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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 47 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: public management; project management, quality management, human resources management, information management, production management, logistics, outsourcing, production management, sustainable development, organization ethic, economics, finances, the impact of COVID-19 pandemic on management, knowledge management, strategic management, innovation management, leadership, supply chain management, smart cities, business analytics and Corporate Social responsibility.

Radosław Wolniak

SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2023
ORGANIZATION AND MANAGEMENT SERIES NO. 176

THE COMPETITIVENESS AND DEVELOPMENT OF REGIONS IN POLAND - SELECTED INSTRUMENTS OF SOCIO-TOURIST INFRASTRUCTURE

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Objective: The aim of the article is to assess the competitive potential of Poland's regions, in the context of effective strategy building for further development thereof.
Design/methodology/approach: The article employs the method of critical investigation of the literature on the subject as well as presents an analysis of statistical data on selected socio-tourist infrastructure instruments. An examination of two selected infrastructure elements was carried out for the purpose of the article, which can form a basis for formulation of strategies to improve the competitiveness and development of regions in Poland.
Results: The Authors present the issue of regional competitiveness, with particular focus on the methods of assessing and building the competitiveness of regions through selection of an optimal strategy for further development thereof. In this context, two selected instruments of socio-tourist infrastructure are discussed, which can form a basis for formulation of strategies to improve the competitiveness and development of regions in Poland. The infrastructure elements presented serve as an example of areas characterized by great potential for growth, as a consequence of years of neglect (health care), or constrained by independent external COVID-19 pandemic associated conditions (accommodation industry).

Keywords: competitiveness, region, socio-tourism infrastructure.

1. Introduction

The process of systemic transformation and the 21st century integration with the European Union Countries has changed, but at the same time revealed, the real value and competitive position of many Polish regions (agglomerations, municipalities, cities). Current assessments turn out to be different, often much lower than the widespread evaluations and perceptions that arose before 1990.

The issue of regional competitiveness, particularly the methods of assessment, the knowledge of regional competitiveness building, as well as the effective use of competitiveness for development of a region's strategy is still poorly recognized, underestimated, and even ignored by Polish regional authorities. Hence, interdisciplinary and multifaceted studies addressing these issues, including scientific analysis thereof, are in demand.

The administrative reform of 1998, resulting from the decentralization of power, initiated the development of local governments, which became the main inheritors of the responsibility for governance and, above all, for setting and managing the strategic directions of regional development.

The post-reform changes which have become increasingly evident in the functioning of territorial units include the increasing competition processes between the regional and local systems. These processes are forcing regional authorities to apply principles and rules ensuring greater success in achieving the territorial units' objectives, the overriding one among which entails the increasing prosperity of the community located on the territory thereof. In view of this, the public demand for efficient and, above all, effective development-favoring management of territorial units has emerged and is constantly intensifying.

The study aims to assess the competitive potential of regions, in the context of effective strategy building for further development thereof. The article analyzes two selected elements of socio-tourist infrastructure, which can serve as a basis for formulation of strategies to improve the competitiveness and development of regions in Poland. The infrastructure elements presented exemplify areas characterized by great potential for growth, as a consequence of years of neglect, or constrained by independent external COVID-19 pandemic-related conditions.

2. Formulation of a region's development strategy

The development of individual regions is dependent, firstly, on the level of the resources and capabilities making up a region's competitive potential, including the configuration thereof, and secondly, on the usability efficiency of those resources and capabilities. This efficiency is determined by the manner in which the region is managed, as well as dependent on the balance of the political forces in the region, the strength of the influence of the so-called 'stakeholders' (pressure groups), the regional development vision and the strategic goals set.

The proposed procedure for formulating a region's development strategy, consisting of successive phases, is shown in Figure 1.

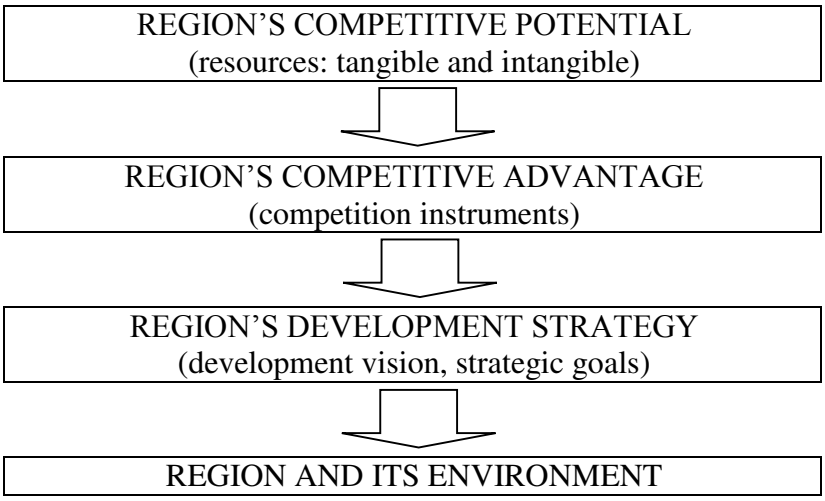

Figure 1. Region's development strategy formulation procedure.
Source: own elaboration.

3. Region's resources as a basis for its competitiveness

A region's competitiveness is directly associated with and strongly dependent on its strategic potential, the basis of which entails the region's resources. These resources can be characterized, however, by varying degrees of usefulness in the creation of that potential and thus can contribute to competitive advantage building to various extents. As such, the resources at a region's disposal are not of equal importance from the perspective of efficiency and effectiveness of operation, which is why they ought to be viewed through the prism of their usefulness for competitive advantage creation and the possibilities of generating, based on those resources, effective instruments of competition. In the long run, these instruments, in turn, will determine the region's competitive strength and the pace of its development. According to the Authors, it can thus be assumed that a region's competitive potential is formed by the tangible and intangible resources possessed, which constitute the basis for construction of instruments for effective competition and development of the region (Borko, Geerts, Wang, 2020).

Unambiguous division of a region's resources is not simple, while each can arouse certain discussions. Based on the well-known classifications of business entity resources, a general division of resources into tangible and intangible can also be made here by analogy.

Primary tangible resources of a region (also called visible in the literature) include:

- natural and environmental wealth,
- the population living in the region,
- the state and level of economic development,

- the region's infrastructure (Główny Urząd Statystyczny, 2022),
- scientific potential.

The second group of a region's resources are intangible resources (referred to as invisible), which include:

- the region's identity and image[1],
- the authorities' management style and skills[2],
- the relationship of the region's governing bodies with the 'stakeholders' (the public, business entities, potential investors, social parties and organizations, media, etc.),
- the regional authorities' ability and means of solving difficult regional problems,
- the authorities' propensity to cooperate and establish internal and external contacts (partnership in action)[3].

A region's competitive potential should constitute an important subject of interest as well as in-depth analyses and assessment by the region's authorities. In practice, this means that a need exists to manage the potential, in both strategic and tactical-operational dimensions. The design and building of a region's potential, including the evaluation and restructuring of its tangible and intangible elements, should be subject to a process of management, in order for it to become the foundation and generator of the region's competitive advantage.

In the process of management, particularly at the time of assessing the region's competitive potential, not all of its elements are equally important in terms of competitive advantage building, therefore, the principle of focus on the key components of this potential should be followed. This, in turn, indicates the need to identify the components of that potential and decide which should be considered of key significance.

Such decisions require a thorough list of selection criteria to be drawn up in advance, to accurately determine the most relevant features of the components making up this potential.

Selection of the key elements of a region's competitive potential, as well as the constant improvement thereof, should constitute the source of competitive advantage. As such, a region's competitive advantage can be considered to emerge from the fact that regions, based in the key (i.e., unique and the strongest) elements of their competitive potential can 'perform' better or 'differently' in certain areas, compared to other rival regions, creating more favorable

[1] The essence of competitive potential determination derives from the collective work edited by Stankiewicz, M.J. (1999). *Budowanie potencjału konkurencyjności przedsiębiorstwa*. Toruń: TNOiK „Dom Organizatora", p. 177.

[2] This element of a region's resources has in recent years played an increasingly important role in both the development and the process of attracting potential investors. For more on the subject see, inter alia: Karwowski, J. *Marketingowe zarządzanie regionem*, p. 29 and Mruk, H. (2002). Obszary współpracy samorządów z przedsiębiorstwami. In: *Marketing w rozwoju regionu (wybrane zagadnienia) (p. 262).* Szczecin: University of Szczecin.

[3] Creation of a region's image is becoming an important task and has been increasingly implemented by the regional authorities as part of promotional activities. For more on the subject, see e.g., Karwowski, J. *Marketingowe zarządzanie regionem.* Marketing w rozwoju regionu, Part IV: Promocja region, pp. 373-471.

conditions and thus achieving superior results, consequently realizing the goal of regional development.

It is important to note that a region's competitive advantage is relative (contextual) in nature. This means that it is maintained as long as the competing regions are not able to act in analogous manner. Development of regional competitiveness should, therefore, be based on and strongly founded in such tangible and intangible elements, which are characterized by:

- a unique nature (difficult to imitate/copy – e.g., monuments, recognized and respected image, rarities – e.g., natural peculiarities),
- adequate size (which is decisive in terms of the competitive advantage magnitude),
- appropriate durability (the necessary time dimension of the advantage),
- difficulty in substituting/replacing (resource substitutability),
- limited in mobility (or lack of mobility).

Knowledge of the detailed resource characteristics thus determines the durability of the region's competitive advantage and can certainly facilitate the decision-making regarding development and improvement of specific resources in available in the region. Based on the above, a conclusion can be drawn, according to the Authors, that a region's competitive advantage should be considered in dynamic terms as well, to seek directions of and opportunities for its expansion and strengthening. This also means that a region of currently few opportunities to compete and develop effectively is not necessarily doomed to be weak and undevelopable.

4. Instruments of a region's competitiveness

One equally important aspect of a strategic dimension is the selection of competitiveness instruments. These decisions should be governed by the effectiveness and ease of being recognized the relevant target groups of 'stakeholders'. The selection and composition of these instruments must not be random, but thoughtful and consciously conceived. From the perspective of the 'stakeholders', the instruments must be noticeable and of a certain value (translated into an attractive offer), in order to win their favor. Such a list of a region's competitiveness instruments practically can be long, as it is subject to the creativity of the region's authorities, who, based on specific competitive advantages, can apply different instruments of competition. The identification and selection of a region's competitiveness instruments, however, should always be carried out in reference to the actual standing of the region's entities and the state of its environment.

5. Formulation of an effective strategy for a region’s development

Building on the foundation of a region's competitive potential as well as the identified and developed competitive advantages, it becomes possible to formulate an effective strategy for the region. A region's development strategy is formulated, on the one hand, as a result, and on the other, as an expression of the development vision chosen by the authorities, which in turn determines the choice of the main strategic goals. It is widely accepted that the overarching and long-term strategic goal of a region (its mission) entails a strive to continuously improve the local community’s well-being. This such an important directional objective can only be realized through accurate and carefully determined bundles of strategic goals, the combined implementation of which can improve the region’s economic efficiency and competitiveness, resulting in its development.

The formulation of the region's strategic development goals is one of the primary tasks for the region's authorities, which places a heavy burden of responsibility on the representatives of the authorities. Very often such an important overarching objective as a region’s vision or directional development goals are formulated during election campaigns by the candidates for the seats of regional authorities. These goals, as a rule, are very ambitious and even often unrealistic. The degree of attractiveness of these goals, from the perspective of various ‘stakeholder’ groups, determines the electorate’s votes of support. In reality, however, the degree of success in achieving the region's strategic development goals, depends on the region’s strengths and the effectiveness of the competitiveness instruments selected. This means that, ultimately, a sustainable basis for a region’s development lies in its competitive potential.

It is not uncommon for a region's authorities, or certain significant pressure groups, to hold particularly exorbitant ambitions, the realization of which is in contraposition with the region's level of strategic resources and capabilities. Nevertheless, these people have a decisive influence on the selection of the region’s strategic development goals and directions. The decision-makers should thus have appropriate knowledge and skills, and above all, hold authority among the region's society. In practice, the decisions on a region's strategic development objectives and paths of implementation are realized over many years and often exceed the decision-makers’ (authorities’) terms of office. Hence, it is crucial that the successive teams of those managing a given region focus on the existing strategic goals, for the success of the strategy selected.

6. Analysis of selected infrastructure elements enhancing regional competitiveness

For the purpose of this study, a detailed analysis of selected elements of socio-tourist infrastructure has been compiled, which can form a basis for formulation of strategies aimed at competitiveness improvement and development of regions in Poland. The infrastructure elements presented serve as examples of areas characterized by great potential for growth, as a consequence of years of neglect, or constrained by independent external COVID-19 pandemic-related conditions.

One of the most neglected social-infrastructure elements in Poland is the health care system. According to reports by independent institutions, including the Supreme Audit Office (NIK), the scale of financing health needs, expressed as the share of health system spending in GDP, is low, compared to other European countries (NIK Report, 19.05.2019). Admittedly, the level of budget spending on health care has been growing every year, reaching 6.2% of GDP in 2023 (Rynek Zdrowia, 16.IX.2022). None the less, the analysis shows that, although the outlays for health care services have increased by nearly 70 percent, compared to 2016, the services performed have only increased by 3 percent. This indicates an insufficient supply of health services, compared to the legitimate health needs of the population and the high share of privately financed services in the total cost of the services provided (NIK Report). Access to primary health services is thus becoming increasingly dependent on the patient's financial standing.

Table 1.
2019-2021 health care expenditures in Poland in relation to GDP

SPECIFICATION		2019		2020		2021	
		PLN million	% GDP	PLN million	% GDP	PLN million	% GDP
	Gross Domestic Product[a]	**2 293 199**	**100**	**2 323 859**	**100**	**2 622 184**	**100**
SHA 2011[b]							
HF.1+HF.2+ HF.3	**Total current health care expenditures[c]**	**147 838.5**	**6.4**	**151 873.5[d]**	**6.5**	**172 884.6[e]**	**6.6**
HF.1	Public spending	106 113.9	4.6	109 752.7	4.7	125 476.5	4.8
	including:						
HF.1.1	general government sector schemes	14 693.6	0.6	14 939.4	0.6	.	.
HF.1.2	compulsory premium-based health insurance schemes	91 420.3	4.0	94 813.3	4.1	.	.
HF.2+HF.3	Private spending	41 724.6	1.8	42 120.8	1.8	47 408.1	1.8
HF.3	including direct household spending	29 701.9	1.3	29 668.4	1.3	33 814.8	1.3

Source: GDP data available at: https://stat.gov.pl/wskazniki-makroekonomiczne.

Noteworthy is the fact that the Polish health care system is characterized by an exceptionally unfavorable structure of the healthcare costs, financed by the National Health Fund, with more than 50% share of the cost of hospital treatment. Compared with European Union countries,

Poland still has one of the highest ratios of hospital beds per 100 000 residents. In recent years, a reversal of this unfavorable trend has been observed, but the share of this type of treatment, the most expensive in the total cost of healthcare services, still dominates in Poland. Inpatient treatment should gradually be displaced by outpatient health care and preventive care. Meanwhile, a systematic decline has been noted in the number of services provided in such areas as (Rynek Zdrowia,16.IX.2022):

- psychiatric care and addiction treatment (-9.7 percent, compared to a 33.5 percent increase in the value of the benefits provided),
- nursing and care services (-23.7 percent vs. a 69.8 percent increase in the value of the benefits provided),
- emergency medical services (-10.5 percent versus a 31.2 percent increase in the value of the benefits provided).

The findings of the NIK audit indicate that some health care providers, without recognizing the health care needs, undertook investment activities, such as purchase of modern equipment, construction work, hiring of additional medical staff, while other health care providers offering the same services had already been operating in the region. This translated into low utilization of the available resources, including hospital beds. The diversity of the entities making up individual hospitals is not facilitative to the coordination of such activities. As the results of the NIK audit indicate, the coordination of activities, between district and provincial governments, to ensure comprehensiveness of the healthcare services provision, adequate planning for participation of individual entities in the health care system, as well as rational restoration and development of the material base, is inadequate as well (NIK Report).

In many international rankings comparing health care systems, the Polish system ranks among the last in the European Union. The public's assessment of the health care system functioning, as reflected in opinion polls results, is mostly negative (Appendix No. 4.1. to the NIK Report). For this reason, it entails one of the primary areas that determining the competitiveness structure of the various regions of Poland.

The second element of socio-tourist infrastructure which can form the basis for development of a strategy to improve the competitiveness of regions in Poland is accommodation facilities. Over the years, the number of accommodation facilities and the accommodation capacity offered in Poland has steadily increased, with current dominance of hotel facilities. This is associated with the growing demand for domestic accommodation services in the period analyzed. i.e., 2012 – 2020. At the time, the tourism sector was assumed to account for about 10 percent of the world's gross product. The Polish tourism sector produced more than 6 percent of GDP, while the entire industry provided jobs for more than 700 000 people. The situation changed dramatically with the outbreak of the COVID-19 pandemic, when tourism became one of the industries most affected by the pandemic. In 2020, due to pandemic-related restrictions, more than 49.9% fewer tourists used accommodation facilities, compared to 2019, which is 21.0% fewer compared to 2012. The same year, the number of accommodation facilities with

10 or more beds amounted to 10 291 facilities (960 fewer than in 2019, i.e., 808 more than in 2012), including 3 990 hotel facilities (62.6% of which were hotels). The tourist accommodations offered 775.3 thousand beds (compared to 675.4 thousand in 2012 and 825.5 in 2019), 45.7% of which were in hotel facilities. The number of beds per 1000 population decreased to 20.2, against the 21.5 in 2019, but was higher than in 2012-2017. In 2020, 17.9 million tourists stayed in tourist accommodation facilities, including 1.9 million foreign tourists, who mainly chose hotels.

The number of tourists using accommodation facilities, per 1000 population, decreased by more than twice (465 vs. 928 in 2019; 20.8% lower compared to 2012). Tourists used 51.4 million overnight stays (including foreign tourists - 6.6 million overnight stays). In 2020, the Pomeranian (15.1%), West Pomeranian (14.4%), Lesser Poland (13.2%) and Lower Silesian (9.8%) regions had the highest number of accommodation facilities. These regions still concentrated more than half of the country's accommodation base. The smallest number of facilities, in turn, was in the Opole region (1.3%) as well as the Masovian (2.2%) and Świętokrzyskie (2.3%) regions. In terms of the number of beds offered in accommodation facilities, the West Pomeranian region has been the leader for years. In 2020, 141.1 thousand beds were available (17.7% more than in 2012 and 2.9% less than in 2019), which accounted for 18.2% of the total number in the country. The highest number of tourists using accommodation facilities was recorded in Lesser Poland region (2.4 million) and the West Pomeranian region (2.1 million) - these regions also hosted the largest number of foreign tourists. In the West Pomeranian region, the rate of beds per 1 000 residents was 4 times higher than the national average (83.0 beds), while the number tourists using accommodation facilities, per 1000 population, was more than 2.5 times higher than the national average per capita (1 239 vs. 465 people) - (Central Statistical Office, Regional Development of Poland, Warsaw, 2022).

Undoubtedly, the development of the tourism industry in Poland, including accommodation facilities, will depend on successful overcoming of the pandemic constraints, as well as on flexible formulation of marketing strategies which take the ever-changing preferences of travelers into account. Travelers' attention will focus on health aspects, on choosing offers which deliver the best value for money and avoiding crowded destinations. Based on an analysis carried out by Skift Research in the fall of 2020, it can be suspected that international travel spending will be redirected to domestic travel, and inbound tourism revenues will be severely disinvested (Tourism industry turned upside down, September 2020, McKinsey & Company).

7. Summary

The paper entails a closer look at the procedure of a region's development strategy formulation and shows the dependence thereof on the region's competitive potential, which constitutes a decisive foundation in the entire process. It draws attention to the elements of a region's competitive potential, the usefulness thereof and the characteristic features determining the magnitude and strength of this potential. The following part of the paper presents considerations on the selection of the competitive advantages of a region forming the planning basis for the list of the competitiveness instruments to be used. The final section of the theoretical part of the article deals with the formulation of a region's development strategy, approximating the issues development vision and strategic objectives in particular. For the purpose of this paper, a detailed analysis of two selected elements of socio-tourist infrastructure has been compiled, which can serve as a basis for formulation of strategies aimed at competitiveness improvement and development of regions in Poland. The infrastructure elements presented serve as examples of areas characterized by great potential for growth, as a consequence of years of neglect, or constrained by independent external COVID-19 pandemic-related conditions.

