed, the issues of decertification from the perspective of the organization, indicate that the disappearance of the factors influencing the decision to first certify makes certification unnecessary in achieving the goals of the organization (Zimon, Dellana, 2020). Also antecedents to decertification propensity are barriers to the initial certification, (absence of) external certification benefits, decertification motivations, and expected performance after decertification (Ferreira, Cândido, 2021). Similar to the motives for implementing the system, the reasons for the withdrawal of the “ISO 9001 certificate” can be divided into external and internal. From the outside point of view decisive is the customers’ lack of interest in ISO 9001 (Chiarini, 2019) and the perceived lack of added value from certification (Simon, Kafel, 2018) as well as the absence of acquisition of new contractors (Midor, Wilkowski, 2021). From the inside point of view the decision to abandon certification is related to a lack of time for improvement efforts and questionable cost-benefit relation (Zimon, Dellana, 2020) as well as internal factors, such as financial problems within the organizations (Simon, Kafel, 2018). Cândido & Ferreira (2022) noticed that the main factors influencing EPAD (expected performance after decertification) are external decertification motivations and internal certification benefits. These authors, in another article, pointed out that the internal motivations for decertification are a result of changes in the relationship over time between motivations and a firm’s previous certification barriers and benefits (Cândido, Ferreira, 2023) but research on decertification motivations is still incipient (Camango, Cândido, 2023).

It can indicate the articles with statistical data about the market diffusion and trends in the number of ISO 9001 certificates worldwide, along with a prediction of their number in the future (Ikram et al., 2021). Mastrogiacommo et al., (2021), after analyzing trends over 25 years, pointed out that the number of certifications tends to stabilize. The saturation of ISO 9001 standard certification differ between countries around the world and mainly is analyzed in the prism of Gross Domestic Product (GDP) (Marra da Silva Ribeiro et al., 2022). The limited implementation of ISO 9001 certifications in some countries could be due to several internal and external factors such as the relatively low awareness level of the certification caused by low grade of internationalization and quality awareness (Aamer et al., 2021).

From the perspective of the purpose of this study it is relevant just to identify macroeconomic indicators that, when juxtaposed with changes in the number of ISO 9001 certificates in each country, will allow us to identify scientifically interesting relationships. Two articles identify specific indicators (presented in Table 3) that define a country's economic situation, against which certificate count data can be analyzed in search of useful relationships.

Table 3.

Indicators for analyzing the saturation of ISO 9001 certifications

Article	Indicators
(Marra da Silva Ribeiro et al., 2021)	Macroeconomic measures: <ul style="list-style-type: none"> – Gross Domestic Product (GDP) – Gross National Income (GNI) – Total exports (EXP) – Total reserves (TR) – Control of Corruption (CC) – Corruption Perception Index (CPI) – Short-term External Debt (EDS) – Foreign Direct Investment (FDI) – Human Development Index (HDI) – Global Competitiveness Index (GCI)
(Toporowicz et al., 2021)	World Bank Indicators: <ul style="list-style-type: none"> – Land area (sq km) – Population (total) – Labour force (total) – Gross Domestic Product (GDP) – Gross National Income (GNI) – Total import (IMP)

Source: own elaboration based on (Marra da Silva Ribeiro et al., 2021) and (Toporowicz et al., 2021).

The adoption of ISO 9001 is usually related to macroeconomic factors, and the literature indicates that it also relates to governance and sociocultural factors (Marra da Silva Ribeiro et al., 2021). With the rapid expansion of international trade, companies are progressively adopting management system standards that “dazzle” the market (Toporowicz et al., 2021).

2.3. Narrow literature results – V4 focus

Of the 112 articles analyzed, ten contain descriptions related to V4 countries.

In 2018, the first article included a description of a survey of 130 different organizations in Poland, aimed at identifying reasons for abandoning quality management system certification. That paper showed that internal factors are the most important reasons for the withdrawal “ISO 9001” like financial problems, a perceived lack of added value from certification, and internal restructuring (Simon, Kafel, 2018). The second article presented data from a survey conducted in Poland and Slovakia between SMEs, which operate in the textile industry with the general conclusion that QMS positively influences business performance (Zimon et al., 2018).

Four articles on the geographic area under study were published in 2020, after none in 2019. A description of them, in a nutshell, is included in Table 4.

Table 4.

Brief description of articles about V4 countries published in the 2020 year

Article	Industry	Country	Scope
(Zimon et al., 2020)	Textile	Poland, Slovakia, Czech Republic	Analysis of the synergy influence of ISO 9001 and ISO 14001 on sustainable supply chain management in the textile industry.
(Moczulska, Rogala, 2020)	Different	Poland	Identification of a set of competences, which should be mastered by a person responsible for a QMS ISO 9001 to fulfill tasks effectively.
(Pacana, Ulewicz, 2020)	Different SMEs	Poland	Analysis of the causes and benefits of implementing a QMS in developing and innovative regions on the example of enterprises from South-Eastern Poland.
(Zimon, Dellana, 2020)	SMEs in the heating technology service industry	Poland	Exploring the expectations for ISO 9001 certification and analyzing the decision to abandon certification.

Source: own elaboration.

Two other articles were published in the 2021 year, both placed the empirical study in Poland. The first one focused on ISO 9001 in local governments and the authors analyzed the relations between the resources that are related to organizational capacity and the implementation of the QMS (Ćwiklicki et al., 2021). The second one concentrated on the metal manufacturing company and the authors analyzed the relation between having ISO 9001 in order to maintain high product quality and customer satisfaction (Midor, Wilkowski, 2021).

In 2022 year was published another paper analyzing organizations in the textile industry in three countries (Poland, Slovakia and the Czech Republic). That study shed some light on the benefits of implementing more than one management system (Zimon et al., 2022).