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MODEL OF DATA OF THE SETTLEMENT OF COSTS OF PUBLIC TRANSPORT OPERATING ON THE TERRITORY OF THE UPPER SILESIAN METROPOLITAN UNION

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Purpose: Development of a coherent unified data model allowing multi-criteria analysis of data on accounting for the costs of public transportation provided in the Upper Silesian-Zagłębów Metropolitan Area (GZM) (https://metropoliagzm.pl).
Design/methodology/approach: The study used automatic data processing methods using Power Query mechanisms, data cleaning and unification techniques.
Findings: In the course of the work it was found: dispersion of data between different cost-controlling units, lack of uniform data structures between units, inconsistency of dictionaries over time.
Practical implications: The data model developed during the work was used to build the analytical platform used within the GZM.
Social implications: The developed model was used for presentation to the mayors of the municipalities that make up the GZM. It is an analytical tool used by the management of the GZM to present and optimize the scope of communication in the designated area.
Originality/value: Authorial model for processing data from heterogeneous sources into a coherent and unified data structure has been developed.

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

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

1. Genesis

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

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

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

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

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

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

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

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

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

2. Input data

The input data for the model were binders of data provided by two departments dealing with the settlement of transportation costs. One of them deals with the determination of the so-called variable contribution, i.e. the fee that individual municipalities pay to the joint budget. The characteristics of these data and how they were processed are presented in the following paragraphs.

2.1. Input data – carriage costs

Department one deals with planning and accounting for transportation costs.

Data is collected in the form of spreadsheet binders, each sheet contains a table that includes a plan and settlement of one unit during one month by individual transportation lines. Two types of billing are maintained. one for bus and trolleybus lines and the other for tramway billing. The units are respectively:

- municipalities included in the GZM (http://gzmetropolia.pl/metropolia),
- municipalities from outside the GZM,
- special units that account for additional special transportation tasks carried out, such as:
  - events,
  - detours,
  - commutes,
  - access to hypermarkets,
  - trips charged entirely to the GZM.

The special units identified above are conventionally referred to by the term "virtual municipalities".

The individual tables include volume (kilometer) and value settlements. Value settlements include volumes resulting from the number of kilometers traveled, as well as volumes resulting from various additional charges specific to bus-trolleybus and streetcar fleets, respectively.

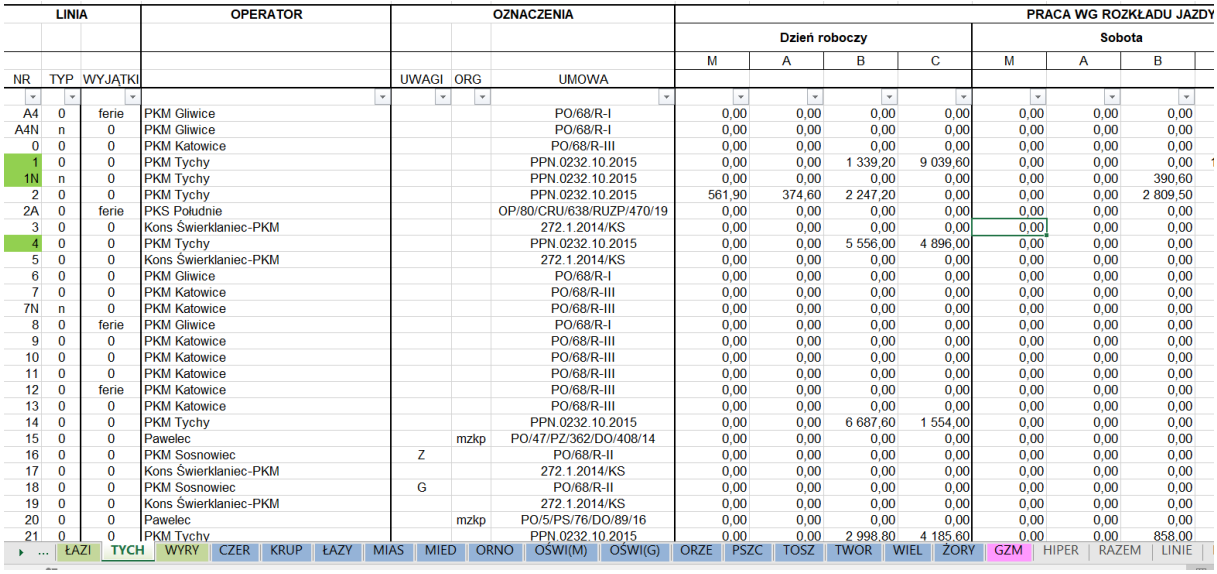
2.1.1. Data – Buses and trolleybuses

Data regarding planning and accounting for bus and trolleybus transportation was contained in 6 workbooks. Four contained planning data for 2020-2023 and two dealt with implementation from 2020-2021.

Within each workbook, there were up to 57 (varying by year) worksheets containing data on individual municipalities and virtual municipalities. Within each sheet, the table rows contained data on individual line numbers. A total of 521 bus lines (including bus lines operating vicariously on tramways) and 8 trolleybus lines were identified. The columns of the tables contain quantitative (wozokilometers - wkm) and value data on wkm traveled and other values charged to individual lines such as:

- AIR CONDITIONING net cost,
- MONITORING net cost,
- WIFI net cost,
- SDIP net cost,
- PPK net cost,
- MIN_WAGE net cost,
- OTHER net cost.

The structure of the data sheets within a single workbook (Fig. 1) was consistent while there were differences in construction between different workbooks (years).



LINIA			OPERATOR	OZNACZENIA			PRACA WG ROZKŁADU JAZDY						
							Dzień roboczy				Sobota		
							M	A	B	C	M	A	B
NR	TYP	WYJĄTKI		UWAGI	ORG	UMOWA							
A4	0	ferie	PKM Gliwice			PO/68/R-I	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A4N	n	0	PKM Gliwice			PO/68/R-I	0,00	0,00	0,00	0,00	0,00	0,00	0,00
0	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1	0	0	PKM Tychy			PPN.0232.10.2015	0,00	0,00	1 339,20	9 039,60	0,00	0,00	0,00
1N	n	0	PKM Tychy			PPN.0232.10.2015	0,00	0,00	0,00	0,00	0,00	0,00	390,60
2	0	0	PKM Tychy			PPN.0232.10.2015	561,90	374,60	2 247,20	0,00	0,00	0,00	2 809,50
2A	0	ferie	PKS Południe			OP/80/CRU/638/RUZP/470/19	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3	0	0	Kons Świerklaniec-PKM			272.1.2014/KS	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4	0	0	PKM Tychy			PPN.0232.10.2015	0,00	0,00	5 556,00	4 896,00	0,00	0,00	0,00
5	0	0	Kons Świerklaniec-PKM			272.1.2014/KS	0,00	0,00	0,00	0,00	0,00	0,00	0,00
6	0	0	PKM Gliwice			PO/68/R-I	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7N	n	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
8	0	ferie	PKM Gliwice			PO/68/R-I	0,00	0,00	0,00	0,00	0,00	0,00	0,00
9	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
10	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
11	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
12	0	ferie	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
13	0	0	PKM Katowice			PO/68/R-III	0,00	0,00	0,00	0,00	0,00	0,00	0,00
14	0	0	PKM Tychy			PPN.0232.10.2015	0,00	0,00	6 687,60	1 554,00	0,00	0,00	0,00
15	0	0	Pawelec		mzkp	PO/47/PZ/362/DO/408/14	0,00	0,00	0,00	0,00	0,00	0,00	0,00
16	0	0	PKM Sosnowiec	Z		PO/68/R-II	0,00	0,00	0,00	0,00	0,00	0,00	0,00
17	0	0	Kons Świerklaniec-PKM			272.1.2014/KS	0,00	0,00	0,00	0,00	0,00	0,00	0,00
18	0	0	PKM Sosnowiec	G		PO/68/R-II	0,00	0,00	0,00	0,00	0,00	0,00	0,00
19	0	0	Kons Świerklaniec-PKM			272.1.2014/KS	0,00	0,00	0,00	0,00	0,00	0,00	0,00
20	0	0	Pawelec		mzkp	PO/5/PS/76/DO/89/16	0,00	0,00	0,00	0,00	0,00	0,00	0,00
21	0	0	PKM Tychy			PPN.0232.10.2015	0,00	0,00	2 998,80	4 185,60	0,00	0,00	858,00

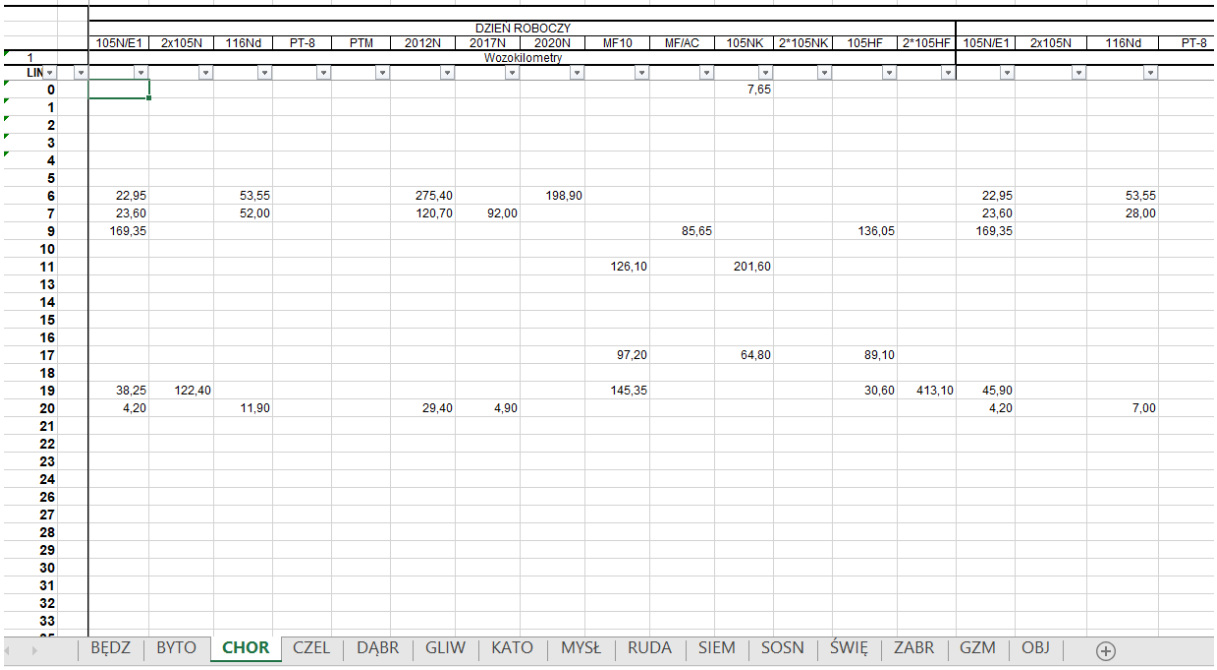
... | ŁAZI | TYCH | WYRY | CZER | KRUP | ŁAZY | MIAS | MIED | ORNO | OŚWI(M) | OŚWI(G) | ORZE | PSZC | TOSZ | TWOR | WIEL | ŻORY | GZM | HIPER | RAZEM | LINIE

Figure 1. An example of a workbook with source data.

Source: Górnośląsko-Zagłębiowska Metropolia (GZM).

2.1.2. Data - Trams

Data on planning and accounting for tram transport is contained in 6 workbooks. Four contain planning data for 2020-2023, and two implementations from 2020-2021. Within each workbook there were up to 17 (varying by year) sheets containing data on individual municipalities and virtual municipalities. Within each sheet, the table rows contained data on individual line numbers. A total of 42 tram lines were identified (Fig. 2).



	DZIEŃ ROBOCZY																	
	105N/E1	2x105N	116Nd	PT-8	PTM	2012N	2017N	2020N	MF10	MF/AC	105NK	2*105NK	105HF	2*105HF	105N/E1	2x105N	116Nd	PT-8
1	Wozokilometry																	
LIN																		
0											7,65							
1																		
2																		
3																		
4																		
5																		
6	22,95		53,55			275,40		198,90							22,95		53,55	
7	23,60		52,00			120,70	92,00								23,60		28,00	
9	169,35									85,65			136,05		169,35			
10																		
11									126,10		201,60							
13																		
14																		
15																		
16																		
17									97,20		64,80		89,10					
18																		
19	38,25	122,40							145,35				30,60	413,10	45,90			
20	4,20		11,90			29,40	4,90								4,20		7,00	
21																		
22																		
23																		
24																		
26																		
27																		
28																		
29																		
30																		
31																		
32																		
33																		

BĘDZ | BYTO | CHOR | CZEL | DĄBR | GLIW | KATO | MYSŁ | RUDA | SIEM | SOSN | ŚWIĘ | ZABR | GZM | OBJ

Figure 2. An example of a workbook with source data.

Source: Upper Silesia and Zagłębie Metropolis (GZM).

The columns of the tables contain quantitative and valuable data on travelled wkm, pkm by type of rolling stock where the following types of tram rolling (Tundys, 2008; Lubka, Stiasny, 2011, pp. 20-21) stock are distinguished:

- 105N/E1,
- 2x105N,
- 116Nd,
- PT-8,
- PTM,
- 2012N,
- 2017N,
- 2020N,
- MF10,
- MF/AC,
- 105NK,
- 2*105NK,
- 105HF,
- 2*105HF,

and other valuable ones such as:

- Air conditioning.
- Cost of commuting courses.
- Bus stop fees.
- Property tax.
- Perpetual use of land.
- Depreciation of other assets.
- Maintenance of tracks, networks, substations.
- Depreciation of infrastructure.
- Depreciation of rolling stock.
- Redemption of bonds.
- Finance costs.

It should be noted that between 2020 and 2021 there was a change in the units of accounting for kilometers traveled by tramway rolling stock, and so until 2020 the applicable unit was wozokilometers (wzk), and from 2021 the applicable unit is train kilometers (pkm). The change consisted in the fact that rolling stock marked with the symbols 2x105N, 2*105NK and 2*105HF consisting of two identical wagons was counted until 2020 for the wagons traveled separately, and from 2021 individually for the entire squad.

2.2. Input data – other data on the calculation of the variable premium

The second department, which is in charge of calculating the surcharge part for individual municipalities, carries out the next step of cost settlements based on a single summary table on the basis of which it makes detailed settlements per line and municipality. The calculation of this part of the costs includes such elements as:

- Ticket revenue.
- Organization costs.
- Lost revenue (free rides for children and youth).
- Lost revenue (railroads).
- Lost revenue (other).
- Sheds (W).
- Other settlements (I).

3. Data processing

3.1. Data – Buses and trolleybuses

In order to aggregate data scattered between sheets additionally contained in separate workbooks, aggregation queries were created for individual workbooks. Due to the different construction of workbooks, it was necessary to create unique queries for each of them separately. The queries were constructed using MS Power Query and the M language that functions within it. A transcript of the translated query written in M is shown in Figure 3:

BUS_Wykon_2021

```
let
    Źródło = Excel.Workbook(File.Contents("C:\Users\.....\!GZM\Projekt_II\Dane\BUS_WYKON_2021 (1) 14-02-2022.xlsx"), true, true),
    #"Przefiltrowano wiersze" = Table.SelectRows(Źródło, each ([Kind] = "Sheet") and ([Hidden] = false) and ([Name] <> "GMINY" and [Name] <
    #"Usunięto inne kolumny" = Table.SelectColumns(#"Przefiltrowano wiersze",{"Name", "Data"}),
    #"Rozwinięty element Data" = Table.ExpandTableColumn(#"Usunięto inne kolumny", "Data", {"Column1", "Column4", "Column7", "Column49", "C
    #"Zmieniono nazwy kolumn" = Table.RenameColumns(#"Rozwinięty element Data",{{"Data.Column1", "NR"}, {"Data.Column4", "OPERATOR"}, {"Dat
    #"Przefiltrowano wiersze1" = Table.SelectRows(#"Zmieniono nazwy kolumn", each ([NR] <> null and [NR] <> "  " and [NR] <> "LINIA" and [N
    #"Dodano kolumnę niestandardową" = Table.AddColumn(#"Przefiltrowano wiersze1", "ROK", each 2021),
    #"Zmieniono kolejność kolumn" = Table.ReorderColumns(#"Dodano kolumnę niestandardową",{"ROK", "Name", "NR", "OPERATOR", "UMOWA", "M km"
in
    #"Zmieniono kolejność kolumn"
```

Figure 3. Example of an M-language query for bus rolling stock.

Source: own study.

The main steps of the inquiry procedure were:

- Selecting the appropriate sheets within the workbook.
- Determining the target columns from which the data was extracted.
- Assigning understandable names to the extracted columns.
- Filtering the rows according to the developed criteria.

The result of carrying out the query procedure was the creation of structurally uniform tables from each year containing data that describe bus and trolleybus transportation.

An example of the table after the execution of the query is shown in Figure 4. The table contains in individual rows data on individual lines of transportation that carry out transportation in individual municipalities. The individual columns contain amount and quantity data that characterize each line.

Zapytania

	ROK	Name	NR	OPERATOR	UMOWA	M km	A km	B km	C km	Razem km	M koszt ne...	A
1	2021	OBJ	A4	PKM Gliwice	OP/3/CRU/51/2021	0	0	1358,4	889,2	2247,6	0	
2	2021	OBJ	A4N	PKM Gliwice	OP/3/CRU/51/2021	0	0	108	0	108	0	
3	2021	OBJ	6	PKM Gliwice	OP/3/CRU/51/2021	0	0	0,2	608,2	608,4	0	
4	2021	OBJ	15	Pawelec	null	0	0	541,8	0	541,8	0	
5	2021	OBJ	24	PKM Sosnowiec	OP/1/CRU/4/2021	0	0	8,8	0	8,8	0	
6	2021	OBJ	27	PKM Sosnowiec	null	0	0	198	80	278	0	
7	2021	OBJ	32	PKM Gliwice	null	0	0	1566,9	17428,4	18995,3	0	
8	2021	OBJ	32N	PKM Gliwice	null	0	0	1720,5	0	1720,5	0	
9	2021	OBJ	35	PKM Sosnowiec	null	0	0	0	115,2	115,2	0	
10	2021	OBJ	40	PKM Sosnowiec	null	0	0	154	0	154	0	
11	2021	OBJ	41	Pawelec	null	0	0	1188,7	0	1188,7	0	
12	2021	OBJ	42	PKM Sosnowiec	null	0	0	147	0	147	0	
13	2021	OBJ	43	PKM Katowice	OP/1/CRU/4/2021	0	0	48,2	0	48,2	0	
14	2021	OBJ	49	PKM Sosnowiec	null	0	0	8,4	0	8,4	0	
15	2021	OBJ	52	Kons Lazar-Nowak-PKS Poł	null	0	0	445,6	0	445,6	0	
16	2021	OBJ	61	PKM Sosnowiec	null	0	0	166,3	0	166,3	0	
17	2021	OBJ	67	Pawelec	WH.50.55.2020	0	81,6	0	0	81,6	0	

Figure 4. Example of the result table for bus fleet settlements.

Source: own study.

3.2. Data – trams

For input workbooks containing data on streetcar traffic, queries were created analogously to those for processing bus transport data, with the exception that procedure steps that aggregate individual types of streetcar rolling stock into groups according to Table 1 were additionally included. .

Table 1.
Tram rolling stock - groups

2021	grupa	Nazwa
105N/E1	I	A
2x105N	III	B
116Nd	IV	BN
PT-8	III	B
PTM	IV	BN
2012N	V	CN
2017N	IV	BN
2020N	V	CN
MF10AC	II	AN
MF/AC	IV	BN
105NK	I	A
2*105NK	III	B
105HF	I	A
2*105HF	III	B

Note. Division of tram rolling stock into groups.

Source: Upper Silesia and Zagłębie Metropolis (GZM).

The specifications of each group are shown in Table 2. It classifies each group according to the capacity of the carts, their length and types (high-floor, low-floor).

Table 2.
Tram rolling stock - description

Grupa	Nazwa	Opis
I	A	pojemności < 150 miejsc (długość < 20m), wysokopodłogowy
II	AN	pojemności < 150 miejsc (długość < 20m), niskopodłogowy
III	B	pojemności > 150 miejsc (długość 20m - 30m), wysokopodłogowy
IV	BN	pojemności > 150 miejsc (długość 20m - 30m), niskopodłogowy
V	CN	pojemności > 150 miejsc (długość > 30m), niskopodłogowy

Note. Description of streetcar fleet groups.

Source: Upper Silesia and Zagłębie Metropolis (GZM).