In 2023 year Czódorová and Gnap (2023) published an article that showed a significant positive difference in average values of transport companies in Slovakia in the period after obtaining ISO 9001 certification when compared to the period without certification.

3. Quality management – certification aspects

Analysis of the structure and trends of ISO 9001 certificates is presented first worldwide. Secondly, particular attention was dedicated to the number of certifications in V4 countries, in alphabetical order.

3.1. World background – Visegrad perspective

Total valid ISO 9001 certificates all over the world are gradually increasing, and the values for the analyzed period 2018-2022 are highlighted in Figure 1.

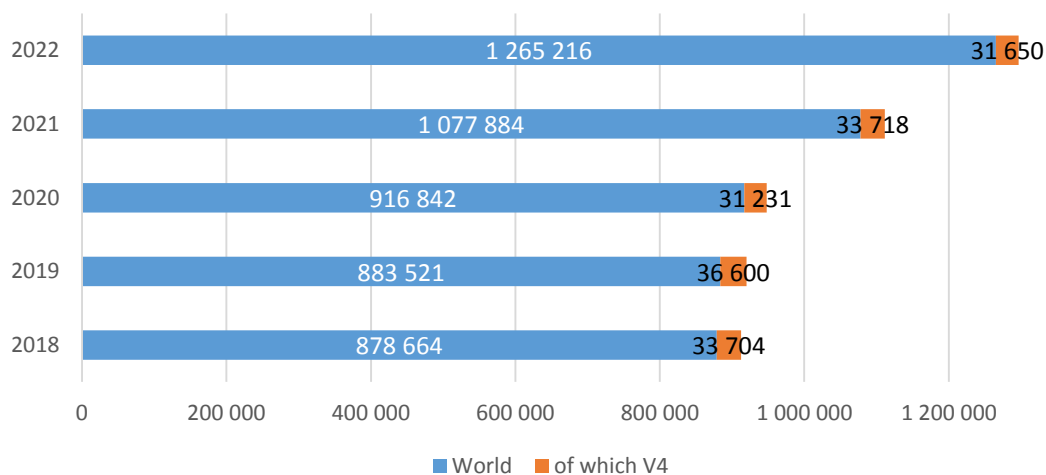


Figure 1. Numbers of ISO 9001 certificates – world vs. V4.

Source: own elaboration based on ISO Survey (2019, 2020, 2021, 2022, 2023).

While the total number of certificates worldwide is increasing year by year, the total for the V4 group of countries is variable. The share of the number of certificates in the V4 countries relative to the global total varies over the analyzed period between 4.14% (in 2019) and the lowest at the end of 2022 (2.50%). That fluctuation is visible in Figure 2.

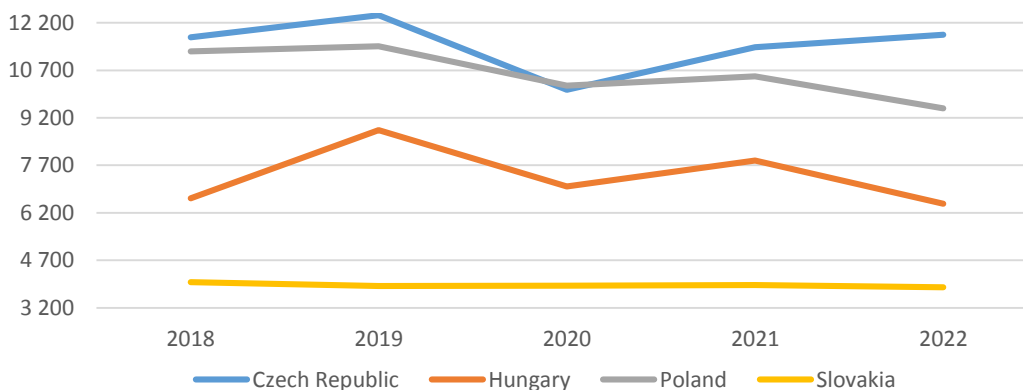


Figure 2. Trends in certificates in V4 countries.

Source: own elaboration based on ISO Survey (2019, 2020, 2021, 2022, 2023).

The data, however, converge in the industry area. The largest number of ISO 9001 certificates in the world has been issued to companies functioning in the industry of “Basic metal & fabricated metal products” (121 728 at the end of 2022). In the second place, with 107 975, is the ABC “Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods” industry. The industry coverage in the four countries is similarly shaped (see Table 5).

Table 5.
ISO 9001 certificates in V4 by sectors

Country	2018	2019	2020	2021	2022
	Sector				
Czech Republic	807	1 983	1 551	1 558	1 747
	Construction		Basic metal & fabricated metal products		
Hungary	914	1 000	884	997	721
	Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods				
Poland	1 363	1 664	1 643	1 637	1 459
	Basic metal & fabricated metal products				
Slovakia	731	742	771	767	755
	Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods				

Source: own elaboration on the basis of basis of ISO Survey (2019, 2020, 2021, 2022, 2023).

The next step is to determine a set of metrics as criteria for making comparisons, and afterwards prepare conclusions, of the number of certificates in each country. The basis is shown in Table 3 as a result of the literature review the following indicators were adopted:

1. Gross Domestic Product (GDP), preferably in per capita version which takes into account country size by population.
2. Labour force (LAB) as the employment rate for persons in relation to population.
3. Gross National Income (GNI) also per capita – as GDP plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production.
4. The Human Development Index (HDI) which links GNI per capita with other social measures.
5. It is underlined that the QMS certificate is important in export, so another indicator is (EXP) Exports of goods and services Total import.
6. The next measure is connected with the previous one – Total import (IMP).
7. Foreign direct investment (FDI) as indirect information about perceptions of a country's economic attractiveness.
8. Corruption Perception Index (CPI) also affects the country's attractiveness.
9. The Global Competitiveness Index (GCI), is a highly comprehensive index, which captures different foundations of national competitiveness.

The data on the above indicators for 2018-2022 were compared with the number of ISO 9001 certifications in each of the V4 countries (in alphabetical order) analyzed.

3.2. Context in Czech Republic

According to Kozel et al. (2017) the quantity of ISO 9001 standard compliance certifications has been steadily increasing on a global scale. Within Europe, including Poland and the Czech Republic, ISO 9001 stands out as the primary standard for quality management systems. These countries adopted quality management principles in 1993, directly influencing the number of certifications issued by accreditation bodies. In 2015, Poland held the 8th position in Europe in terms of certificate count, whereas the Czech Republic held the 9th spot. A detailed analysis spanning from 1993 to 2015 underscores the Czech Republic's higher level of involvement in implementing the ISO 9001 standard. Only in 2003, 2008, and 2015 did Poland exceed the Czech Republic in the issuance of ISO 9001 certificates (Kozel et al., 2017).

The change in the number of ISO 9001 certifications over the years, compared with macroeconomic data in Czech Republic, is included in Table 6. Taking 2018 as the base year, the table provides information on the percentage changes in the data year-on-year (2018 as a base), which allows relative comparability between the data.

Table 6.

Czech Republic – country's indicators versus ISO 9001 certificate numbers

No	Indicator (number year-on-year)	2018	2019	2020	2021	2022	Pearson correlation coefficient*
1.	GDP per capita (US\$)	23 424.5	23 664.8 1.03%	22 992.9 -2.84%	26 822.5 16.66%	27 638.4 3.04%	- 0,66
2.	LAB (%)	84,21	84,40 0.23%	84,44 0.05%	84,90 0.54%	85.95 1.24%	- 0,84
3.	GNI per capita (US\$)	38 890	41 540 6.81%	40 690 -2.05%	43 760 7.54%	47 780 9.19%	- 0,78
4.	HDI	0.894	0.897 0.34%	0.892 -0.56%	0.889 -0.34%	-	0,05
5.	EXP (% of GDP)	76.9	73.9 -3.90%	69.9 -5.41%	72.7 4.01%	74.8 2.89%	0,32
6.	IMP (% of GDP)	71	67.9 -4.37%	63.2 -6.92%	69.8 10.44%	74.9 7.31%	- 0,28
7.	FDI (% of GDP)	3.3	4.3 30.30%	3.5 -18.60%	4.6 31.43%	3.6 -21.74%	0,19
8.	CPI	59	56 -5.08%	54 -3.75%	54 0.00%	56 3.70%	0,46
9.	GCI	29	33 13.79%	33 0.00%	34 3.03%	26 -23.53%	0,44
10.	ISO 9001	11 294	11 460 1.47%	10 219 -10.83%	10 512 2.87%	9 494 -9.68%	

* refers to the first value in the cells.

Source: own elaboration based on: (1) <https://data.worldbank.org>; (2) <https://data.oecd.org>; (3) <https://data.worldbank.org>; (4) <https://hdr.undp.org>; (5) <https://data.worldbank.org>; (6) <https://data.worldbank.org>; (7) <https://data.worldbank.org>; (8) <https://www.transparency.org>; (9) <https://www.imd.org>; <https://tradingeconomics.com>; (10) www.iso.org

Analyzing the year-to-year data shows a decline in the highest number of indicators in 2020, the year of the beginning of the Covid-19 pandemic in Europe. The number of ISO 9001 certificates at the end of 2020 declined by 10% from the previous year. After a minimal upward rebound the following year, at the end of 2022 this number fell by another 10% (year-on-year).

There was a big decrease in Global Competitiveness Index (GCI) in 2022 year with a small but nevertheless increase in imports. Correlation between numbers of ISO 9001 certificates and GCI is positive moderate (0.44 – the highest positive rank in last column) and weak negative with IMP (-0.28). The highest negative correlation for number of ISO 9001 certificates is with LAB (-0.84 very strong correlation) and little less with GNI (-0.78) and GDP (-0.66).

Analyzing the data between the cut-off dates in the analyzed period 2018-2022, it is the number of ISO 9001 certifications that decreased (by 16%), while the value of Gross Domestic Product (GDP per capita) increased by 18% and Gross National Income (GNI per capita) 23%. On the other hand, Global Competitiveness Index (GCI) decreased by 10%, as well as exports (EXP) decreased by almost 3%.

Current trend in area of quality assurance and quality assessment in Czech Republic goes beyond the mere requirements of ISO 9001:2015 standard, not only in the production sphere, but also in public service. There are cases in higher education institutions (schools, faculties) where the QMS has been certified according to ISO 9001 as a base. Moreover, all activities provided by the higher education institution to stakeholders represent public service (Vykydal et al., 2020). Vykydal & Nenadál (2022) state in their research that many certified quality management systems, especially according to the requirements of ISO 9001:2015, are rigid, static and do not meet the current requirements for the new era of digitalization within the framework of today's Quality 4.0 trend. The authors are sure that Czech manufacturing companies will not be able to afford to ignore the concept of Quality 4.0, because the transformation of quality management is perhaps not only an opportunity, but also a strong requirement to adapt each company to the new industrial reality (Vykydal, Nenadál, 2022).

3.3. Context in Hungary

The change in the number of ISO 9001 certifications over the years, compared with macroeconomic data in Hungary, is included in Table 7. Taking 2018 as the base year, the table provides information on the percentage changes in the data year-on-year (2018 as a base).

Table 7.