Analogous to the bus queries, the MS Power Query tool was used. Due to the inconsistency of the sheets between periods (years), queries were created separately for each period. A transcript of the translated query written in M is shown in Figure 5:

TRAM_Plan_2022

```
let
    Źródło = Excel.Workbook(File.Contents("C:\Users\mbartnicki\Documents\!GZM\Projekt_II\Dane\SZ_TRAM_2022_dojazdy_20.09.21.xlsx"), true, tru
    #"Przefiltrowano wiersze" = Table.SelectRows(Źródło, each ([Hidden] = false) and ([Kind] = "Sheet") and ([Name] <> "GMINY" and [Name] <>
    #"Usunięto kolumny" = Table.RemoveColumns(#"Przefiltrowano wiersze",{"Item", "Kind", "Hidden"}),
    #"Rozwinięty element Data1" = Table.ExpandTableColumn(#"Usunięto kolumny", "Data", {"Column1", "Column145", "Column146", "Column147", "Co
    #"Usunięto pierwsze wiersze" = Table.Skip(#"Rozwinięty element Data1",3),
    #"Nagłówki o podwyższonym poziomie" = Table.PromoteHeaders(#"Usunięto pierwsze wiersze", [PromoteAllScalars=true]),
    #"Zmieniono nazwy kolumn" = Table.RenameColumns(#"Nagłówki o podwyższonym poziomie",{{"Column2", "T_NR"}, {"ZREALIZOWANA", "105N/E1 PLN"}
    #"Przefiltrowano wiersze1" = Table.SelectRows(#"Zmieniono nazwy kolumn", each ([T km] <> null and [T km] <> 0 and [T km] <> "RAZEM") and
    #"Dodano kolumnę niestandardową" = Table.AddColumn(#"Przefiltrowano wiersze1", "T ""A""", each [#"105N/E1"]+[105NK]+[105HF]),
    #"Dodano kolumnę niestandardową1" = Table.AddColumn(#"Dodano kolumnę niestandardową", "T ""AN""", each [MF10AC]),
    #"Dodano kolumnę niestandardową2" = Table.AddColumn(#"Dodano kolumnę niestandardową1", "T ""B""", each [2x105N]+[#"2*105NK"]+[#"2*105HF"]
    #"Dodano kolumnę niestandardową3" = Table.AddColumn(#"Dodano kolumnę niestandardową2", "T ""BN""", each [116Nd]+[PTM]+[2017N]+[#"MF/AC"])
    #"Dodano kolumnę niestandardową4" = Table.AddColumn(#"Dodano kolumnę niestandardową3", "T ""CN""", each [2012N]+[2020N]),
    #"Dodano kolumnę niestandardową5" = Table.AddColumn(#"Dodano kolumnę niestandardową4", "T ""A"" koszt", each [#"105N/E1 PLN"]+[105NK PLN]
    #"Dodano kolumnę niestandardową6" = Table.AddColumn(#"Dodano kolumnę niestandardową5", "T ""AN"" koszt", each [MF10AC PLN]),
    #"Dodano kolumnę niestandardową7" = Table.AddColumn(#"Dodano kolumnę niestandardową6", "T ""B"" koszt", each [2x105N PLN]+[#"PT-8 PLN"]+[
    #"Dodano kolumnę niestandardową8" = Table.AddColumn(#"Dodano kolumnę niestandardową7", "T ""BN"" koszt", each [116Nd PLN]+[PTM PLN]+[2017
    #"Dodano kolumnę niestandardową9" = Table.AddColumn(#"Dodano kolumnę niestandardową8", "T ""CN ""koszt", each [2012N PLN]+[2020N PLN]),
    #"Usunięto kolumny1" = Table.RemoveColumns(#"Dodano kolumnę niestandardową9",{"105N/E1", "2x105N", "116Nd", "PT-8", "PTM", "2012N", "2017
    #"Zmieniono kolejność kolumn" = Table.ReorderColumns(#"Usunięto kolumny1",{"T_GMINA", "T_NR", "T ""A""", "T ""AN""", "T ""B""", "T ""BN""
in
    #"Zmieniono kolejność kolumn"
```

Figure 5. Example of an M-language query for streetcar rolling stock.

Source: own study.

The result of running the query procedure was the creation of structurally uniform tables from each year containing data that describe streetcar transportation.

An example of the table after the query procedure is shown in Figure 6.

Zapytania

	T_GMINA	T_NR	T "A"	T "AN"	T "B"	T "BN"	T "CN"	T km	T "A" koszt	T "AN" koszt	T "B" koszt
1	BĘDZ	21	106183	0	13685,8	98581,85	0	218450,65	1041106,976	0	180445,03
2	BĘDZ	22	98273	0	0	68762,95	0	167035,95	963550,7176	0	
3	BĘDZ	27	130193,75	0	53705,5	0	0	183899,25	1276528,459	0	708098,24
4	BĘDZ	28	66414	18649,8	0	0	0	85063,8	651178,425	208035,4736	
5	BĘDZ	42	6827,6	0	0	0	0	6827,6	66943,50309	0	
6	BĘDZ	ZASTĘPCZA T.ŚL.	1,0E-17	0	0	0	0	1,0E-17	1,081E-16	0	r
7	BYTO	2	44369,4	0	30353,4	100991,85	0	175714,65	435034,7217	0	400204,62
8	BYTO	5	11304,4	0	0	113888,6	0	125193	110837,7961	0	
9	BYTO	6	20515,5	0	0	26987,4	279941,4	327444,3	201151,1274	0	
10	BYTO	7	9894	0	17136	49388,4	75711,2	152129,6	97009,05437	0	225935,36
11	BYTO	9	110754,1	0	0	28342,25	0	139096,35	1085925,865	0	
12	BYTO	17	12707,8	0	0	0	0	12707,8	124597,9039	0	
13	BYTO	19	131256	129650,85	235321,65	0	0	496228,5	1286943,647	1446234,061	3102677,5
14	BYTO	30	18308	0	0	0	0	18308	179506,9504	0	
15	BYTO	38	0	38130,2	0	0	0	38130,2	0	425336,1546	
16	BYTO	49	140681,05	0	0	0	0	140681,05	1379354,723	0	
17	BYTO	ZASTĘPCZA	1,0E-44	0	0	0	0	1,0E-44	1,081E-43	0	r
18	CHOR	6	11130,75	0	0	14642,1	151883,1	177655,95	109135,1862	0	
19	CHOR	7	5747,4	0	10080	29052	44536	89415,4	56352,31848	0	132903,1
20	CHOR	9	114794,35	0	0	28962,75	0	143757,1	1125539,857	0	
21	CHOR	11	13688,4	0	13889,7	122372,1	37615,65	187565,85	134212,5268	0	183133,42
22	CHOR	17	73523,7	0	0	0	0	73523,7	720887,8725	0	
23	CHOR	19	42755,85	42403,95	77066,1	0	0	162225,9	419214,1275	473009,1379	1016103,5
24	CHOR	20	28473,7	0	39	84435	84734,6	197682,3	279179,9789	0	514,2086
25	CHOR	40	11035,9	0	0	0	0	11035,9	108205,1974	0	

Figure 6. An example of a result table for the settlement of tramway rolling stock.

Source: own study.

The table contains, in individual rows, data on individual streetcar lines that carry out transportation in each municipality. The individual columns contain amount and quantity data characterizing each line.

3.3. Input data – other data on the calculation of the variable premium

With regard to the remaining data, the structure of which was already partially aggregated, only the necessary range of data was selected and filtered.

In terms of source data, there was no standardized approach to the naming and data types used. Thus, for example, the name of one municipality, depending on the data source, was presented in the following forms:

- CZER.
- Czerwionka-Leszczyny.
- CZERWIONKA LESZCZYNY.

Accordingly, relevant dictionaries were created to standardize the naming of municipalities and the numbering of individual lines. Procedures were developed to emerge headings describing individual data. Thus, individual data are described with the following headings.

- Type of data.
  - Plan.
  - Execution.
- Affiliation.
  - Other.
  - Municipalities GZM.
  - Foreign municipalities.
  - Airport.
  - GZM.
- Operator type.
  - PKM.
  - PRYW.
  - TROLLEYBUS.
  - TRAM.
- Line_Type.
  - A – Bus.
  - TR – Trolleybus.
  - T – Tram.
- Municipality (name of Municipality).
- Number of line.
- Opreator (name of Operator).

All data after the process was aggregated into one standardized dataset. On the basis of the obtained data, a model was developed for the analysis and presentation of the acquired data. This model received approval and was made available to the heads and treasurers of each municipality. A sample table and charts are shown in Figure 7 and 8.

Przynależność	(Wszystko)	
Typ_Operatora	(Wszystko)	
Typ_Lini	(Wszystko)	Dokonaj wyboru (Pola Niebieskie)
Opreator	(Wszystko)	
Nr_linii	(Wszystko)	
Gmina	(Wszystko)	

Wartości	2021 Plan	2021 Wykonanie	2021-2021 Różnica Wykonanie-Plan	2021-2021 Odchylenie % Wykonanie-Plan	2021-2021 Efekt wzkm (PLN)	Wykonanie-Plan Efekt stawki (PLN)
M koszt netto	16 295 957	15 676 879	-619 078	-3,8%	-994 362	375 284
A koszt netto	22 599 137	22 454 352	-144 786	-0,6%	-743 747	598 961
B koszt netto	308 501 419	328 288 699	19 787 280	6,4%	5 001 140	14 786 140
C koszt netto	196 232 930	212 817 356	16 584 426	8,5%	6 754 663	9 829 763
TB koszt netto	11 817 481	12 704 174	886 694	7,5%	886 694	0
T koszt netto	222 617 629	199 627 138	-22 990 490	-10,3%	-19 088 796	-3 901 695
A i TB koszty dodatkowe	13 333 495	13 531 146	197 651	1,5%		
T koszty dodatkowe	39 467 920	38 834 920	-633 000	-1,6%		
Klimatyzacja	*0*	*0*	*0*			
Koszt kursów dojazdowych	*0*	*0*				
Finansowane przez Gminy (T)	*39 467 920*	*38 834 920*	*-633 000*	*-1,6%*		
Finansowane przez GZM			*0*			
Koszty Przew. finansowane przez Gminy	**791 398 049**	**805 099 745**	**13 701 696**	**1,7%**		
Dochody z biletów	237 800 000	145 752 718	-92 047 282	-38,7%		
Koszty organizacji	35 383 179	13 516 178	-21 867 001	-61,8%		
Utracone dochody (bezpłatne przejazdy dzieci i młodzież)	15 616 653	15 697 000	80 347	0,5%		
Utracone dochody (kolej)	2 314 815	1 537 396	-777 419	-33,6%		
Utracone dochody (inne)	0	61 724	61 724			
Składka zmienna	**571 049 760**	**655 567 085**	**84 517 324**	**14,8%**		
Wiaty (W)	1 024 743	0	-1 024 743	-100,0%		
Inne rozliczenia (I)	0	31 238	31 238			
Składka zmienna + T + W + I	**611 542 423**	**694 433 242**	**82 890 819**	**13,6%**		
M wzkm	3 949 423	3 711 261	-238 162	-6,0%		
A wzkm	4 589 286	4 440 258	-149 028	-3,2%		
B wzkm	54 579 660	55 443 906	864 247	1,6%		
C wzkm	29 407 592	30 395 515	987 923	3,4%		
TB wzkm	1 320 389	1 419 461	99 072	7,5%		
T pkm	13 818 542	12 622 690	-1 195 852	-8,7%		
T "A" pkm	*6 200 316*	*4 731 969*	*-1 468 347*	*-23,7%*		
T "AN" pkm	*785 775*	*899 111*	*113 336*	*14,4%*		
T "B" pkm	*2 790 504*	*2 119 947*	*-670 557*	*-24,0%*		
T "BN" pkm	*2 033 852*	*2 838 831*	*804 979*	*39,6%*		
T "CN" pkm	*2 008 095*	*2 032 832*	*24 737*	*1,2%*		
Kursy Dojazdowe pkm	*0*	*0*	*0*			
Praca eksploatacyjna (wzkm;pkm)	**107 664 892**	**108 033 092**	**368 199**	**0,3%**		
Koszt M PLN/wzkm	4,13	4,22	0,10	2,4%		
Koszt A PLN/wzkm	4,92	5,06	0,13	2,7%		
Koszt B PLN/wzkm	5,65	5,92	0,27	4,8%		
Koszt C PLN/wzkm	6,67	7,00	0,33	4,9%		
Koszt TB PLN/wzkm	8,95	8,95	0,00	0,0%		
Koszt T PLN/pkm	16,11	15,81	-0,30	-1,8%		
Koszt przewozowy PLN/wzkm;pkm	7,23	7,33	0,10	1,4%		
Koszt całkowity z narzutami PLN/wzkm;pkm	5,68	6,43	0,75	13,2%		
Wydatki ZTM + UM nie finansowane składką zmienną - razem	**64 234 842**	**22 258 913**	**-41 975 929**	**-65,3%**		
Wydatki UM nie finansowane zmienną częścią składki rocznej	64 234 842	22 258 913	-41 975 929	-65,3%		
Wydatki ZTM nie finansowane zmienną częścią składki rocznej	151 361 633	73 047 799	-78 313 834	-51,7%		

Figure 7. Example of the result table for bus fleet settlements.

Source: own study.

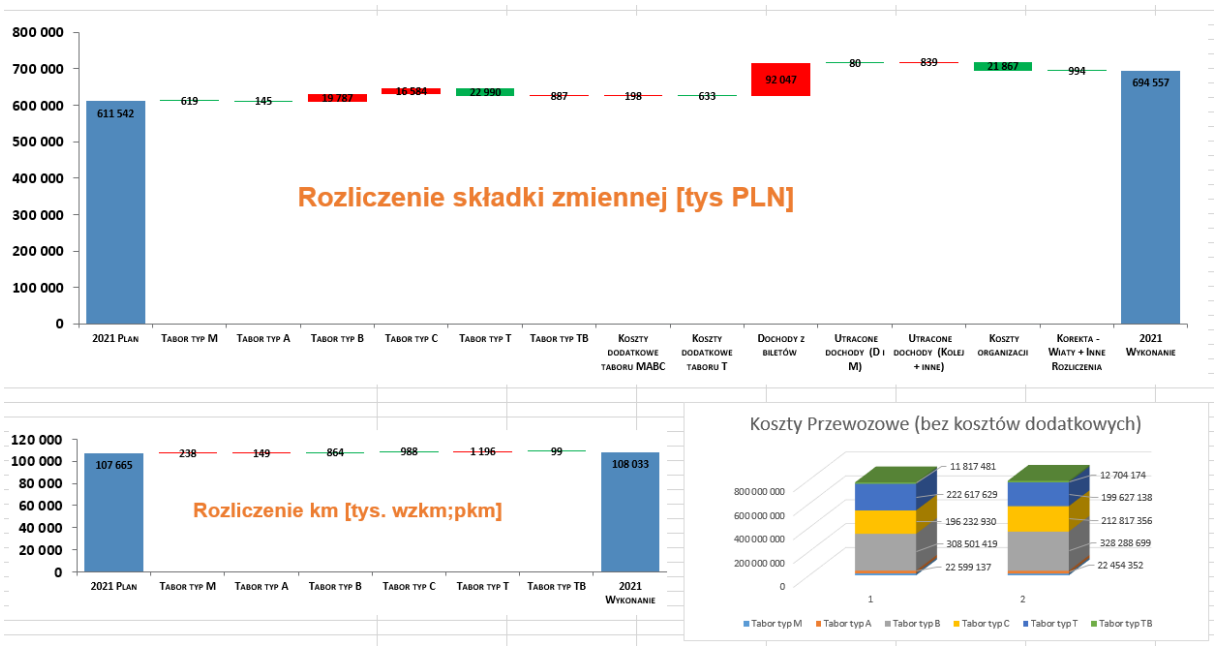


Figure 8. Example of the charts presenting bus fleet settlement.

Source: own study.

The scope of this paper is limited to the first stage of the work, which was the collection and processing of data. The problems of building a model for data processing and analysis will be presented by the author within the framework of the next article in this series.

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postępowania przy wyliczaniu zmiennej części składki rocznej dla gmin Górnośląsko-Zagłębiowskiej Metropolii (GZM) oraz dotacji dla gmin nienależących do GZM".
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AGILE PROJECT TEAM MANAGEMENT IN THE SMALL AND MEDIUM-SIZED ENTERPRISE SECTOR – EMPIRICAL RESEARCH

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Purpose: The project approach is often used to implement projects in enterprises. Traditional project management becomes insufficient due to the changing environment and the need for flexible functioning of the organization. Hence, agility in management gains recognition. The article presents the results of the study, the purpose of which was to determine whether the assumptions of agile management are known and used in project management and to identify factors that sustain the involvement of project team members.
Design/methodology/approach: The presented empirical research was carried out using the quantitative and qualitative methods. Techniques of expert interviews were used, and in the case of quantitative research - a questionnaire. The use of two research techniques was aimed at obtaining a broad view of the project management methods used, with particular emphasis on the conditions of the working environment of agile project teams. Enterprises from the small and medium-sized enterprise sector were invited to the study, the main variable in the selection of entities for the research sample was the location by region, i.e. the northern subregion of the Silesian Voivodeship, and cooperation with the Częstochowa University of Technology for the commercialization of knowledge in the region. The latter condition made it possible to include enterprises that implement projects.
Findings: Research has shown knowledge of the assumptions of agile management among small and medium-sized enterprises, but less than half of the surveyed experts use this methodology in managing project teams. According to experts, the main condition for implementing agile management is a "good", i.e. primarily a self-organizing project team. Its members are required to have appropriate skills and competences, such as self-discipline or independence in making decisions. The research also identified work conditions that keep members of agile project teams engaged. They are strongly related to the intrinsic motivation of employees. On this basis, it can be concluded that the agile approach in shaping work conditions is stimulating to stimulate the expected behavior of employees.
Originality/value: The article draws attention to the rarely discussed issue of implementing project management in small and medium-sized enterprises. The conditions for implementing agility in project team management were emphasized, among which the most important is the right selection of employees. They should have appropriate skills and competences, as well as an internal motivation system, which agile management methodologies will stimulate the activity and involvement of project team members.

Keywords: project, project management, agile management, project team.

Category of the paper: research paper.

1. Introduction

Looking from the perspective of the entire enterprise, the definition of agility may be the ability to prosper in a competitive environment characterized by constant and unpredictable changes in customer expectations, or in other words, a way to "adaptively and flexibly manage the enterprise in a dynamic and constantly changing business environment" (Sherehiy, Karwowski, Layer, 2007). From the systemic perspective, agility defines the feature of a "production system with specific capabilities and capabilities (soft and hard techniques, people management, qualified management staff, information flow) that is able to meet the changing needs of the market (speed, flexibility, customers, competition, suppliers, infrastructure reactivity)" (Yusuf, Sarhadi, Gunaserkaran, 1999, p. 36).

The year 1991 is considered to be the moment when the concept of agile management was created. This is related to the establishment of the Lehigh Agility Forum by the Iacocca Institute and the publication of the report: 21st Century Manufacturing Enterprise Strategy (Ramesh, Devadasan, 2007, p. 183). The "agility" of management appeared as a response to the observation that changes in the environment precede adaptation changes in the organization (Hormozi, 2009, p. 13), and thus, the benefits from the use of opportunities are limited. An additional aspect is the fact that the concept of agile management is considered in opposition to Japanese companies using "lean" management. This involves the interpretation of key objectives. In the case of the Lean concept, the elimination of waste comes to the fore (Pichler, Schulze, 2005, pp. 371-373). "Agile" management focuses on flexibility in relation to the recipients' requirements and the use of opportunities (Krishnamurthy, Yauch, 2007, p. 588). Enterprises strive for effective use of knowledge and competences, treated as key resources. Thanks to this, it becomes possible to enter emerging markets or take a leading position in mature markets. Companies operating in accordance with the Agile concept are already successfully competing in many cases with traditional concerns (Yang, Liu, 2012a). We are even talking about a new paradigm of the enterprise (Trzcieliński, 2011, pp. 5-6).

Agility identified with a certain feature of project teams, projects or even entire organizations has become a kind of fashion and operating philosophy in various types of design companies, both from the software development industry and from other areas of activity, such as production, logistics or services. The business environment of enterprises is subject to constant changes, which means that enterprises are constantly looking for new ways to increase their effectiveness and productivity, while striving to reduce waste. This pursuit, supplemented with a process of continuous observation, learning from mistakes, adaptations and focusing on people and the individual within project teams, has become an integral part of the agile approach - as a response to the needs, challenges and problems of modern project management caused by the above-mentioned changes in the environment (Beck et al., 2001). The above observations have become a reason to consider the use of agile project management in small and medium-

sized enterprises, which more and more often implement innovative, complex projects. The article presents the results of research aimed at determining whether the assumptions of agile management are used in project management and identifying the conditions of the project team's work that are related to the agile management methodology.

2. Agility in project management - literature review

The concept of agility is widely used in project management, where traditional paradigms are based on long-term planning, a high level of detail, including the description of the final effect (Highsmith, 2004). Critics challenge this approach due to the high level of standardization and the inflexibility of project management norms. The consequence is unsuccessful attempts to create detailed requirements or the project life cycle, which often differs from the real needs. At the testing stage, the plans turn out to be ineffective or fail to meet the expectations of the end customer.