Hungary – country's indicators versus ISO 9001 certificate numbers

No	Indicator	2018	2019	2020	2021	2022	Pearson correlation coefficient*
1.	GDP per capita (US\$)	16 425.2	16 786.2 2.20%	16 125.6 - 3.94%	18 772.1 16.41%	18 463.2 - 1.65%	- 0,01
2.	LAB (%)	81.93	82.67 0.90%	83.20 0.64%	84.53 1.60%	85.95 1.68%	- 0,27

Cont. table 7.

3.	GNI per capita (US\$)	30 660	33 730 10.01%	33 360 - 1.10%	35 650 6.86%	40 620 13.94%	- 0,20
4.	HDI	0.849	0.853 0.47%	0.849 - 0.47%	0.846 - 0.35%	-	0,50
5.	EXP (% of GDP)	83.8	81.5 - 2.74%	78.7 - 3.44%	80.3 2.03%	90.4 12.58%	- 0,52
6.	IMP (% of GDP)	79.5	79.2 - 0.38%	76.8 - 3.03%	79.9 4.04%	94.5 18.27%	- 0,46
7.	FDI (% of GDP)	- 40.1	60.0 249.63%	106.6 77.67%	16.4 -84.62%	- 7.8 -147.56%	0,42
8.	CPI	46	44 - 4.35%	44 0.00%	43 - 2.27%	42 - 2.33%	- 0,02
9.	GCI	48	47 - 2.08%	47 0.00%	42 - 10.64%	39 - 7.14%	0,26
10.	ISO 9001	6 658	8 815 32.40%	7 030 -20.25%	7 856 11.75%	6 482 - 17.49%	

* refers to the first value in the cells

Source: own elaboration based on: (1) <https://data.worldbank.org>; (2) <https://data.oecd.org>; (3) <https://data.worldbank.org>; (4) <https://hdr.undp.org>; (5) <https://data.worldbank.org>; (6) <https://data.worldbank.org>; (7) <https://data.worldbank.org>; (8) <https://www.transparency.org>; (9) <https://www.imd.org>; <https://tradingeconomics.com>; (10) www.iso.org

Analyzing the year-to-year data shows a decline in the highest number of indicators in 2020, the year of the beginning of the Covid-19 pandemic in Europe. The number of ISO 9001 certificates at the end of 2020 declined by 10% from the previous year. After a minimal upward rebound the following year, at the end of 2022 this number fell by another 10% (year-on-year).

There was a big decrease in Global Competitiveness Index (GCI) in 2022 year with a small but nevertheless increase in imports. Correlation between numbers of ISO 9001 certificates and GCI is positive moderate (0.44 – the highest positive rank in last column) and weak negative with IMP (-0.28). The highest negative correlation for number of ISO 9001 certificates is with LAB (-0.84 very strong correlation) and little less with GNI (-0.78) and GDP (-0.66).

Analyzing the data between the cut-off dates in the analyzed period 2018-2022, it is the number of ISO 9001 certifications that decreased (by 2.64%), while the value of Gross Domestic Product (GDP per capita) increased by 12.41% and Gross National Income (GNI per capita) 32.49%. On the other hand, Global Competitiveness Index (GCI) decreased by 18.75%, versus 18.87% increase of imports (EXP).

The period between 2018-2022 brought a lot of challenges for Hungarian organizations, including COVID-19, price and salary inflation, and raw material shortages as well. The boom and widespread dissemination of digitalization and automation became the dominant environmental trend and significant pillar of competitiveness in the whole economy. This policy-crises environment demands that organizations pay particular attention to risk management in any sector. The most remarkable focus of recent ISO 9000 and 14000 standards released in 2015, answer exactly this challenge (Berényi, 2018; Schmuck, 2021).

The recent wave of digitalization focuses on the implementation of new digital technologies in the processes and value creation on the system or organizational level. This approach requires process and system-based thinking for decision-makers to gain value within the organizations. To operationalize the process and system-based view, ISO 9000:2015 standards ensure a comprehensive and merged management framework. Schmuck's (Schmuck, 2023) research confirmed that ISO 9001-certified SME organizations could explore real benefits in digitalization compared to those, which had not. Berényi (2018) has already analyzed the correlation between the volume of ISO standards and some national macroeconomic indicators in several CEE countries such as Bulgaria, Czech Republic, Hungary, Poland, Romania, and Slovakia. The study analyzed the period from 1993 to 2015, and showed a strong linear relationship between indicators (GDP, export, export ratio, capital formation, capital formation per capita, and HDI) and the number of ISO certifications per million employees, except for employment indicator. The employment indicator in this study showed a strong negative correlation, especially in Romania (Berényi, 2018).

The analyzed five-year term in this study started a strong rise in the number of ISO certifications with a peak in 2019, but later, there was a steady decrease, except for a solid rise in 2021 again. This fluctuation in the number of ISO standards over such a short period does not show that strong linear relationship with the analyzed indicators, which can be read in the former research. The picture is mixed, FDI, HDI and GCI have positive and strong correlations with certifications, however, the variables indicate weak or strong negative relationships. Behind this fluctuation, not the impact of or reaction to COVID-19 may stand, but rather the implementation of or change for ISO 9001:2015 standard.

3.4. Context in Poland

The fluctuation in the number of ISO 9001 certifications over the years, compared with macroeconomic data in Poland, is included in Table 8. The table provides information on the percentage changes in the data year-on-year (2018 as a base).

Table 8.

Poland – country's indicators versus ISO 9001 certificate numbers

No	Indicator	2018	2019	2020	2021	2022	Pearson correlation coefficient*
1.	GDP per capita (US\$)	15 504.5	15 700 1.26%	15 816.8 0.74%	17 999.8 13.80%	18 321.3 1.79%	0.09
2.	LAB (%)	76.47	76.80 0.43%	77.73 1.21%	79.99 2.91%	80.84 1.06%	- 0.05
3.	GNI per capita (US\$)	30 680	33 510 9.22%	33 970 1.37%	36 340 6.98%	41 310 13.68%	0.07
4.	HDI	0.877	0.881 0.46%	0.876 - 0.57%	0.876 0.00%	-	0.77
5.	EXP (% of GDP)	52.7	53.2 0.95%	53 -0.38%	57.9 9.25%	61.7 6.56%	0.18

Cont. table 8.

6.	IMP (% of GDP)	50.7	49.5 - 2.37%	47.3 -4.44%	54.5 15.22%	60.6 11.19%	0.36
7.	FDI (% of GDP)	3.3	3 - 9.09%	3.2 6.67%	5.5 71.88%	5.1 - 7.27%	0.07
8.	CPI	60	58 - 3.33%	56 - 3.45%	56 0.00%	55 -1.79%	0.36
9.	GCI	37	38 2.70%	39 2.63%	47 20.51%	50 6.38%	0.07
10.	ISO 9001	11 740	12 439 5.95%	10 085 -18.92%	11 429 13.33%	11 822 3.44%	

* refers to the first value in the cells

Source: own elaboration based on: (1) <https://data.worldbank.org>; (2) <https://data.oecd.org>; (3) <https://data.worldbank.org>; (4) <https://hdr.undp.org>; (5) <https://data.worldbank.org>; (6) <https://data.worldbank.org>; (7) <https://data.worldbank.org>; (8) <https://www.transparency.org>; (9) <https://www.imd.org>; <https://tradingeconomics.com>; (10) www.iso.org

In 2020, there was a significant decrease in the number of certificates (18.92% less than the year before) with the other indicators essentially unchanged, where it was the initial period of the Covid-19 pandemic. In the following year, more changes are noticeable. The number of certificates increased by more than 13%, as did GDP and the largest increase (almost 72%) was recorded in the FDI indicator. The highest (and positive) correlation for ISO 900 certificates is with respect to the HDI index (0.77) and also for IMP (0.36). It is connected with external context of quality management system what is important for decision-making of implementing and also for functioning that system (Dziedzic et al., 2023).

Changes of the number of ISO 9001 QMS implemented, are noticeable. Reasons of this state of matters are strongly differentiated and (Spsychalski, 2022) underlined two threats in this process of ISO 9001 dissemination: technical complications connected with fulfilling formal requirements and financial aspect (because standard is not directly focused on increasing financial performance of an organization).

Wolniak (2019) analyzed the problem of measuring the maturity of quality management systems what is connected with certification QMS ISO 9001 and also decertification as well. “The more positive the organization’s management’s attitude to the implementation of certified quality management systems, the higher the quality management system maturity” (Wolniak, 2019, p. 13) was one of several conclusions. Also there were indicated positive interrelations between the quality management system maturity and the size of the organization and also the market position, and the financial condition, as well.

3.5. Context in Slovakia

ISO 9001 standard requires subsequent certification of the management system in place (of the processes in place) in the organization. The result is a certificate that is internationally recognized and is a prerequisite for a certain maturity and maturity of the organization (Kollár et al., 2016). On the basis of the summarized Table 9, is noticeable that the development of the number of ISO 9001 certificates in the study period 2018-2022 has a volatile character.

In 2018 the number of certificates was 4012, but in 2019 there is a decrease of 126 certificates. Subsequently, in 2020, their number increased again by 11 certificates. From 2021 onwards, the trend was downward, with a decrease of 24 certificates in that year and 69 certificates in 2022. Between the set of indicators presented in Table 9 and the number of ISO 9001 certificates in the study years 2018-2022, we can conclude that the development of each indicator had a volatile character with a trend of gradual increase. For most of the indicators, a decrease was observed in 2020, which is related to the outbreak of the global pandemic COVID-19. However, from 2021 onwards, there is again an increase in the values for the set of indicators under study. The least significant decrease in values in 2020 was recorded in the following indicators: GDP per capita (US\$), LAB (%), HDI and CPI.

Table 9.

Slovakia – country's indicators versus ISO 9001 certificate numbers

No	Indicator	2018	2019	2020	2021	2022	Pearson correlation coefficient*
1.	GDP per capita (US\$)	19 486.4	19 381.6 - 0.54%	19 551.6 0.88%	21 782.9 11.41%	21 258.1 - 2.41%	- 0,33
2.	LAB (%)	79.81	80.39 0.73%	80.28 - 0.14%	83.14 3.56%	84.67 1.84%	- 0,50
3.	GNI per capita (US\$)	30 880	32 650 5.73%	32 510 - 0.43%	33 490 3.01%	36 840 10.00%	- 0,80
4.	HDI	0.859	0.862 0.35%	0.857 - 0.58%	0.848 - 1.05%	-	0,02
5.	EXP (% of GDP)	95.8	91.9 - 4.07%	85.1 - 7.40%	92.4 8.58%	99.1 7.25%	0,05
6.	IMP (% of GDP)	94	91.6 - 2.55%	83.4 - 8.95%	92.4 10.79%	104.8 13.42%	- 0,24
7.	FDI (% of GDP)	2.1	2.2 4.76%	- 1.1 - 150.00%	0.8 - 172.73%	3.5 337.50%	- 0,11
8.	CPI	50	50 0.00%	49 - 2.00%	52 6.12%	53 1.92%	- 0,39
9.	GCI	41	53 29.27%	57 7.55%	50 - 12.28%	49 - 2.00%	- 0,72
10.	ISO 9001	4 012	3 886 - 3.14%	3 897 0.28%	3 921 0.62%	3 852 - 1.76%	