The heterogeneity of defining the agility of the project management methodology and its assessment is forced by the variety of ways to implement the agile approach in project management and the constantly growing group of agile methodologies. E.C. Conforto et al. (2016) drew attention to the lack of consistency, completeness and clarity of the definition of agility, and at the same time pointed to key implications for the theory and practice of project management. Namely; agility should be understood in the context of team performance and results; agility as a performance may depend on a combination of factors related to the organization, the project team and the project itself; the level of agility performance can be measured in the context of two main factors of change in the speed of project planning and the degree of customer involvement (Sharp, Ryan, 2008).

Design responsibility may reflect the ability of a broadly understood project to respond effectively to a changing environment, manifested by the adaptability of the dynamics that exist in the needs of stakeholders, technological changes and other needs resulting from the specificity of a given project (Mafakheri, Nasiri, Mousavi et al., 2008). The response to continuous and unpredictable changes in the environment requires estimation of the scope of adaptability of projects to changes in the form of an assessment of certain parameters, such as: the dynamics of change, the size of the project team, communication, approach to testing, the level of expertise of project team members, organizational culture and many others (Dove, 2001; Mafakheri et al., 2008).

Project agility, and thus the success of the entire project, is influenced by factors present both in the project itself (e.g. team empowerment, team size, budget, size, duration and importance of the project) and in the project environment (e.g. organizational culture, form of contracts and contracts with the client, training), and to assess this impact, both objective

criteria (time, budget, scope, quality) and subjective criteria (product usability, customer satisfaction, project team satisfaction) can be used (Sheffield, Lemetayer, 2013). This is an interesting approach to the discussed issues, because it allows you to look at project agility and its complexity from the perspective of the entire project, and at the same time shows how important and how much influence the project team has on this agility. This is an important contribution to the creation of this article.

3. Project team agility

The project team is an organizational unit, established on the basis of subject specialization, implementing the project under the direct supervision of the project manager (Bosschers, Boutelegier, Dierick, 2003). J. Katzenbach and D. Smith define a project team as a small number of people with complementary skills, involved in the implementation of a common general goal and partial goals, whose approach is based on shared responsibility (2001, p. 260). In the paradigm of modern, agile project management, an agile team is "a temporary group of people willing to take risks, entrepreneurial, with clearly defined leadership, boundaries, empowerment, competencies, structure, manageability and motivation, people who have been matched together to create a new product or services with a high risk of complexity and critical importance" (Rico, 2018).

Project teams are looking for a creative way to solve problems that cannot be solved centrally (Schwaber, 2004). They are committed to delivering business value to the client, and when given the necessary resources, they achieve broadly understood success. Thanks to regular inspection and adaptation sessions, these teams undergo a process of continuous learning and improvement, leading them to become masters in their profession.

Team agility is its behavior or specific ability to flexibly, easily and quickly adapt to expected or unexpected changes, the shortest possible response time to market needs, the use of the most economical and simple quality assessment tools in a dynamically changing environment and the use of constantly updated knowledge and experiences from both the internal and external environment (Qumer, Henderson-Sellers, 2008a).

The agility of the project team is strongly related to psychological and behavioral aspects as well as to the development and maturity level of the group, which is often manifested by: increased job satisfaction, the need for situational leadership, the need for direct communication and a shared physical workplace, submission to the discipline of agile project management (the need to participate in regularly repeated activities such as team planning), overt aspects of group development and the personality of members of agile project teams (hiring people who fit such a work culture) (Gren, Torkar, Feldt, 2017). The above-mentioned aspects allow to better define the essence of an agile project team by assessing the condition, needs and behavior

of employees by: assessing the degree of maturity and implementation of various team cooperation practices, assessing the impact of direct and open communication on knowledge sharing mechanisms in the team, honest feedback addressed to managers and an assessment of other overt aspects affecting group development (Gren, Torkar, Feldt, 2017).

Values, principles and way of thinking that are important when implementing the agile approach in the organization of the project team's work can be indicated. According to the author, the key is: cooperation between business stakeholders and team members, which ensures the identification of customer needs and influences making effective decisions; customer satisfaction understood as frequent and early customer involvement in product development; communication - especially informal and related to gathering the team in one physical space. Agility is strongly correlated with self-discipline and self-organization of the team. Internally motivated, decision-makers, responsible for their own product, communicative, sharing ideas and knowledge, employees are ideal members of an agile project team. According to the author, agility in project management is conducive to maintaining the involvement of team members at a sufficiently high level. Therefore, the project team must be properly managed and, consequently, certain conditions must be ensured that will foster the development of agility in the team's operation.

4. Research methodology

A review of the literature on the subject indicates that agile management methodologies are a response to rapid economic growth, turbulence of the environment and an attempt to meet the expectations of customers and competition (Sajdak, 2014, pp. 138-152). Changes in the labor market and in the economy mean that the agile approach to project management is gaining popularity.

The aim of the study was to determine whether the assumptions of agile management are known and used in project management and to identify factors that sustain the involvement of project team members. The presented empirical research was carried out using the quantitative and qualitative methods in the period from November 2022 to February 2023. Techniques of expert interviews were used (Konecki, 2000, pp. 169-190), and in the case of quantitative research - a questionnaire. The use of two research techniques was aimed at obtaining a broad view of the project management methods used, with particular emphasis on the conditions of the working environment of agile project teams.

Enterprises from the small and medium-sized enterprise sector were invited to the study, the main variable in the selection of entities for the research sample was the location by region, i.e. the northern subregion of the Silesian Voivodeship, and cooperation with the Częstochowa University of Technology for the commercialization of knowledge in the region. The latter

condition made it possible to include enterprises that implement projects. The quantitative research involved 70 respondents working in project teams on a daily basis, including 24 in agile teams. The survey was conducted via the interankiety.pl platform. The questionnaire consisted of closed questions with a 5-point Likert scale for the assessment of individual phenomena, as well as explanations of key concepts and details. On the other hand, 11 experts took part in the qualitative research, which made it possible to separate the factors resulting directly from the agile methodology from those that are not related to it. They were specialists who manage projects on a daily basis, including 5 of them using agile methodologies in project management.

The research was of a pilot nature. They allowed to determine whether there is a need to modify the online questionnaire in terms of its transparency and comprehensibility. Thanks to this, it will be possible to continue the research in the group of small medium-sized enterprises in the Silesian Voivodeship. In order to determine whether the assumptions of agile management are known and used in project management in small and medium-sized enterprises in the Częstochowa region, the following research questions were formulated:

RQ 1. Do enterprises manage projects using the assumptions of agile management?

RQ 2. Are there conditions for working in agile project teams that keep team members engaged?

To determine the conditions for the work of agile project teams that maintain commitment, the concepts of motivating employees were used the "5P" model by M. Sroka (2017, p. 7) (Kopertyńska, 2008, pp. 21-64; Czarniawska, 1990, p. 139; Krzysztofek, Kumańska, 2011, p. 48; Minnullina, Abdrazakov, Graboviy, 2018, pp. 383-402). On this basis, a list of work conditions was created (Table 1). Respondents were asked to select the 20 most important factors in their opinion, and then to rank the 10 most important factors in order from highest to lowest.

Table 1.
Project team work conditions

Financial conditions	
Salary	Financial rewards
Financing of training by the company	Bonuses
Profit share	Raises
Non-financial conditions	
Training and development	Benefits (insurance, multisport cards, vouchers)
Social benefits	Offer of trainings and courses
Medical care	Proposal to gain other experiences
Privileges (company car, company phone, discounts on services, products of business partners)	International contacts

Cont. table 1.

Intangible conditions		
Setting team goals Supporting the achievement of team goals Mobilization and support of the manager Relationship with your immediate supervisor Relationships with team members Communication Team atmosphere Ability to make independent decisions Trust Opportunity to develop your own skills Self-realization	Distinction Promotion opportunity Praise Technical comfort of work Interesting/varied work content A job that requires creativity Cooperation with competent people Access to information Flexible working time The way of organizing work Ability to work remotely Clear requirements	Feedback provided on an ongoing basis Ability to use your skills and competencies Possibility to perform more and more responsible tasks Ethical company activities The feeling of creating something of value Work-life balance Coaching/mentoring Low stress level

Source: based on Sroka, M. (2017). Współczesne metody motywowania do pracy w zespole projektowym. *Journal of Modern Management Process, No. 2(2),* pp. 36-45; Kopertyńska, M.W. (2008). *Motywowanie pracowników – teoria i praktyka*. Warszawa: Placet; Czarniawska, B. (1990). *Motywacyjne problemy zarządzania*. Warszawa: PWN; Krzysztofek, A., Kumańska, W. (2011). Wpływ motywowania pracowników na efektywność pracy w przedsiębiorstwie. *Studia i materiały Miscellanea Oeconomicae, No. 2*, pp. 41-52; Minnullina, A., Abdrazakov, R., Graboviy, P. (2018). Evaluation of the coaching effective-ness as an instrument for motivating company's employees. *MATEC Web of Conferences*, *Vol. 170*, pp. 383-402.

5. Results and discussion

The survey was attended by 70 employees representing companies from the sector of small and medium-sized enterprises, who deal with the implementation of projects on a daily basis. 34% of respondents are members of agile project teams. The results of quantitative research, in the first stage at the level of selection of the 20 most important conditions in the implementation of projects, indicated the advantage of the commonly known - remuneration and bonuses. Other conditions include: training and development, possibility of learning and development, team atmosphere, possibility of balancing private and professional life, flexible working time, possibility of promotion, convenient forms of work organization, possibility of performing more and more responsible tasks, work requiring creativity cash prizes, mobilization of the team leader, privileges (e.g. a company car or telephone), distinction, benefits, the ability to make independent decisions, cooperation with competent people, feedback provided on an ongoing basis and a sense of creating something valuable. The obtained results indicate that there are conditions for the work of a project team that are particularly important for agile team management. The data presented in the chart below (Fig. 1) shows that these are primarily intangible conditions - the opportunity to learn and develop, flexible working hours, the ability to perform increasingly responsible tasks and work that requires creativity. These conditions were rated much higher by members of agile project

teams. They can be assessed as maintaining commitment to the implementation of project tasks and limiting the monotony of work. Equally important for both groups of respondents were convenient forms of work organization and the balance between private and professional life.

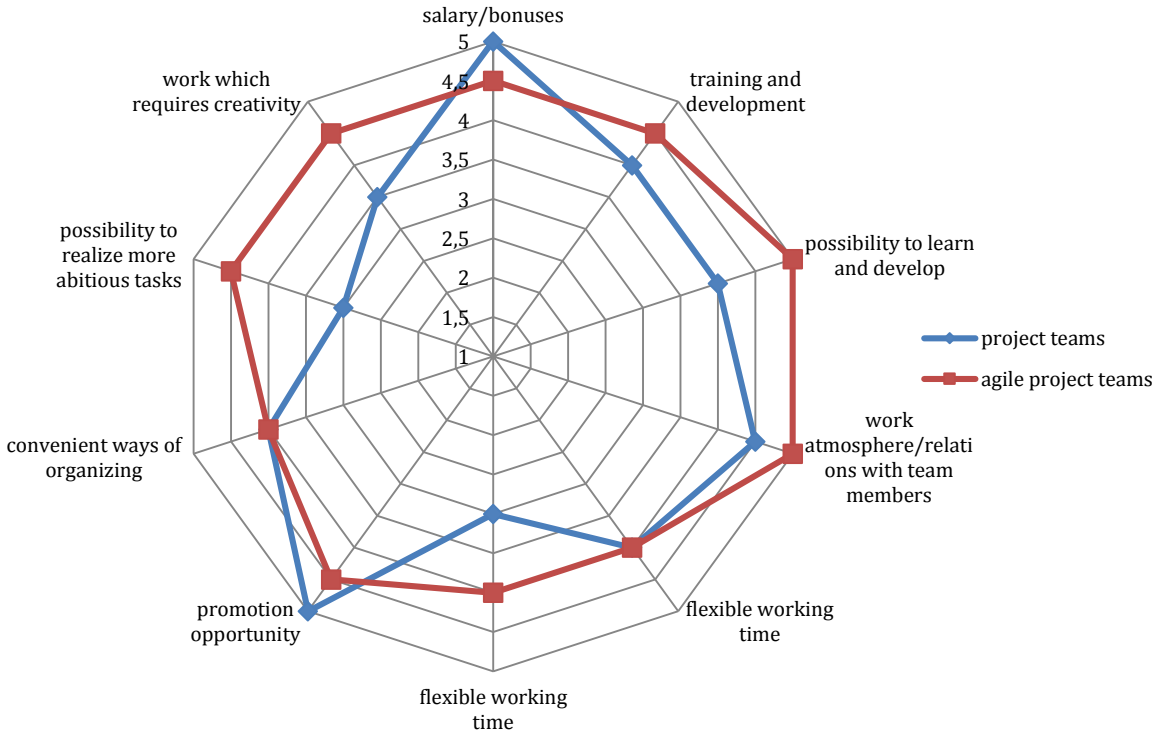

Figure 1. The most important conditions for the work of project teams.

Source: own research.

The results of the qualitative study showed that the agile project management methodology is widely known (nearly 91% of respondents), but only 5 out of 11 experts decided to implement it. The main reason was the resistance of project team members and the lack of appropriate skills and compeences of employees to work in an agile project team, including, above all, self-discipline. According to the respondents, the most important obstacle is the lack of employees' independence and developed methods of maintaining constant communication between team members.

As for the assessment of the working conditions of project teams, experts pointed out the differences between teams managed in a traditional and agile way. The respondents agreed that remuneration, bonuses and training are very important factors, but they do not result from agile methodologies. However, in terms of factors related to the methodology, experts pointed out that it is extremely important to show employees the goal, while constantly verifying where the team is today in relation to what it wants to achieve. That is why the agile methodology assumes frequent summarizing meetings, e.g. daily so-called Daily, as well as numerous meetings with the client, during which problems and needs are identified on an ongoing basis during the "life" of the project. According to experts, the opportunity to share your achievements, especially in the case of young employees, is valuable and encourages involvement. Regardless of the age of employees and experience, each team member has the right to express their own opinions

and ideas. Having the opportunity to present their opinion, all group members feel important. In addition, the methodology points to the joint responsibility of all project participants, which builds their commitment. Another important issue emphasized by experts is acting here and now, this applies to cooperation with the client, providing feedback, as well as planning. Cooperation with the client also causes a sense of creating things that are needed, which makes employees see the usefulness of the result of their actions. The list of factors indicated by the respondents during the expert interviews is presented in Table 2.

Table 2.
Conditions for the work of project teams related to the agile methodology - results of qualitative research

	Conditions of work in agile project teams - experts' answers
1	High frequency of presenting newly created project elements, and thus satisfaction with the achieved goal. Visible work result
2	Sense of purpose
3	Tasks that are challenging
4	Short-term Project
5	Supporting someone who will be the "good spirit" of the team
6	Independence - the team decides what tasks will be carried out
7	Managing your own area - the so-called empowerment
8	Opportunity to express one's own opinion - joint "ceremonies" (meetings) that make all team members feel important and have the opportunity to express themselves
9	Real feedback provided on an ongoing basis
10	Planning and acting on an ongoing basis - resulting from daily meetings
11	The usefulness of the final project/the feeling of creating things needed - the result of close and constant cooperation with the business

Source: own research.

6. Summary

In summary, the research showed knowledge of the assumptions of agile management, but less than half of the surveyed experts use this methodology and only 24% of respondents work in agile project teams. According to experts, the main condition for implementing agile management is a "good", i.e. primarily a self-organizing project team. Its members are required to have appropriate skills and competences, such as self-discipline or independence in making decisions. An important factor in working in an agile team is also constant communication between employees.

The research allowed to identify the key work conditions that sustain the involvement of members of agile project teams. They are strongly related to the intrinsic motivation of employees. On this basis, it can be concluded that the agile approach in shaping work conditions is stimulating to stimulate the expected behavior of employees. The obtained results indicate the need to continue research, taking into account the role of the project team leader. Requirements for members of an agile project team emphasize the importance of internal

motivation, and this entails its skillful shaping. It seems that the role of a manager boils down to eliminating barriers in the team's work, indicating ways of dealing with problems and focusing on business goals. The manager is supposed to be a support to effectively influence the behavior of people in the organization. The study was a pilot study, therefore its weakness is drawing conclusions based on a small sample, as well as examining opinions, not objective criteria. However, it gave hints and recommendations for further research in order to deepen the subject.

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SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

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QUALITY OF MEDICAL SERVICES IN THE OPINION OF OLDER ADULTS WITH THE EXAMPLE OF MEDICAL FACILITIES OF THE SILESIAN VOIVODESHIP IN POLAND

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Purpose: The aging society poses new challenges to managers of medical facilities to ensure that older adults have adequate conditions and access to professional health care and provide them with opportunities to increase their level of satisfaction and improve the quality of their functioning in society. The aim of the survey was to examine the opinions of older adults aged 65 years and older on the quality of medical services and to identify the most important characteristics of the quality of medical services included in their assessment.
Design/methodology/approach: The study used a diagnostic survey method based on a questionnaire technique that was addressed to older adults living in the Silesian Voivodeship. The survey was conducted in late 2022 and early 2023 and covered 128 older adults.
Findings: The survey showed that older adults living in the Silesian Voivodeship rated the medical services offered relatively well. Older adults gave the highest ratings to the location of health facilities, the approach to patients, the efficiency of service, and the availability of services provided by primary care physicians.
Research limitations/implications: Analysis of the survey of older adults' opinions on the quality of medical services identified key areas in need of corrective actions, such as the availability of night and holiday care, the use of modern solutions, the need for additional fees for medical services, and the number of medical staff members in medical facilities.
Practical implications: By measuring patient satisfaction, healthcare facilities gain information on how well their healthcare delivery meets patients' expectations and needs, and what in their services is a source of patient dissatisfaction. The results of the survey provide the basis for corrective measures to improve the services provided whereas the managers in healthcare facilities gain knowledge about the needs of older adult patients and areas requiring solutions to improve the quality of the services offered.
Social implications: The use of information from the survey makes it possible, through changes, to adapt the care system to the needs of older adults and suggests a direction for further quality assurance measures in healthcare.
Originality/value: The paper provides an introduction to the complex topic of improving the quality of medical services and achieving a sufficient level of satisfaction among older adults.

Keywords: medical services, quality of medical services, older adults, satisfaction.

Category of the paper: empirical research paper.

1. Introduction

Increasing life expectancy is undoubtedly a positive achievement of modern civilization, associated with rising living standards, medical advances, and the functioning of the social security system. In the long term, the increasing health awareness and interest in the concept of successful and thus active aging is observed among representatives of the older adult generation. This involves the desire to ensure health, independence, and productivity in older adulthood, which are three critical spheres that determine the optimal quality of life. According to this concept, successful aging is associated with activity: both vocational and social, adapted to the health status. All medical services provided by healthcare facilities play an important role in realizing the above concept. According to K. Krot (2008), a medical service is "a series of activities of an intangible nature: from the patient's first contact with a healthcare facility until his or her leaving it, undertaken to ensure health or improve personal qualities". In the Polish medical services market there is public healthcare, financed from public funds, and private healthcare, financed from other sources (Nagraba, 2015, pp. 15-127.). The market for medical services should meet the basic health needs of society. Increasing resources, especially human resources, with their availability determining the number and quality of medical services, is a priority task. The World Health Organization (WHO) defines the term "quality in medical services" as a composite of the characteristics of a service product, while assuming that quality consists of all those characteristics of a service product that, taken together, ensure that the product can satisfy both expressed and unexpressed needs of the buyer. Quality in the area of medical care is the result and the way the resources are used, organization of services, and patient satisfaction. It is the degree to which health services, involving individuals and populations, increase the likelihood of meeting the expectations for treatment outcomes and demonstrate compliance with current professional knowledge (Wiśniewska, 2016). Many authors have demonstrated that patient satisfaction with treatment is, along with the knowledge and experience of the staff and access to increasingly modern diagnostic methods, a prerequisite for good treatment results.

Therefore, the quality of medical services is one of the main elements of the effectiveness of healthcare entities in a competitive market, and patient satisfaction with medical services is a prerequisite for good treatment results. Relationships occurring between the level of providing healthcare services, patient satisfaction, and the degree to which the health needs of society are met indicate the need to set quality criteria for health services to enable them to be valued. The results of the evaluation of the quality of health services are the basis for their improvement, and, at the same time, determine the implementation of the principle of customer-patient orientation. The present paper provides a kind of introduction to the complex topic of improving the quality of medical services and achieving a sufficient level of satisfaction among patients: older adults.