* refers to the first value in the cells

Source: own elaboration based on: (1) <https://data.worldbank.org>; (2) <https://data.oecd.org>; (3) <https://data.worldbank.org>; (4) <https://hdr.undp.org>; (5) <https://data.worldbank.org>; (6) <https://data.worldbank.org>; (7) <https://data.worldbank.org>; (8) <https://www.transparency.org>; (9) <https://www.imd.org>; <https://tradingeconomics.com>; (10) www.iso.org

The implementation of the quality management system according to ISO 9001 is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development (Knop, 2021). Karhalíková (2016) indicated that implementation of management systems has mainly marketing's motives, and thus they are more intensively concerned with their appearance, behavior and public presentation in order to differentiate themselves from competitors. Vanova et al. (2017) conducted research on a sample of 125 companies in Slovakia. That research found that effective communication between

senior managers and employees and also with key stakeholders is essential in functioning QMS. Czödöróvá and Gnap (2023) investigated the impact of introducing an ISO 9001 quality management system on the performance of 17 transport companies in Slovakia. The first significant finding was that the selected studied indicators such as return on assets, return on sales, size of the transport company and age of the transport company in the selected transport companies showed a significant positive difference in their mean values in the year of the period after obtaining ISO 9001 certification compared to the period without certification. Further investigation of the financial situation of the transport companies that already had an ISO 9001 quality management system in place revealed that all the values of the selected indicators became positive in 2020 during the COVID-19 pandemic, which may have been due to the fact that the transport companies retained their customers. Innovation in the manufacturing sector must be introduced to meet the demands of industrial production in the competitive era of Industry 4.0 and to increase the competitiveness and performance of the companies. As there is more competition among companies in the Industry 4.0 era, many are forced to innovate to improve the productivity and profitability of their organization (Richnák, 2022).

3.6. The Visegrad Group

Relationships between the number of ISO 9001 certificates and individual macroeconomic indicators are not unidirectional and unified for the analyzed countries in the V4 group. That fluctuation is visible in Figure 3.

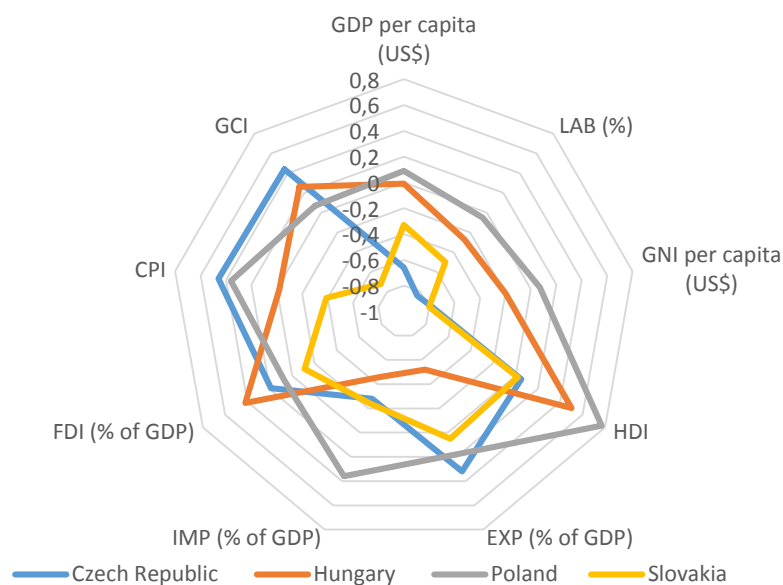


Figure 3. ISO 9001 and macroeconomic indicators – correlations according to Pearson coefficient.

Source: own elaboration based on Tables 6-9.

Comparing the Pearson maximum positive and negative index values for each country, the data in the table 10 can be pointed out.

Table 10.*Pearson correlation coefficient – maximum and minimum value for every country*

Minimum value Indicator	Country	Maximum value Indicator
-0,84 LAB (%)	Czech Republic	0,46 CPI
-0,52 EXP (% of GDP)	Hungary	0,5 HDI
-0,05 LAB (%)	Poland	0,77 HDI
-0,8 GNI per capita (US\$)	Slovakia	0,05 EXP (% of GDP)

Source: own elaboration based on Tables 6-9.

There is a twofold (Czech Republic and Poland) negative relationship for the LAB index. This means that the decline in the number of certificates is accompanied by an increase in the employment rate for persons in relation to population, and also conversely. In positive relationships, there is also variation in the same direction twice (for Poland and Hungary) in the number of ISO 9001 certifications vs. HDI (Human Development Index).

These relationships and the detailed data presented in this article do not allow to give a clear answer to the question indicated as the main purpose of the study: What and when influences on market saturation with a formal approach to quality management (ISO 9001 certificates)?

With regard to the "when" aspect, in the analyzed period it is noticeable data declines in 2020, followed by a rebound, which is unilaterally linked to the period of the Covid-19 pandemic. With regard to the "what" aspect, it should be noted that there are no clear trends in the analyzed data, and also between countries of V4. At the same time, when analyzing the data on the number of certificates, it is necessary to take into account the postponement over time. Time passes from the decision to implement a QMS to its certification. At the same time, QMS certification is granted by a certification body for three years, and the decision to decertify also results after a certain period of time, as well as the data in the ISO Survey pre-reports the state a few months before their publication.