2. Patient satisfaction level as an important element of the quality of medical services

Recent years have seen an increased interest in patient satisfaction surveys. According to the Dictionary of Polish, satisfaction means a pleasant feeling a person experiences when their desires or expectations are fulfilled (Słownik Języka Polskiego PWN, 2007, p. 279). R. Veenhoven, on the other hand, believes that satisfaction has an individual dimension as it is an expression of internal benefits and is characterized by relative persistence and moderate dynamics (Kasprzyk, 2012, pp. 187-188). The term "satisfaction" is used interchangeably with the term "contentment." Most researchers treat them as synonyms, although sometimes the time of occurrence is considered as a differentiating factor. Contentment can be temporary, while satisfaction is usually experienced after a prolonged period of contentment (Kunecka et al., 2007, pp. 192-196). Nowadays, it is believed that the problem of feeling satisfied is becoming both a goal and a measure of organizational effectiveness and contentment is an indicator of management effectiveness (Borkowska, 2008, pp. 317-353).

The topic of satisfaction is a frequently discussed issue for older adults due to the increasingly common aging. The level of life satisfaction of older adults depends on many objective and subjective factors, including living conditions, health status, personal beliefs and feelings, culture, and psychosocial development (Swierżewska, 2010). On the other hand, the main factors affecting the satisfaction of older adults are health, economic situation, relationship with family, and level of education. However, these determinants are multifaceted, complex, and individualized (Zielińska-Więczkowska, Kędziora-Kornatowska, 2010, pp. 11-6).

The impact of health status on life satisfaction became the subject of a study by López-Ortega et al., whose study group consisted of Mexican residents aged over 50 years. A study they conducted showed that life satisfaction was correlated with the poor health of the respondents (Holloway, 1996, pp. 1169-74). In contrast, a study of US older adults found that their satisfaction with life is significantly influenced by the frequency of appointments with the doctor. It was observed that people with higher levels of life satisfaction are less likely to attend medical appointments (Kim et al., 2014, pp. 86-93). Increased dependence is influenced by good health, social involvement and support, healthy habits, and having a sense of meaning and purpose in life (Strine et al., 2008).

With increasing competition, medical facility managers have to take measures to make the patient choose their clinic. This increasing competition has resulted in the patient being considered a customer, with specific demands and expectations of these demands to be met. These requirements primarily concern the areas of providing professional service, which should be provided first and foremost quickly and at an appropriate level of quality. The relationships

that exist between the quality of medical service delivery and the degree of patient satisfaction and meeting their health needs give rise to the need to set quality criteria for health services.

Therefore, patient satisfaction surveys aim to recognize the state of healthcare based on patient opinion in standardized quantitative or qualitative measurements and serve to improve the quality of health services. Improving the quality of medical services should be of interest to various entities such as the government, local government, the payer of medical services i.e. The National Health Fund (Narodowy Fundusz Zdrowia, NFZ), suppliers of equipment, medicines, and the judiciary. The quality of services in healthcare, like no other area of human activity, has a huge impact on the health of society and quality of life.

It is important to remember that achieving good treatment outcomes requires a professional approach from healthcare employees and satisfaction with treatment (Blenkiron, Hammill, 2003). Satisfaction depends not only on the quality of services but also on the level of expectations. The level of expectations depends on the needs of patients, whereas the interest in these needs and the attempt to learn about the expectations of patients is one way of expressing concern for their health and well-being. Showing interest in patients can give them some contentment while examining their satisfaction with medical care can consequently help improve their sense of value and importance within the healthcare system (Garczyk, 2013, pp. 48-56). Patient satisfaction is a desirable outcome of the medical services offered and a fundamental factor in measuring their quality. The quality of services will not be high until the patient is satisfied (Grol et al., 2000, pp. 882-887). Therefore, patients' opinions on the quality of medical services offered to them are of great importance. for their final assessment. In the following part of the present paper, an attempt was made to diagnose the opinion of older adults regarding the services offered by healthcare facilities.

3. Methodology

The survey of patient satisfaction surveys aims to recognize the state of healthcare through patient opinion in a standardized quantitative or qualitative measure and serve to improve the quality of medical services. For the purposes of this paper, a medical facility is defined as a private or public entity that provides medical services. In the present study, a survey was conducted to obtain the opinions of adults aged 65 years and older on the quality of medical services provided in medical facilities in the Silesian Voivodeship. The results of the evaluation of the quality of health services are the basis for their improvement and help implement the principle of patient orientation. The findings presented in the paper are part of a quantitative survey conducted among older adults in 2022/2023. The study was conducted using quantitative research methods and survey questionnaire techniques due to direct contact with respondents. A diagnostic survey method was used in the study. The research tool was a questionnaire with

a respondent data section with questions about sociodemographic factors (age, gender, place of residence, marital status, education) addressed to residents of the Silesian Voivodeship. Characterization of the study population was based on an analysis of the percentage distribution of the frequencies of qualitative variables and the calculation of descriptive statistics: the mean and standard deviation of quantitative data. The questionnaire consisted of 18 statements. The survey was conducted among adults aged 65 years and older. The research tool (questionnaire) was designed by the author and was created by the author of the paper. STATISTICA software was used in the process of compiling the findings. The study was pilot research.

4. Study results

Purposive sampling was used to select the study population. The survey included 152 respondents, with 128 correctly filled questionnaires at an 84% return rate. The responses from 128 individuals were analyzed. The study included 68 women (53.1%) and 60 men (46.8%) aged 65-87, with the average age of the subjects close to 73. Just over half of the study sample was female. Furthermore, more than half of the surveyed older adults lived in rural areas. The majority of the respondents were married people with vocational or secondary education. The socio-demographic details of the respondents are shown in Table 1.

Table 1.
Socio-demographic criteria used in the group of older adults studied

Variables	**Socio-demographic criteria (n = 128)**		
		n	**%**
Sex	Women	68	53.1
	Men	60	46.8
Place of residence	city	52	40.62
	rural areas	76	59.3
Marital status	unmarried	6	4.6
	married	74	57.8
	divorced	14	10.9
	widow/widower	28	21.8
	cohabitation	6	4.6
Education	higher	31	24.2
	vocational/secondary	64	50.0
	primary	33	25.7

Source: own elaboration.

The relationships that exist between the quality of medical services provided and the degree of patient satisfaction and meeting their health needs give rise to the need to identify quality criteria for health services. For the purpose of the study, the nine most relevant criteria were used: quality of treatment, approach to the patient and efficiency of service, availability of services of specialists and diagnostic tests, availability of night and holiday care, use of modern

solutions, convenience for health care users (good information, convenient hours), convenient location and availability of services of primary care physicians, additional fees for the service and number of medical personnel in health facilities.

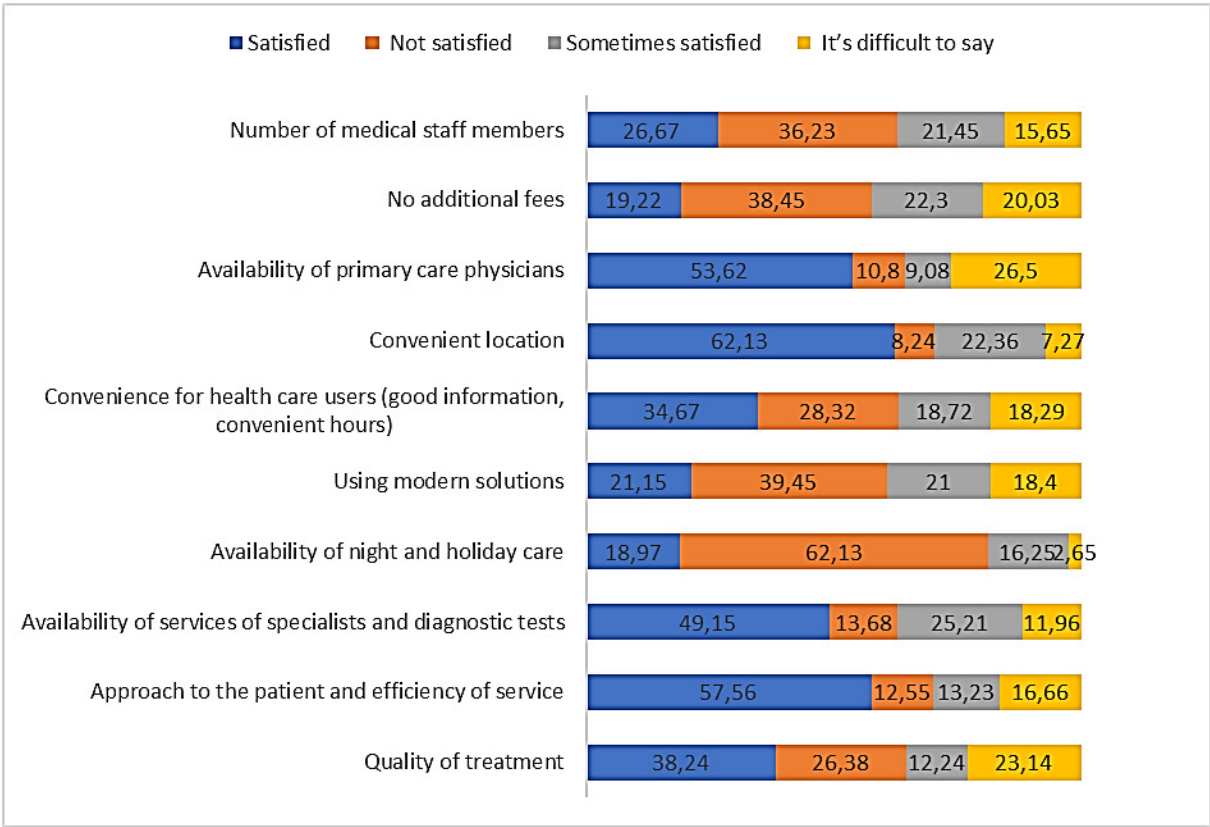

Figure 1. Level of satisfaction with medical services among older adults in the Silesian Voivodeship. Source: Own study based on the results of own research.

Of all the categories presented, the older adults surveyed rated best the convenient location of the medical facilities (62%). This was likely due to the fact that older adults, when choosing a health facility, are primarily guided by proximity to their place of residence and habit. According to the survey, the average distance between the medical facility and the patient's place of residence was 4.2 kilometers.

The largest group of respondents (39%) were patients living within 1-5 km of the facility. Slightly fewer (27%) indicated a distance of 0.5-1 km. The second criterion that had a positive effect on the satisfaction of older adults was the approach to the patient and the efficiency of the service. In this case, 57.56% of the older adults surveyed were satisfied. More than half of the respondents are satisfied with the work of nurses and receptionists. Their friendliness and willingness to help were declared by just over half of the older adults and only 11% said they had never been served at a satisfactory level. More than half of the respondents also commented positively on the availability of primary care physicians (53.63%) and almost half of the respondents (49.15%) were satisfied with the availability of specialists and diagnostic testing options. Dissatisfaction with access to a specialist was indicated by 13.68% of respondents. The problem most often concerned referrals to an orthopedist, allergist, urologist, and

cardiologist, and with getting referrals for specialized tests, mainly blood tests, and ultrasound and X-ray examinations.

In contrast, the biggest problem for older adults surveyed was access to night and holiday care. The vast majority of them believe that there is no chance of getting help from a doctor in an emergency. This problem concerned more than half (62%) of the older adults surveyed. A big problem causing dissatisfaction among older adults is the use of modern solutions in medical services. This is often because of the lack of skills in using modern technology, lack of appropriate equipment, or difficulties with Internet access. This problem affects almost 40% of older adults surveyed. Another problem causing a sense of dissatisfaction with medical services is the need to pay additional fees for certain tests and procedures, which is often associated with too great a financial burden for people aged 65 and older. Nearly 39% of respondents reported their dissatisfaction with the insufficient number of medical staff members at the medical facilities they attended.

Opinions of the level of satisfaction of the respondents were significantly influenced by the division into the methods of financing medical services. The data are presented in Table 2.

Table 2.
Level of satisfaction with medical services among older adults in the Silesian Voivodeship by the method of financing

Older adults who used medical services in the six months preceding the survey	**Level of satisfaction with health care among older adults in the Silesian Voivodeship**		
	satisfied	**unsatisfied**	**It's hard to say**
only under universal health insurance	42%	56%	2%
under universal health insurance and at the same time from services provided outside this system (subscription, policy)	25%	71%	4%
only fully self-funded or available under supplementary health insurance	19%	73%	8%
not using medical services	21%	63%	16%

Source: own elaboration.

The survey indicated a strong dependence of the level of satisfaction with the quality of the service on the way it is financed. Older adults who used services using the universal healthcare system declared a significantly higher level of satisfaction (42%) than those who co-financed the service (25%). The survey also revealed that the least satisfied with the quality of medical services were older adults who used supplemental insurance or self-funded such services (19%).

5. Discussion

Patients' satisfaction, especially in the case of older adults, with the medical care provided to them is an important factor in assessing the quality of medical services. In recent years, there has been a steady increase in patients' expectations in terms of medical services. A positive

patient evaluation indicates patient satisfaction. Satisfaction, on the other hand, represents the difference between a patient's expectations and his or her experience of a specific contact with a service provider. Assessment of the level of satisfaction is not easy due to the multiplicity and variety of determinants and the subjectivity of the phenomenon. Among the factors that affect the quality of services offered are: the way the patient is treated, the attention and time devoted to the patient by the doctor and nurses, the sense of security, the availability of health services, and the time of waiting for services (Lenartowicz, 2010). The survey showed that older adults living in the Silesian Voivodeship rated the medical services offered relatively well. Of the categories that were presented to them during the survey, by far the highest rated items were the location of health facilities, the approach to the patient and efficiency of service, and the availability of primary care physician services. However, it should be remembered that high ratings of the medical services provided for older adult patients are not always a clear indication of their high quality. This is because patients may rate their doctors positively despite negative experiences with them, which may be due to their reluctance to give negative ratings (Kersnik, 2003, pp. 247-250). This situation is especially true for older adults, who, due to their age and health, are more likely to use family doctors, which fosters closer relationships and positive feelings. Studies conducted in this area indicate that patients who have recently seen a doctor speak more positively about the doctor than those who have not met a doctor recently (Judge, Solomon, 1993, pp. 299-327). Also, in the case of older adults, it was observed that they have lower expectations of medical services. Their inflated ratings are a reflection of their understanding of the "patient role" and their acceptance of paternalism in doctor-patient relations. This phenomenon is referred to in the literature as the "generation effect" (Levinson et al., 2005, pp. 531-535). Numerous studies have demonstrated that older patients are more likely to feel satisfied with the services they receive than younger patients (Grol et al., 2000; pp. 882-887).

On the other hand, the areas that were rated the worst by older adults were the availability of night and holiday care, the use of modern solutions, the additional fees for medical services, and the number of medical staff members in health facilities. An area that needs improving by the managers of health facilities and the staff employed in such entities, according to the older adults studied, are any measures aimed at making it easier for the patients to use healthcare services, such as information and convenient hours. The survey also revealed the problem of using advanced solutions based on modern technologies. Compared to younger groups, access to new technologies and digital competencies is still limited for older adults, which is a barrier for them to use digital health services. The study, therefore, confirmed the need for corrective action in this regard. In interpreting the assessment of ratings for medical services, it is also important to analyze how they are funded (Ankiel, Kuczynska, 2017). Studies of older adults' satisfaction with medical services have demonstrated a strong dependence of its level on how the service is financed. Patients receiving services under the universal healthcare system report

significantly higher levels of satisfaction (39%) than those who co-finance the service (27%) (CBOS, 2018, p 3), which was also confirmed in the survey.

6. Conclusion

The quality of services in healthcare has a huge impact on the health of society and quality of life. However, assessment of the performance of the healthcare system is a complex task. There is no perfect method of examining the quality of medical services that can be applied to every organization. The choice of the right factors, measurement, and monitoring specific values, or comparing systems with different organizational structures is a major challenge for researchers. One of the indices comparing the healthcare system of different countries is the Euro Health Consumer Index (EHCI), published by Health Powerhouse. The idea of the index is not to compare healthcare systems themselves but to assess the patient-friendliness of the system. Using this index, Poland ranked thirty-second among the selected 35 European countries (https://healthpowerhouse.com/publications/).

By measuring patient satisfaction, healthcare facilities gain information on how well their healthcare delivery meets patients' expectations and needs, and what in their services is a source of patient dissatisfaction. The use of information from the survey makes it possible, through changes, to adapt the care system to the needs of older adults and suggests a direction for further quality assurance measures in healthcare. The results of the survey provide the basis for corrective measures to improve the services provided whereas the managers in healthcare facilities gain knowledge about the needs of older adult patients and areas requiring solutions to improve the quality of the services offered.

The market for medical services should meet the basic health needs of society. Increasing resources, especially human resources, with their availability determining the number and quality of medical services, is a priority task. Furthermore, the focus should be on finding solutions aimed at increasing the number and improving medical services provided to older adults.

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PREFERRED MANAGEMENT STYLES IN SELECTED DOMESTIC ENTERPRISES

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Purpose: The study was conducted in order to identify positive and negative factors in the manager's function. The study gives the insight of the management style in the enterprises which is used define the role of the manager.
Design/methodology/approach: A survey was conducted by the method of questioning among 12 enterprises.
Findings: Research reveals that about 97% of enterprises due to the managerial glitch and by adopting unethical management practice went bankrupt. This evidence reveals the importance of role of the manager in the company.
Research limitations/implications: The results of the study show that the presence of a flexible method of management as well as the desire to change is an indicator of effective management.
Practical implications: This paper depicts the proper coordination of managers with their subordinates and it can also assist the managers in order to develop their approach towards personal management.
Social implications: Building a trusting atmosphere has the potential for effective development of both a manager and a subordinate, thereby leading enterprises to economic growth. However, it should be taken into account that the creation of a trusting culture in an organization requires additional research.
Originality/value: The article has cognitive value for managers. The results can be used as a manual for senior managers to manage the team and to build organizational culture.

Keywords: management, human resources, management model, cooperation.

1. Introduction

The article consists of an introduction, two chapters on the role of the manager in managing and improving the enterprise. Research conducted by the authors on the preferred management styles and models for selected enterprises, included in the third chapter of the conclusion and bibliography.

Managers play a critical role in enterprises. They have a capability to identify the suitable person for the job done. They should have an expertise to motivate the team and help the team members to accomplish the task successfully. They should have a quality to encourage their team members in order to job done within the time frame. This ability is successful in everything they do (Bednarski, 1995). Carne Ige wrote on his tombstone (Coates, 1996): "Here lies a man who was able to mobilize and induce the best people to work for him".

The attributes of the Manager can be measured by his ability to manage people. It can be achieved by continues learning and by gaining experience from the past. Manager who learns positive things from the experience and keep on motivating himself lead to become the successful manager. This will affect the overall performance and help in increasing the sales and profit margins of the company, but when they reach a certain level where further success is limited, they simply fail. They have not yet learned the art of multiplying success by exploring the potential of others. A manager is a person who is engaged in a profession, but he is the type of person who shows others the way to success. Responsibility, creativity, flexibility, motivation, self-confidence, discipline, strategic sense, broad view, activity - these are skills that cannot be trained. Of course, there are basic and routine skills that can be acquired. Professional experience combined with education conducted by experts can only strengthen the qualities of a manager. A manager should be not attached with their team members, he should be self-abnegation. There is no one type of manager that works in every situation. Making rational decisions in complex and changing conditions requires not only knowledge and experience, but above all, appropriates personality traits, intelligence, a sense of responsibility to take "real risk", the ability to cooperate with a team, understanding and sensitivity to emerging problems. There are no cases where a manager has all the qualities, but his role is still huge and crucial. Studies have shown that 97% of enterprises went bankrupt as a result of managerial errors and incorrect management styles (Czubasiewicz, Grajewski, 1993). This fact alone shows how important the manager is in managing the company.

Own researches of preferred management styles for selected enterprises were carried out and it turns out that out of the 12 surveyed enterprises: as many as 7 showed a dominant coaching style, 3 had a coaching-supporting style, 1 used a supporting-delegating style and only 1 managed only a supporting style.