4. Conclusions

The study attempts to determine the role of the ISO 9001 quality management system in economic development. The paper aimed to investigate the relationship between the number of ISO 9001 certificates and key macroeconomic indicators. The analysis covered the situation in four countries (Czech Republic, Hungary, Poland and Slovakia) in 2018-2022. The key findings are that:

1. ISO 9001 quality management system is a crucial quality management method. This is evidenced by the constantly increasing number of ISO 9001 certificates.
2. While the number of certificates is increasing globally, this trend is unclear in the Visegrad Group countries. During the period covered by the analysis, this number sometimes increased and sometimes decreased.
3. It is impossible to indicate a clear relationship between the number of ISO 9001 certificates and any of the nine macroeconomic indicators for Visegrad Group. However, in the case of some countries, such a relationship was observed (but it is not universal, i.e. it does not apply to all V4 countries). It seems that the causal relationship between macroeconomic factors and the number of ISO 9001 certifications is bottom-up rather than top-down. A top-down relationship would imply an influence of macroeconomics on the number of certificates. However, it seems that the implementation of the ISO 9001 QMS is an individual issue, and their sum forms a macro level, with no global relationship between the data. This finding contradicts the results of several previous studies, which showed a correlation between the number of ISO 9001 certificates and the country's macroeconomic situation. The existence of such a correlation could have been confounded by disturbances such as the pandemic crisis and the war in Ukraine.

The content and conclusions in this article are subject to the limitations of focusing on publications issued during a given period, while concentrating on V4 countries. Therefore, further research is needed covering a larger number of countries and taking into consideration the longer period. The results may find application in subsequent research in management and quality sciences.

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Appendix

Table 11.

Journals with “9001” in the article title in Scopus database – published in 2018

No.	Journal title	Item identification
1.	Sustainability	10.3390/su10124569
2.	Production Engineering Archives	10.30657/pea.2018.21.02
3.	International Journal of Quality & Reliability Management	10.1108/IJQRM-12-2016-0217
4.	Jurnal Cakrawala Pendidikan	10.21831/cp.v38i3.16486
5.	Total Quality Management	10.1080/14783363.2016.1253466
6.	Total Quality Management	10.1080/14783363.2018.1487216
7.	Journal of Industrial Engineering and Management	10.3926/jiem.2412
8.	The TQM Journal	10.1108/TQM-12-2017-0173
9.	International Journal of Production Economics	10.1016/j.ijpe.2018.05.005
10.	Total Quality Management	10.1080/14783363.2016.1164012
11.	Innovar: Revista de Ciencias Administrativas y Sociales	10.15446/innovar.v28n70.74449
12.	Cuadernos de Gestión	105295/cdg.140507cd
13.	South African Journal of Industrial Engineering	10.7166/29-2-1741
14.	AUTEX Research Journal	10.1515/aut-2018-0020
15.	European Research on Management and Business Economics	10.1016/j.iedeen.2017.02.002
16.	International Journal for Quality Research	10.18421/IJQR12.03-07
17.	International Journal of Automotive and Mechanical Engineering	10.15282/ijame.15.3.2018.17.0432
18.	International Journal of Productivity and Performance Management	10.1108/IJPPM-05-2015-0080

Source: own elaboration.

Table 12.

Journals with “9001” in the article title in Scopus database – published in 2019

No.	Journal title	Item identification
1.	Total Quality Management	10.1080/14783363.2019.1665867
2.	Studies in Educational Evaluation	10.1016/j.stueduc.2019.03.013
3.	Quality Assurance in Education	10.1108/QAE-09-2018-0103
4.	SAGE Open	10.1177/2158244019870773
5.	International Journal of Quality and Service Sciences	10.1108/IJQSS-06-2018-0057
6.	Production Planning & Control	10.1080/09537287.2019.1566840
7.	Quality - Access to Success	https://eds.s.ebscohost.com/eds/pdfviewer/pdfviewer?vid=1&sid=3881223b-65de-46aa-a7e2-3a5d8f3cc2a3%40redis
8.	International Journal of Quality & Reliability Management	10.1108/IJQRM-09-2017-0174
9.	The TQM Journal	10.1108/TQM-07-2017-0072
10.	Business Horizons	10.1016/j.bushor.2018.08.008
11.	Journal of Information Systems Engineering & Management	10.29333/jisem/5890
12.	International Journal for Quality Research	10.24874/IJQR13.04-20
13.	International Journal of African Higher Education	10.6017/ijaje.v6i1.10671

Source: own elaboration.

Table 13.*Journals with “9001” in the article title in Scopus database – published in 2020*

No.	Journal title	Item identification
1.	Total Quality Management & Business Excellence	10.1080/14783363.2018.1490640
2.	Industrial Management & Data Systems	10.1108/IMDS-01-2020-0038
3.	International Journal of Innovation Science	10.1108/IJIS-10-2019-0095
4.	Systematic Reviews in Pharmacy	http://repository.uinbanten.ac.id/id/eprint/5802
5.	Quality - Access to Success	https://eds.s.ebscohost.com/eds/pdfviewer/pdfviewer?vid=1&sid=ce5cdba1-2b44-4220-97d3-8bdf34c10720%40redis
6.	Journal of Scientific & Industrial Research	http://op.niscpr.res.in/index.php/JSIR/article/view/41722/465478088
7.	The TQM Journal	10.1108/TQM-05-2019-0147
8.	Sustainability	10.3390/su12104282
9.	European Journal of Operational Research	10.1016/j.ejor.2019.11.042
10.	International Journal of Quality & Reliability Management	10.1108/IJQRM-06-2018-0154
11.	Dyna	10.15446/dyna.v87n213.83230
12.	Total Quality Management	10.1080/14783363.2017.1404428
13.	International Journal of Quality & Reliability Management	10.1108/IJQRM-10-2018-0281
14.	International Journal of Quality & Reliability Management	10.1108/IJQRM-02-2019-0048
15.	International Journal of Quality & Reliability Management	10.1108/IJQRM-07-2018-0171
16.	Gestão & Produção	10.1590/0104-530X4715-20
17.	Gestão & Produção	10.1590/0104-530X4043-20
18.	IEEE Access	10.1109/ACCESS.2020.2998434
19.	International Journal for Quality Research	10.24874/IJQR14.03-18
20.	IEEE Access	10.1109/ACCESS.2020.3029744
21.	Management Science Letters	10.5267/j.msl.2020.6.039
22.	Polish Journal of Management Studies	10.17512/pjms.2020.21.1.21
23.	Systematic Reviews in Pharmacy	10.31838/srp.2020.10.134
24.	The TQM Journal	10.1108/TQM-02-2019-0053
25.	The TQM Journal	10.1108/TQM-05-2019-0141
26.	International Journal of Quality & Reliability Management	10.1108/IJQRM-10-2018-0284

Source: own elaboration.