2. The role of the manager in enterprise management

In the Centre for Creative Leadership in Greensboro, North Carolina were investigated twenty-one managers, who failed (Griffin, 1998). It seemed that they would go even higher, but when they reached a certain level of career peak, they were simply fired from their jobs, it is due to the over confidence and arrogance. They were then compared to twenty other managers who had gone even higher. These groups were very similar to each other. Each of the subjects has their own merits and demerits. Despite various advantages and disadvantages, it turned out that success can be achieved. A manager should be responsible to unite the team and try to motivate their deserving team members time to time. It will increase their working yield. One of the merits is trust in a person, and its abuse is a disadvantage. Honestly plays a crucial role in building and strengthening the trust, which is created over time. The manager should follow a specific protocol: "I will do exactly what I say, and exactly when I promise. Otherwise, no one will trust you anymore. Managers promise too much and sometimes don't deliver, and every partner must be treated with respect. Decisions made by the mangers will be based on honestly and for the betterment of the company. There should not be any kind of wrong doing done by the managers. This will result in building up the trust among employees. There is not scope of dishonesty, immorality in the workspace; it will lead to failure of the company. Everyone carefully observes others, and then looks at himself, and then the question arises: is it fair and just what I do? The manager must be honest and fair (Gruszecki, 1994). For instance, when a team feels that the reward system is inconsistent, their motivation to act is suddenly reduced. In 1972, sociologists Schmitt and Marvell did an interesting study. Two employees were selected, to whom large offers were submitted. They could work separately and earn less money, or together and earn more, in the latter case one would earn more than the other for the same work. It turned out that 40% of employees decided to work for a lower salary than to accept the set rules of remuneration (Hannaway, Hunt, 1994). These studies have shown the great need to treat others fairly. It is the manager who plays an important role in the organization and is responsible for remuneration, productive use of resources, influence on employee behavior. His decisions affect the behavior of partners. His actions serve the efficient implementation of goals, so he should anticipate the behavior of others as much as possible. He is a man who should focus on humbly making decisions and looking for the best and most effective solutions.

Each company is different and the team of partners also needs different management styles. The manager should be aware of the skills and intellectual potential of the team. To know whether partners deal with difficult situations, whether they are creative in solving problems, how they react to crises and whether they have adequate perseverance in achieving goals. The worst effect of cooperation is giving up and withdrawing from cooperation. You won't find a warrior soul in your partner there. Why does this happen sometimes? Is it a matter of strength

of character and charisma of the partner? Is it worth considering whether the partner is characterized by a sense of responsibility for the decisions made, whether he would work better if he was more motivated to achieve results? The partner commits to something and accepts the terms of cooperation, why then resigns and gives up? He doesn't see the point in it because it's ineffective?

The manager has an expertise in selecting the appropriate team management style. It should be the manager's duty to develop the passions of his partner's optimum utilization of their intellectual potential and to be effective (Hopej, 1998). Before selecting a style, he adjusts his style to the level of development of the team he manages. For many people, the ideal manager is someone who decides everything for himself and thinks he knows everything best. Manager should respect the ideas and proposal given by his team members and try to encourage him. Consequently he is scared when his partners gain a lot of independence. It seems to him that he is losing control over the course of things, so he wants to decide every detail. A manager should have a capability to distribute the responsibility according to the skill of their subordinates. Moreover he has to be accepting the contribution of his team members in case of success and should have courage to take the responsibility in case of failure. But he is unable to run everything himself. Then he gets annoyed and goes into a fury, accusing everyone of being easy going. This style of management is awful and suits people who are distrustful and possessed by a sense of all competence. The opposite of this style is the style of implied competence of partners, which consists in delegating tasks (Koźmiński, 1999). The problem with managers' bad management style is that, in their opinion, they cannot delegate tasks without giving their partner any chance to prove themselves. The consequence of this way of management is a very acute crisis in which the partners do not see the sense of their work (McGinnis, 1997). However, as a consequence of using the style of presuming someone else's competence, the manager has more time and can focus on strategic thinking. There are managers who are self-oriented and do not expect dialogue or exchange of ideas. Occasionally, they allow speech but constantly interrupt, including criticizing someone's views before they are even said and substantiated. It also happens that they allow others to speak up and express their opinions, but they do not really take them into account. The manager must be guided by the opinions of partners, if he asks them for their opinion, he confronts them with his reasons. Otherwise, he will be left alone as a finger and will have nothing to confront, and as a consequence, he will receive the passivity of his partners. A wise manager expresses his opinions and is willing to listen to others, considers the opinions of others and allows others to speak freely. Thanks to this, partners behave spontaneously and feel needed, noticed, and taken seriously (Monkiewicz, 1995). Poorly organized manager, he is in a hurry and rarely punctual. Eventually he forces others to work unnecessarily and, most importantly, he does not admit his mistakes. You can't build true authority by hiding and pretending. Some managers say that they always make the right decisions (Penc, 1997). These are people who think they have succeeded. On this basis, they perpetuate an impulsive decision-making style, and the warning signals coming from the

environment either ignore or interpret in their favor. In this case, a catastrophe is inevitable. A dangerous manager cheats his own conscience, covers up his own mistakes and imposes the blame on others. Fortunately, we respect those who fail from time to time and are able to admit it. Self-management is a constant drawing of conclusions. This is the beauty of managerial life. The principle of good governance is to think in terms of possibilities and opportunities, not obstacles. What becomes impossible for some becomes a challenge and a goal for others. We cannot think negatively without believing in success. Remember that there are always two ways out of a situation, you just need to ask the right questions. Those who don't like just lose. Posing questions, doubts and doubts allows you to refine the goal. In fact, very effective solutions, the effects of which we experience in the form of primary and external. Asking lots of questions is important when formulating long-term goals.

3. The role of the manager in improving the manager

In many cases, the condition for the company's survival in a highly competitive environment becomes the strategic possession of human capital (Penc, 1993). One of the effective methods of human resources management is conducting the so-called reengineering (Hopej, 1998). It is a way of radical changes in the company, it is a philosophy of evolutionary thinking in a situation of need. It consists in looking at the situation from a different perspective and rejecting existing thinking in creating new solutions, taking the necessary risk, bold and consistent decisions. Changes may occur in various areas, e.g.: job positions change, different roles and competences are assigned to individual positions, training is introduced and emphasis is placed on education, other measures of remuneration efficiency are used depending on the effects of the activity, promotion criteria change changed, the mission values are more important, the hierarchy of organizational levels is also flattened, and much more (Penc, 1997). This change program for managers becomes for them a kind of shock to improve the organization. The role of the manager in improving the company has a multithreaded dimension. When certain problems arise, common difficulties have one common cause. Both groups know that the success of change depends on the vision of management. Very few leaders give much thought to how individual units engage in making change happen. Typically, leaders see change as an opportunity to strengthen the company, for example by aligning operations with the company's strategy to take on new challenges and risks and to continue their careers. For some partners, these changes are not welcome. They are rather destructive and undesirable (Penc, 1996). Why is this happening? Leaders misjudge the effect of change and their personal relationship with subordinates to obtain the necessary approvals for change, and it is incorrect. To bridge this gap, leaders need to learn to see things a little differently. They must get into the position and skin of their subordinates to understand what

the prospects for change look like through someone else's eyes. The true wisdom of man is to be able to distinguish good changes from bad changes, to distinguish good decisions from bad decisions. And it's not that simple. We managers think that we make good decisions, but in the eyes of others, not necessarily good ones. Seeing yourself through the eyes of your partners must be an interesting experience. Few people see the sense in it and are able to do it. We have mutual obligations to each other. Such agreements are what may be called a "personal compact" (Stoner, Freeman, Gilbert, 1997). Interesting phenomena appear in such an arrangement. Some satisfied partners will try to undermine the authority of leaders and well-thought-out plans, and some may see initiatives where a personal arrangement has been successfully accepted to support major change. A very important issue in the direction of good changes are business goals, which define the expectations of leaders as to the effects of changes. In exchange for a commitment to work efficiently, managers delegate the power and resources necessary to each partner to do their job. If an obligation is not expressly stated in writing, it is stated orally. You have to be honest with these arrangements. Then there are a lot of different questions, such as: What help will I get to do my job? When will my performance be assessed? How will I be rewarded and what will my relationship be after that?. A clean, clearly defined formal personal arrangement guarantees satisfaction from cooperation. The psychological arrangement of a personal partnership in business involves various aspects of work that are basically clearly defined. They include elements of mutual expectations and commitments that affect mutual trust. This psychological dimension is often not specified in writing, but it fully captures the issue of achieving goals (Sudoł, 1994). Leaders in this arrangement expect loyalty from their partners. Within the psychological dimension of this personal relationship, questions arise: How hard will I work? or what recognition will I get for my efforts? A wise leader is able to meet these questions and formulate answers. Let us remember that loyalty and commitment are the partner's key features for a leader, closely related to the belief in readiness to cooperate. When fundamental changes are required, a manager's understanding of this dimension of the partner relationship is critical to their commitment to new tasks and new standards of performance. The manager introduces some values to the company. As part of the psychological dimension, the partner learns these values, and therefore the fundamental question arises: Are my values similar to those of the leader? Then conflicts arise, communication fails, the dimension of the personal relationship is most often undermined. When a leader loses credibility, this is where it is most difficult for him to regain it. Changes are a feature of the vitality of every company, an attribute of its entrepreneurship. Each company, wanting to be successful, must make changes in its organizational culture, and the changes taking place in the environment must be treated not as threats, but as an opportunity for new actions. Introducing changes is a prerequisite for the development of any enterprise. Changes should be accepted and supported by partners (Zbichorski, 1994). Unfortunately, the nature of the changes is increasingly complex. Organizations consist of different units and have different stakeholders. Each of them has their

own dreams, experiences their dramas, fears and hopes. The success of change does not depend on accumulated wisdom (past experience), but mainly on the current situation (Filipczuk, Soroka, 1998). And that is why the ability to anticipate the behavior of partners is crucial in decision making and management. The manager must understand that the old ways of doing things are useless. A visionary strategy plays a priority role in this case, stimulating organizational energy. Sometimes we have to dream about success, define it and determine the steps necessary to achieve it, develop new operating practices, a new policy of conduct. New practices must be accepted by partners. Building an organization depends on human resource management, the purpose of which is to generate awareness in the pursuit of a common belief in success (Aniszewska, 1998). In order for the company to survive, it must change the rules of coordination towards reducing the organizational structure, e.g. by flattening its levels. The relatively flat structure of the hierarchy means that common goals determine mutual control and coordination. The organizational structure should be compact, transparent and enable easier decision-making. A large number of organizational units hinders the flow of information and significantly extends the way of document circulation. The biggest challenge in improving an enterprise is the ability to constantly adapt to the changing environment. For example, the role of the salesperson and his work are perceived as capital, the approach to labor costs is changing. It is no longer about minimizing labor costs, but about finding the optimal relationship between inputs and sales effects. The modern entrepreneur wonders about the costs of an inefficient salesman and his employment. He is no longer interested in sales training, but in specific sales results. Thus, not only quality is important, but also speed. The human resources management policy is always aligned with the company's mission, its strategic goals and development strategies. A good manager should adopt an optimal strategy, e.g. described in a transparent way so that it is visible what rules and processes are related to it, e.g. sales. The process of a company "awakened" to change depends on the leader's imagination, energy and courage. We often ask ourselves whether changes can help the company? Managers observe the strategy of other managers and try to learn from others. Some effective tactics can emerge from mutual observation. Every manager should know that tactics are not formulas and that any program of change creates many opportunities and threats, and depends on various circumstances. Tactical choices must be made before the shifts begin.

4. Management models and research methodology

The authors' own research was carried out for 12 selected enterprises on the basis of a questionnaire consisting of 12 questions (Reddin, 2020). There were four possible behaviors for each question. Each Leader of the enterprise could mark only one answer that best suited his/her behavior. The survey template with questions and possible answers is below.

Question 1:

The group's performance has been declining for several months. Your employees' engagement has dropped significantly and you constantly need to remind them of goals, tasks and deadlines. In the past, when similar situations happened to you, recalling tasks and responsibilities had the desired effect.

Answers:

A. You allow the group to define tasks and responsibilities for themselves.
B. You take into account the group's recommendation, but ensure that the goals are met.
C. You redefine tasks and responsibilities and closely supervise the implementation of changes.
D. You allow the group to participate in defining tasks and responsibilities and do not impose your will.

Question 2:

Group performance and interpersonal relationships are good, but you are unsure whether the group recognizes your leadership role.

Answers:

A. You allow the group to move on freely.
B. You talk to the group about the current situation and then make the necessary changes.
C. You try to make the group work in a specific way.
D. You facilitate discussions in the group about the current situation and do not impose your solutions.

Question 3:

The group has achieved extremely valuable achievements. Employees successfully completed long-term tasks. Recently, however, there have been some disruptions in their work. They have been a good team for several years. Everyone is qualified.

Answers:

A. You try to apply your own solutions, check the need for a new style of work.
B. You let employees solve the problem themselves.
C. Correct actions quickly and decisively.
D. Together with the group you try to solve the problem, you support your subordinates.

Question 4:

The work efficiency of your group has clearly improved. You ensured that all employees knew their tasks and responsibilities regarding performance.

Answers:

A. You maintain friendly relations, but still ensure that all employees are aware of their duties and job requirements.
B. You do not take any specific action.
C. You do your best to make the group feel important and involved.
D. Together with the group you try to solve the problem, you support your subordinates.

Question 5:

You are considering changing your company structure to one that is not known to your group. The group has been working effectively so far and has been able to adapt to any conditions.

Answers:

A. You determine what change is necessary and supervise its implementation.
B. Together with the group, you prepare a plan for the implementation of the change, but let the employees organize its implementation.
C. You are willing to consider any suggestions, but you retain control over the implementation of the change.
D. You avoid confrontation, give the group the opportunity to adapt to changes on their own.

Question 6:

Your subordinates, usually fulfilling their duties well, do not fulfill their recently assigned tasks.

Answers:

A. You allow the group to participate in the re-establishment of performance and you do not take control.
B. you redefine standards and strictly supervise adherence to them.
C. You don't apply pressure, you give the group the opportunity to make changes themselves. You are waiting for results.
D. You take into account the group's recommendation, but ensure that the goals are met.

Question 7:

Subordinates have not been responding to your requests for friendly conversation and interest lately. Their productivity is rapidly deteriorating.

Answers:

A. You emphasize the importance of getting the job done.
B. You are ready to talk but not intrusive.
C. You talk to subordinates and then set goals.
D. You are knowingly not interfering.

Question 8:

You have been promoted to a higher position. The person previously holding this function was not interested in the problems of the group. The group did its job properly. Relations within the group are good. When problems arise:

Answers:

A. You work with a group and try to solve a problem together.
B. You let the group find solutions on their own.
C. Correct actions quickly and decisively.
D. You encourage the group to try to solve the problem and become helpful to them.

Question 9:

Team members cannot solve the problem on their own. You usually left them free to act. Group performance and interpersonal relationships are good.

Answers:

A. You work with a group and try to solve a problem together.
B. You let the group find solutions on their own.
C. Correct actions quickly and decisively.
D. You encourage the group to try to solve the problem and become helpful to them.

Question 10:

Your supervisor put you in charge of a work team that caused you to be late in submitting your expected change recommendations. The group does not understand what its goals are. Attendance during the session is correct - they meet in a social meeting. However, employees have the potential to solve the problem.

Answers:

A. You allow the group to work on a problem in their temple on their own.
B. you make recommendations, but you will ensure that the goals are met.
C. you define tasks directly and properly supervise the application of changes.
D. You allow the group to formulate the goal, you do not exert pressure.

Question 11:

You consider making changes. Two employees have therapeutic experience and understand the handling of planned changes.

Answers:

A. You allow the group to develop changes and then impose solutions.
B. You announce changes and then implement them under close supervision.
C. You allow you to share your own courses of action.
D. you depend on the recommendations of the group, but by entering into changes yourself.

Question 12:

You have started working in a managed company. The previous manager correctly controlled the device. Consider the advantageous one, but at the same time in formalize relations in the organization.

Answers:

A. You do what you can to help a vulnerable, important and involved group.
B. you explain the meaning of terms and tasks.
C. You knowingly do not interfere, followed by the group that made the change.
D. you include the group to take part in solving the problem, but you keep an eye on the achievement of goals.

After the Leader completes the questionnaire, the selected answers are entered in the table. In order to determine the preferred management style, we enter the Leader's answers in the appropriate, numerically assigned fields in the "Leaders' answers" column. In order to

determine the manager's ability to be flexible in management, select selected cells containing the answers indicated by the Leader from the "Leaders' answers" column with blue color, then add up the points from individual rows and enter them into the appropriate cells in the "Number of points received" column. The sum of the points in the column determines the manager's ability to be flexible in management. The minimum possible number of points is 0, while the maximum is 36 points. The greater the sum score, the greater the capacity for flexibility (Reddin, 2020). It was found that a score in the range of 0-9 points indicates a lack of flexibility in management, a score in the range of 10-18 indicates a low ability to be flexible, a score in the range of 19-27 indicates an average ability to manage, and a score in the range of 28-36 points means a high capacity for flexibility in management. Individual scores from 0 to 36 were determined on the basis of a color scale, where 0 means red and 36 means green.

Table 1.
Scheme of the algorithm for determining the management style and its flexibility

Question number	**Answers Leaders**	**Scheme of the algorithm guiding a given management style and its flexibility**								**Number of points received**
		Management styles				**Flexibility of management styles**				
		1	**2**	**3**	**4**	**A**	**B**	**C**	**D**	
1		C	B	D	A	0	2	3	1	
2		C	B	D	A	3	1	0	2	
3		C	A	D	B	1	3	0	2	
4		D	A	C	B	3	0	2	1	
5		A	C	B	D	0	3	1	2	
6		B	D	A	C	2	0	1	3	
7		A	C	B	D	3	1	2	0	
8		A	C	B	D	0	3	1	2	
9		C	A	D	B	2	1	0	3	
10		C	B	D	A	0	2	3	1	
11		B	D	A	C	2	0	3	1	
12		B	D	A	C	1	2	0	3	
Sum										
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating					
0 1 2 3 4 5 6 7 8 9		10 11 12 13 14 15 16 17 18				19 20 21 22 23 24 25 26 27				28 29 30 31 32 33 34 35 36
No flexibility in management		Little flexibility in management				Medium elasticity in management				Great flexibility in management

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

4.1. Findings

A collective summary of research results for all 12 enterprises, corresponding to the 12 questions asked in the survey, is presented in figures 1 to 12.

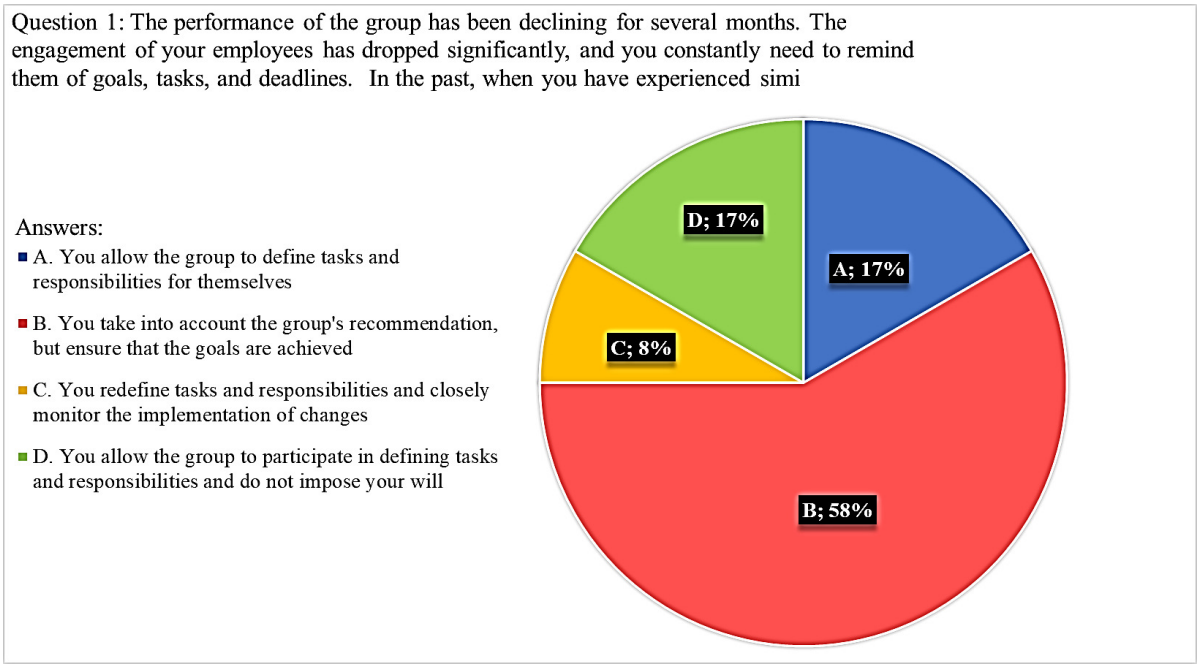

Figure 1. Answers Leaders of selected enterprises in the case of using question 1 of the research survey.

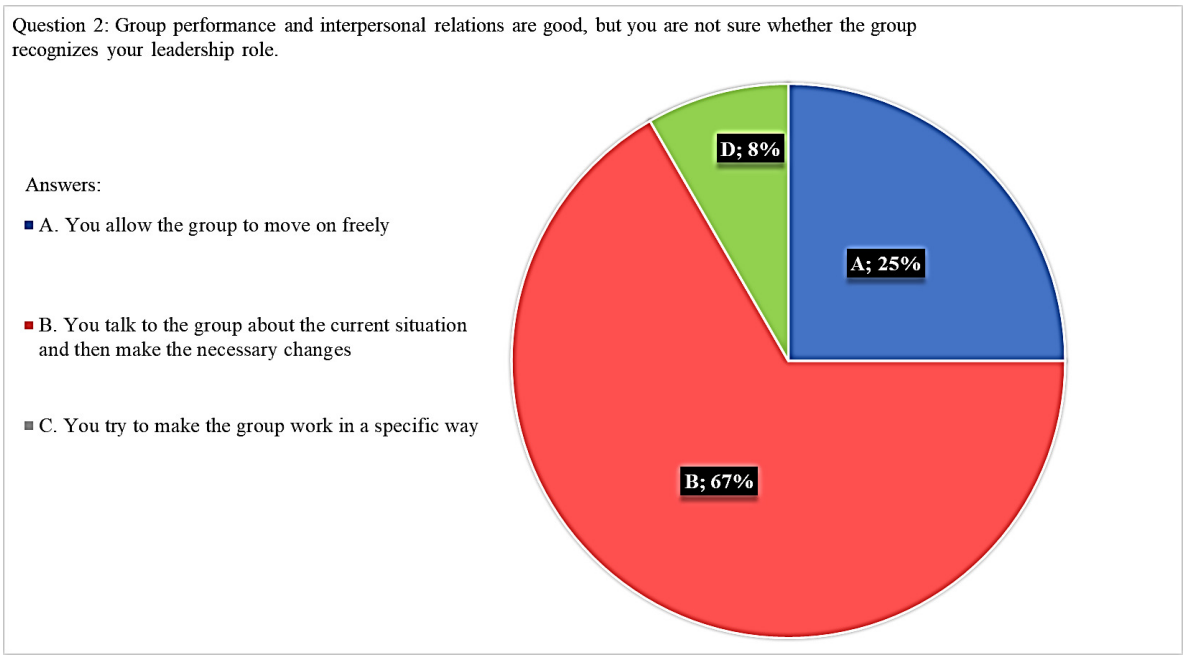

Figure 2. Answers Leaders of selected enterprises in the case of using question 2 of the research survey

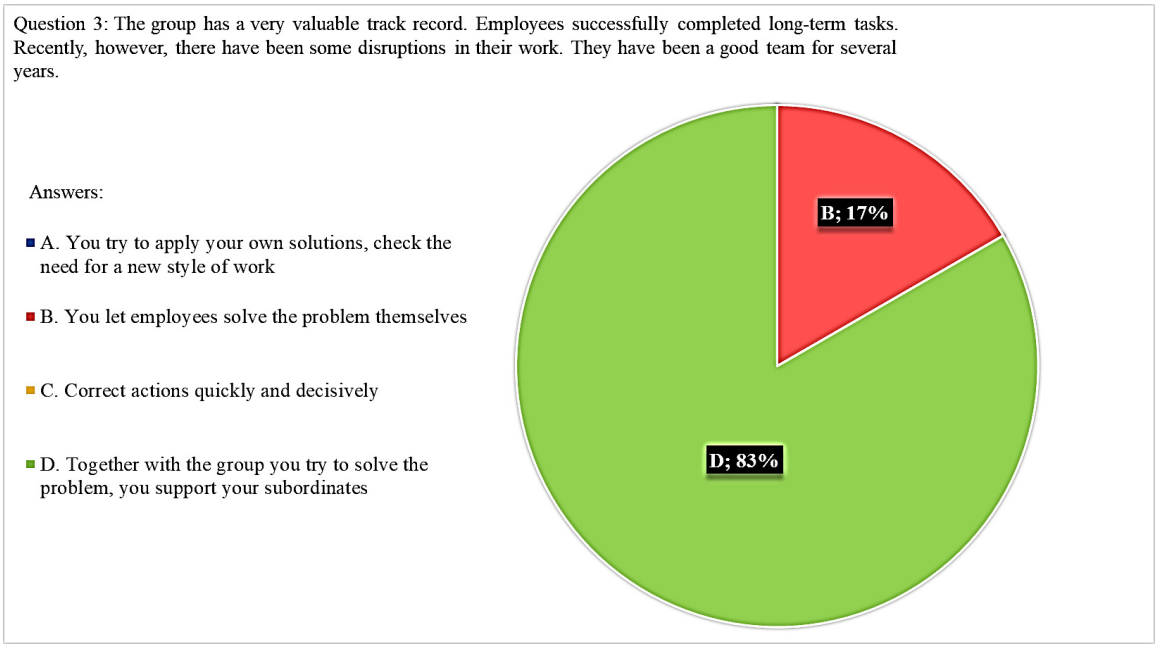

Figure 3. Answers Leaders of selected enterprises in the case of using question 3 of the research survey

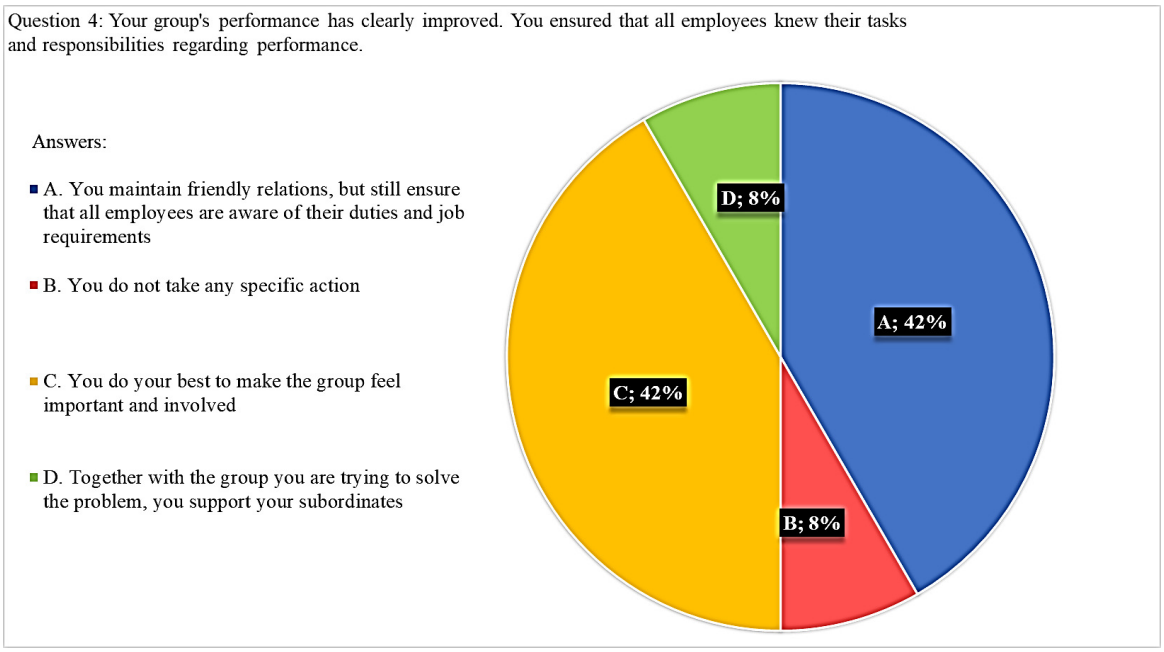

Figure 4. List of responses Leaders of selected enterprises in the case of using questions 4 of the research survey

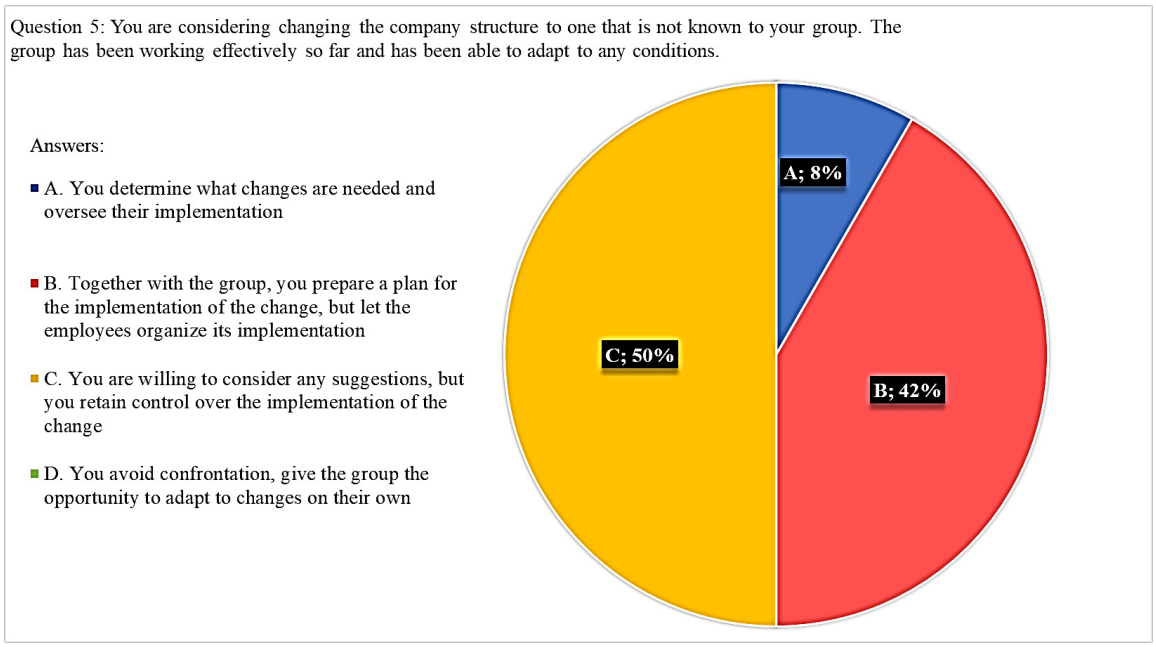

Figure 5. List of Answers Leaders of selected enterprises in the case of applying question 5 of the research survey

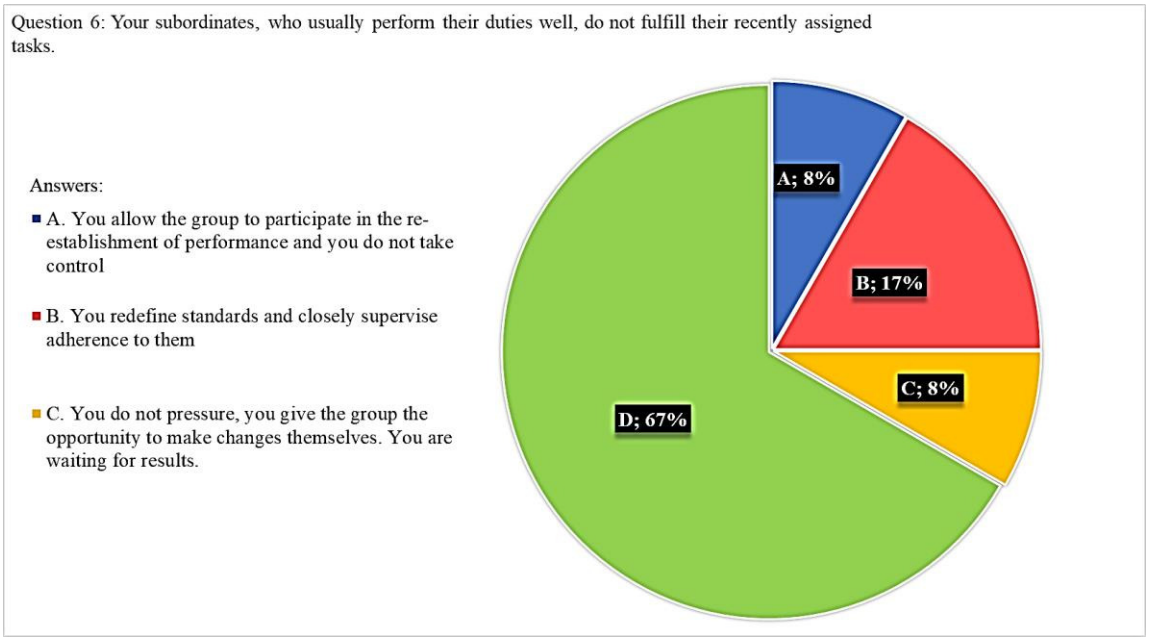

Figure 6. Answers Leaders of selected enterprises in the case of applying question 6 of the research survey

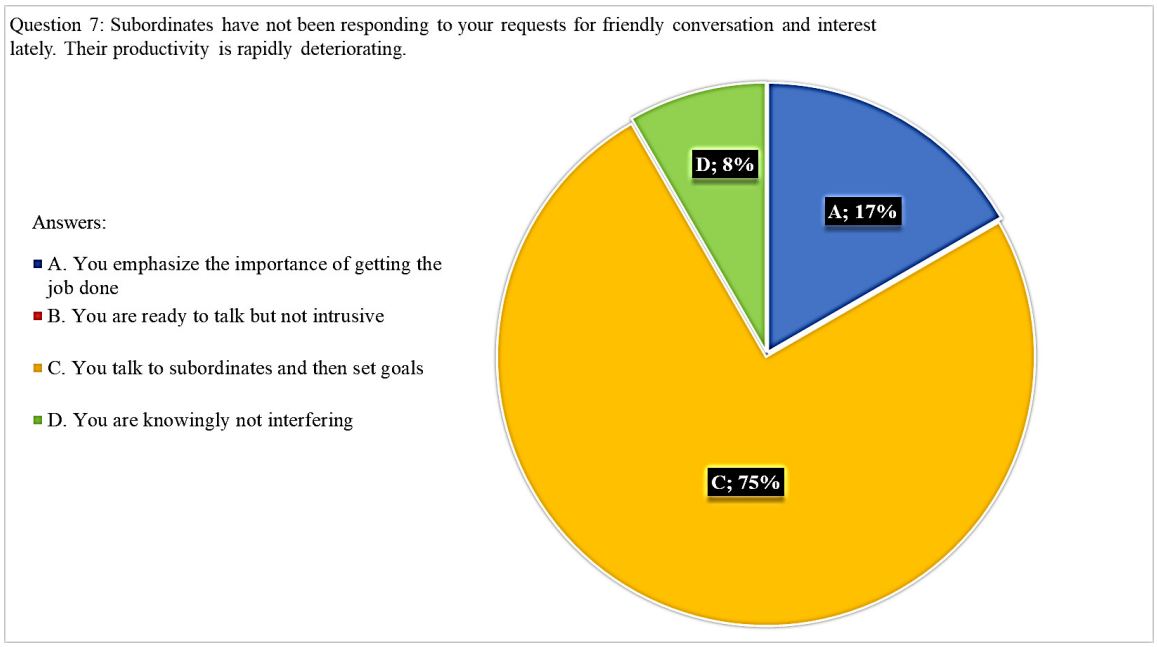

Figure 7. Answers Leaders of selected enterprises in the case of applying question 7 of the research survey

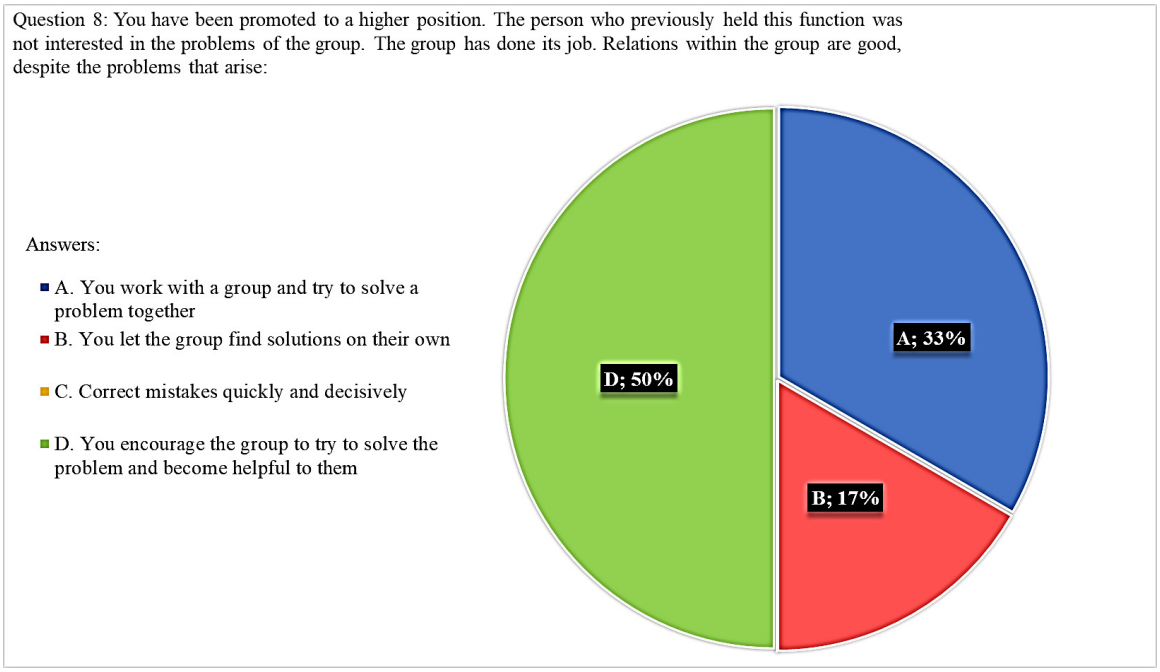

Figure 8. Answers Leaders of selected enterprises in the case of applying question 8 of the research survey

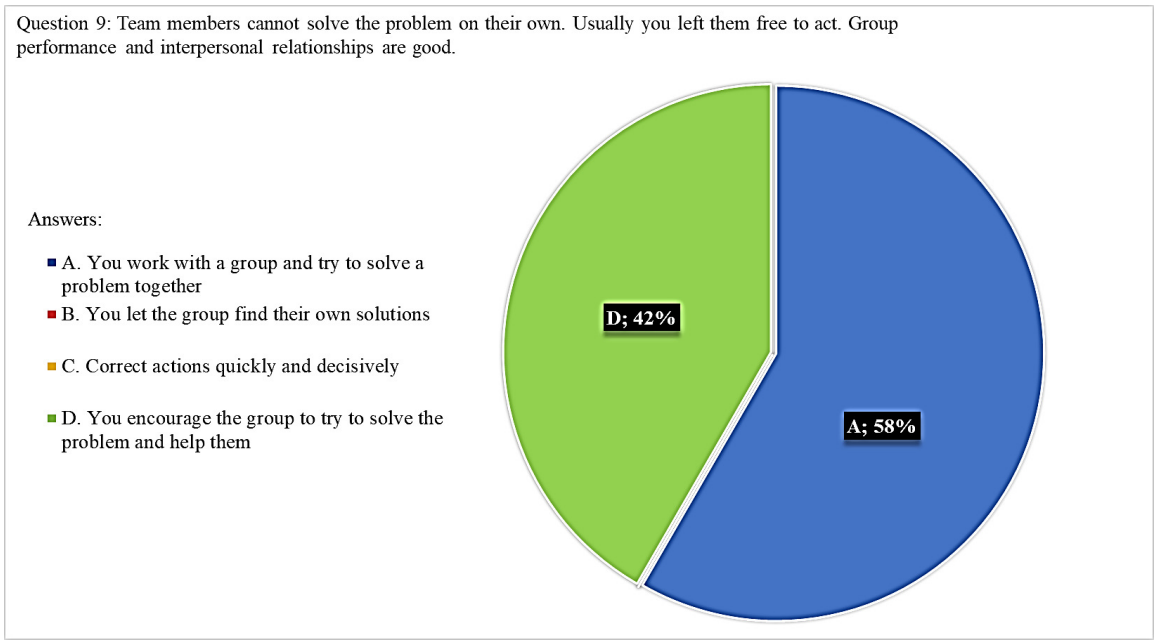

Figure 9. Answers Leaders of selected enterprises in the case of applying question 9 of the research survey