Table 14.*Journals with “9001” in the article title in Scopus database – published in 2021*

No.	Journal title	Item identification
1.	The TQM Journal	10.1108/TQM-04-2020-0071
2.	Production Engineering Archives	10.30657/pea.2021.27.29
3.	The American Journal of Surgery	10.1016/j.amjsurg.2020.11.014
4.	International Journal of Production Economics	10.1016/j.ijpe.2020.108024
5.	The TQM Journal	10.1108/TQM-04-2020-0068
6.	Computer Standards & Interface	10.1016/j.csi.2020.103453
7.	Construction Management and Economics	10.1080/01446193.2021.1983186
8.	The TQM Journal	10.1108/TQM-03-2020-0055
9.	FME Transactions	10.5937/FME2104835F
10.	International Journal for Quality Research	10.24874/IJQR15.03-14
11.	Measuring Business Excellence	10.1108/MBE-07-2020-0100
12.	South African Journal of Industrial Engineering	10.7166/32-2-2415
13.	Total Quality Management & Business Excellence	10.1080/14783363.2019.1625266
14.	Total Quality Management & Business Excellence	10.1080/14783363.2019.1677151
15.	Total Quality Management & Business Excellence	10.1080/14783363.2019.1696672
16.	Total Quality Management & Business Excellence	10.1080/14783363.2020.1717332
17.	Total Quality Management & Business Excellence	10.1080/14783363.2020.1756246
18.	Total Quality Management & Business Excellence	10.1080/14783363.2020.1768062

19.	The TQM Journal	10.1108/TQM-03-2019-0076
20.	Journal of Environmental Planning and Management	10.1080/09640568.2020.1817729
21.	Public Organization Review	10.1007/s11115-020-00485-2
22.	Total Quality Management & Business Excellence	10.1080/14783363.2020.1724508

Source: own elaboration.

Table 15.

Journals with “9001” in the article title in Scopus database – published in 2022

No.	Journal title	Item identification
1.	The TQM Journal	DOI 10.1108/TQM-09-2021-0263
2.	The TQM Journal	10.1108/TQM-08-2020-0177
3.	International Journal of Social Ecology and Sustainable Development	10.4018/IJSESD.292037
4.	Journal of the Knowledge Economy	10.1007/s13132-021-00805-x
5.	Corporate Social Responsibility and Environmental Management	10.1002/csr.2214
6.	The TQM Journal	DOI 10.1108/TQM-01-2021-0025
7.	International Journal of Quality and Service Sciences	10.1108/IJQSS-02-2021-0031
8.	International Journal of Lean Six Sigma	10.1108/IJLSS-10-2020-0164
9.	International Journal of Quality & Reliability Management	10.1108/IJQRM-04-2020-0127
10.	Fibres and Textiles in Eastern Europe	10.2478/ftce-2022-0003
11.	International Journal for Quality Research	10.24874/IJQR16.02-07
12.	<i>International Journal of eBusiness and eGovernment Studies</i>	10.34109/ijeveg.202214121
13.	South African Journal of Industrial Engineering	10.7166/33-1-2521
14.	Total Quality Management & Business Excellence	10.1080/14783363.2020.1829969
15.	Total Quality Management & Business Excellence	10.1080/14783363.2021.1944083
16.	Total Quality Management & Business Excellence	10.1080/14783363.2021.1997142

Source: own elaboration.

Table 16.

Journals with “9001” in the article title in Scopus database – published in 2023

No.	Journal title	Item identification
1.	Accreditation and Quality Assurance	10.1007/s00769-023-01543-0
2.	Engineering, Construction and Architectural Management	10.1108/ECAM-07-2021-0656
3.	Cogent Business & Management	10.1080/23311975.2023.2203304
4.	Food Policy	10.1016/j.foodpol.2023.102455
5.	Sustainability	10.3390/su15032401
6.	Benchmarking: An International Journal	10.1108/BIJ-06-2022-0355
7.	International Journal of Productivity and Performance Management	10.1108/IJPPM-05-2023-0224
8.	International Journal of Productivity and Performance Management	10.1108/IJPPM-08-2022-0398
9.	International Journal of Organizational Analysis	10.1108/IJOA-05-2021-2753
10.	International Journal of Productivity and Performance Management	10.1108/IJPPM-07-2022-0345
11.	International Journal of Productivity and Performance Management	10.1108/IJPPM-12-2021-0716
12.	International Journal of Quality & Reliability Management	10.1108/IJQRM-08-2022-0233
13.	Production Planning & Control	10.1080/09537287.2021.1916638
14.	Quality Innovation Prosperity	10.12776/QIP.V27I1.1808
15.	Statistics in Transition	10.59170/stattrans-2023-026
16.	Total Quality Management & Business Excellence	10.1080/14783363.2023.2192916
17.	Total Quality Management & Business Excellence	10.1080/14783363.2023.2203379

Source: own elaboration.

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