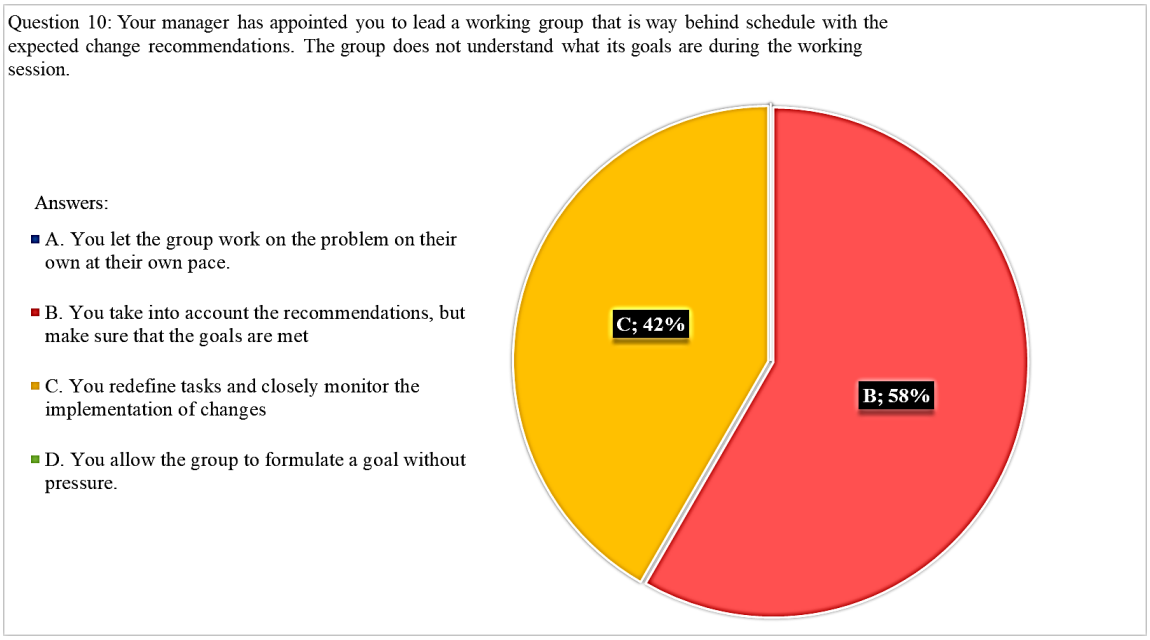

Figure 10. Answers Leaders of selected enterprises in the case of using question 10 of the research survey

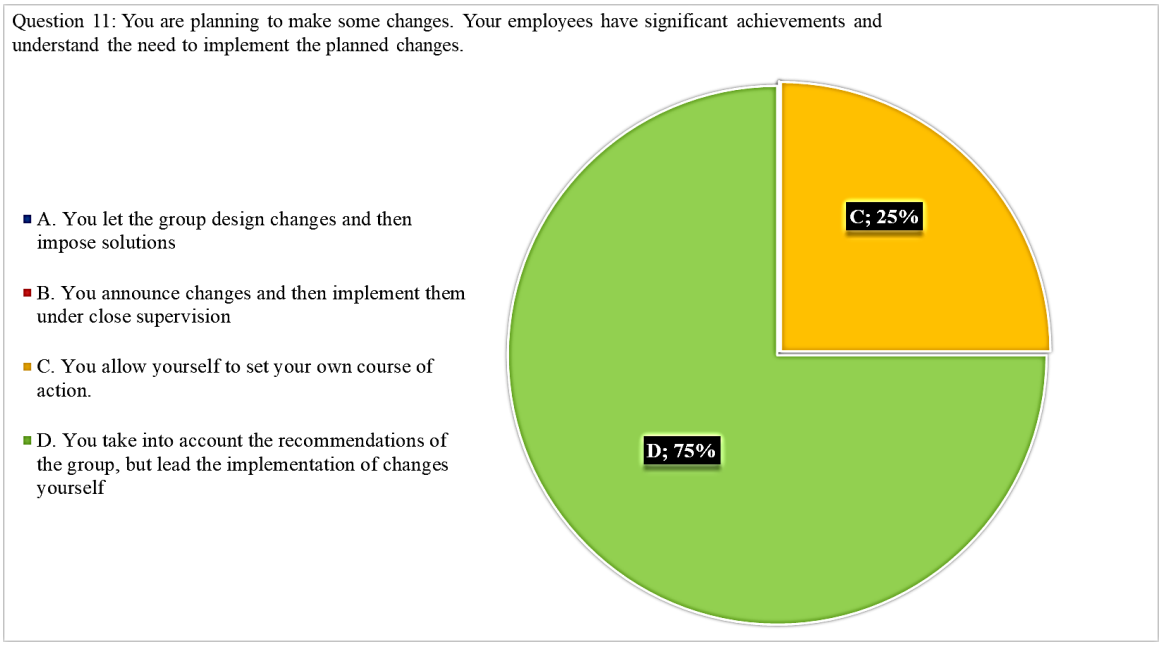

Figure 11. Answers Leaders of selected enterprises in the case of applying question 11 of the research survey

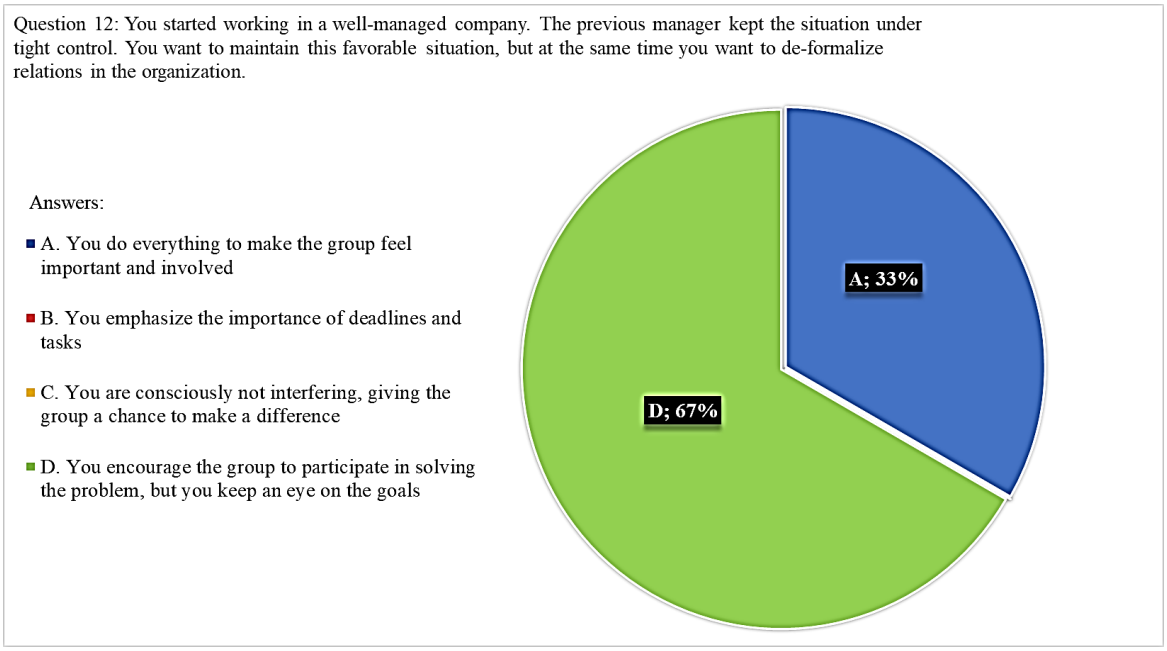

Figure 12. Answers Leaders of selected enterprises in the case of applying question 12 of the research survey

4.2. Analysis of research results

In order to interpret the results of the survey, an algorithm scheme for determining the management style and its flexibility was used. Tables with the interpretation of management styles for all 12 surveyed enterprises are presented below.

Table 2.
Preferred management style and its flexibility for Enterprise 1

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	A	D	A	C	B	3	0	2	1	3
5	A	A	C	B	D	0	3	1	2	0
6	B	B	D	A	C	2	0	1	3	0
7	C	A	C	B	D	3	1	2	0	2
8	A	A	C	B	D	0	3	1	2	0
9	A	C	A	D	B	2	1	0	3	2
10	B	C	B	D	A	0	2	3	1	2
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		**0**	**16**	**2**	**0**	**5**	**5**	**7**	**6**	**23/36**
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36										
No flexibility in management		Little flexibility in management				Medium elasticity in management			Great flexibility in management	

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 3.
Preferred management style and its flexibility for Enterprise 2

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	1	2	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	A	D	A	C	B	3	0	2	1	3
5	C	A	C	B	D	0	3	1	2	1
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	1
8	D	A	C	B	D	0	3	1	2	2
9	D	C	A	D	B	2	1	0	3	3
10	C	C	B	D	A	0	2	3	1	3
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		**3**	**15**	**5**	**2**	**3**	**3**	**6**	**14**	**26/36**
		Style Directing/Di rective	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36										
No flexibility in management		Little flexibility in management				Medium elasticity in management			Great flexibility in management	

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 4.

Preferred management style and its flexibility for Enterprise 3

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	1	2	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	C	D	A	C	B	3	0	2	1	2
5	B	A	C	B	D	0	3	1	2	3
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	2
8	A	A	C	B	D	0	3	1	2	0
9	D	C	A	D	B	2	1	0	3	3
10	B	C	B	D	A	0	2	3	1	2
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		**0**	**14**	**10**	**0**	**0**	**8**	**4**	**12**	**24/36**
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management									Medium elasticity in management									Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 5.

Preferred management style and its flexibility for Enterprise 4

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	D	C	B	D	A	0	2	3	1	1
2	D	C	B	D	A	3	1	0	2	2
3	D	C	A	D	B	1	3	0	2	2
4	D	D	A	C	B	3	0	2	1	1
5	B	A	C	B	D	0	3	1	2	3
6	C	B	D	A	C	2	0	1	3	1
7	C	A	C	B	D	3	1	2	0	2
8	D	A	C	B	D	0	3	1	2	2
9	D	C	A	D	B	2	1	0	3	3
10	B	C	B	D	A	0	2	3	1	2
11	C	B	D	A	C	2	0	3	1	3
12	A	B	D	A	C	1	2	0	3	1
Sum		**1**	**4**	**12**	**6**	**1**	**5**	**6**	**11**	**23/36**
		Style Directing/ Directive	Coach Style	Style ofSupporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management									Medium elasticity in management									Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 6.

Preferred management style and its flexibility for Enterprise 5

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	A	C	B	D	A	0	2	3	1	0
2	A	C	B	D	A	3	1	0	2	3
3	D	C	A	D	B	1	3	0	2	2
4	A	D	A	C	B	3	0	2	1	3
5	C	A	C	B	D	0	3	1	2	1
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	2
8	A	A	C	B	D	0	3	1	2	0
9	A	C	A	D	B	2	1	0	3	2
10	C	C	B	D	A	0	2	3	1	3
11	D	B	D	A	C	2	0	3	1	1
12	A	B	D	A	C	1	2	0	3	1
Sum		**3**	**12**	**3**	**3**	**9**	**0**	**6**	**6**	**21/36**
		Style Directing/ Directive	Coach Style	Style ofSupporting	Style ofDelegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36										
No flexibility in management		Little flexibility in management				Medium elasticity in management			Great flexibility in management	

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 7.
Preferred management style and its flexibility for Enterprise 6

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	A	C	B	D	A	3	1	0	2	1
3	B	C	A	D	B	1	3	0	2	2
4	C	D	A	C	B	3	0	2	1	3
5	B	A	C	B	D	0	3	1	2	0
6	A	B	D	A	C	2	0	1	3	0
7	C	A	C	B	D	3	1	2	0	2
8	D	A	C	B	D	0	3	1	2	0
9	A	C	A	D	B	2	1	0	3	2
10	C	C	B	D	A	0	2	3	1	2
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		**3**	**10**	**3**	**3**	**7**	**8**	**7**	**6**	**28//36**
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36										
No flexibility in management		Little flexibility in management				Medium elasticity in management			Great flexibility in management	

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 8.
Preferred management style and its flexibility for Enterprise 7

		Scheme of the algorithm guiding a given management style and its flexibility	

Question number	Answers Leaders	Management styles				Flexibility of management styles				Number of points received
		1	2	3	4	A	B	C	D	
1	A	C	B	D	A	0	2	3	1	0
2	B	C	B	D	A	3	1	0	2	1
3	B	C	A	D	B	1	3	0	2	3
4	A	D	A	C	B	3	0	2	1	3
5	B	A	C	B	D	0	3	1	2	3
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	2
8	B	A	C	B	D	0	3	1	2	3
9	D	C	A	D	B	2	1	0	3	3
10	B	C	B	D	A	0	2	3	1	2
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		**0**	**15**	**9**	**3**	**3**	**12**	**2**	**10**	**27/36**
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management										Medium elasticity in management								Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 9.
Preferred management style and its flexibility for Enterprise 8

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	A	D	A	C	B	3	0	2	1	3
5	C	A	C	B	D	0	3	1	2	1
6	D	B	D	A	C	2	0	1	3	3
7	A	A	C	B	D	3	1	2	0	3
8	D	A	C	B	D	0	3	1	2	2
9	A	C	A	D	B	2	1	0	3	2
10	C	C	B	D	A	0	2	3	1	3
11	D	B	D	A	C	2	0	3	1	1
12	A	B	D	A	C	1	2	0	3	1
Sum		**6**	**13**	**3**	**2**	**9**	**3**	**4**	**8**	**24/36**
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management										Medium elasticity in management								Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 10.
Preferred management style and its flexibility for Enterprise 9

		Scheme of the algorithm guiding a given management style and its flexibility	

Question number	Answers Leaders	Management styles				Flexibility of management styles				Number of points received
		1	2	3	4	A	B	C	D	
1	D	C	B	D	A	0	2	3	1	1
2	A	C	B	D	A	3	1	0	2	3
3	D	C	A	D	B	1	3	0	2	2
4	C	D	A	C	B	3	0	2	1	2
5	C	A	C	B	D	0	3	1	2	1
6	D	B	D	A	C	2	0	1	3	3
7	A	A	C	B	D	3	1	2	0	3
8	D	A	C	B	D	0	3	1	2	2
9	D	C	A	D	B	2	1	0	3	3
10	B	C	B	D	A	0	2	3	1	2
11	C	B	D	A	C	2	0	3	1	3
12	A	B	D	A	C	1	2	0	3	1
Sum		3	6	9	8	7	2	6	11	26/36
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9	10 11 12 13 14 15 16 17 18 19	20 21 22 23 24 25 26 27	28 29 30 31 32 33 34 35 36							
No flexibility in management	Little flexibility in management	Medium elasticity in management	Great flexibility in management							

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 11.
Preferred management style and its flexibility for Enterprise 10

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	C	D	A	C	B	3	0	2	1	2
5	C	A	C	B	D	0	3	1	2	1
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	2
8	A	A	C	B	D	0	3	1	2	0
9	A	C	A	D	B	2	1	0	3	2
10	C	C	B	D	A	0	2	3	1	3
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	3
Sum		3	15	4	0	2	3	8	9	22/36
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				
0 1 2 3 4 5 6 7 8 9	10 11 12 13 14 15 16 17 18 19	20 21 22 23 24 25 26 27	28 29 30 31 32 33 34 35 36							
No flexibility in management	Little flexibility in management	Medium elasticity in management	Great flexibility in management							

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 12.
Preferred management style and its flexibility for Enterprise 11

		Scheme of the algorithm guiding a given management style and its flexibility	

Question number	Answers Leaders	Management styles				Flexibility of management styles				Number of points received
		1	2	3	4	A	B	C	D	
1	C	C	B	D	A	0	2	3	1	3
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	B	D	A	C	B	3	0	2	1	0
5	C	A	C	B	D	0	3	1	2	1
6	B	B	D	A	C	2	0	1	3	0
7	D	A	C	B	D	3	1	2	0	0
8	B	A	C	B	D	0	3	1	2	3
9	A	C	A	D	B	2	1	0	3	2
10	B	C	B	D	A	0	2	3	1	2
11	D	B	D	A	C	2	0	3	1	1
12	D	B	D	A	C	1	2	0	3	1
Sum		3	8	5	0	2	6	4	6	18/36
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management										Medium elasticity in management								Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

Table 13.
Preferred management style and its flexibility for Enterprise 12

Question number	Answers Leaders	Scheme of the algorithm guiding a given management style and its flexibility								Number of points received
		Management styles				Flexibility of management styles				
		1	2	3	4	A	B	C	D	
1	B	C	B	D	A	0	2	3	1	2
2	B	C	B	D	A	3	1	0	2	1
3	D	C	A	D	B	1	3	0	2	2
4	C	D	A	C	B	3	0	2	1	2
5	B	A	C	B	D	0	3	1	2	3
6	D	B	D	A	C	2	0	1	3	3
7	C	A	C	B	D	3	1	2	0	2
8	D	A	C	B	D	0	3	1	2	2
9	A	C	A	D	B	2	1	0	3	2
10	B	C	B	D	A	0	2	3	1	2
11	C	B	D	A	C	2	0	3	1	3
12	D	B	D	A	C	1	2	0	3	3
Sum		0	15	7	5	2	8	7	10	27/36
		Style Directing/ Directive	Coach Style	Style of Supporting	Style of Delegating	Average management flexibility				

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
No flexibility in management										Little flexibility in management										Medium elasticity in management								Great flexibility in management								

Source: Own elaboration, taken from Reddin, B. (2020). *Tests for managers focusing on efficiency. Psychological guide.* Warsaw: Alma-Press.

In order to collectively present the analysis of the results of research defining the management style in selected enterprises, figure 13 was used.

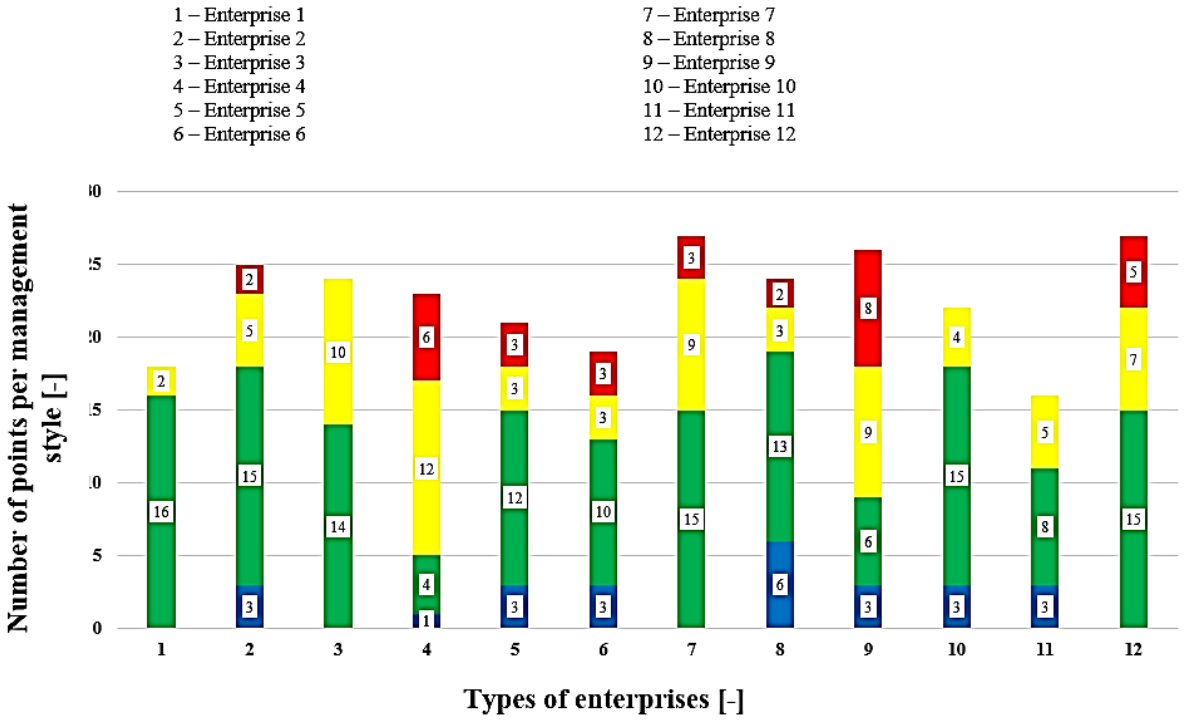

Figure 13. Preferred Management styles in selected enterprises.

Source: Own elaboration based on the results of conducted research.

5. Conclusions

Management comprises a set of many activities such as: planning, decision-making, organizing, managing people, using the organization's resources (financial, material and information), performed with the intention of efficient and effective achievement of goals. A manager is a person whose duties consist in carrying out the management process and make the company profitable. The basic activities that make up this process are:

- planning and decision-making (determining the mode of operation),
- organizing (coordinating activities and resources),
- management (people management),
- controlling (observing and evaluating the organization's activities).

These activities are not carried out according to a systematic and predictable schedule, although it is always worth imposing one. Leading a team is a busy, sometimes very difficult job. It requires many advantages, such as: building authority, insight, a sense of responsibility, simplicity, understanding and patience, and above all, predictability of behavior, and many others. Everyone in the team has their own strengths and weaknesses. The manager's job is to make everyone work together for success.

a) as many as 7 showed a dominant coaching style,

b) 3 had a coaching-supporting style,
c) 1 used the supporting-delegating style,
d) 1 only managed the supporting style.

The conducted research showed that out of the 12 surveyed companies.

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IMPLEMENTING THE QUALITY ASSURANCE SYSTEM AND ASSURING HEALTH SAFETY IN THE LIGHT OF INCREASING BREAD QUALITY

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Purpose: The aim of the article is to presents rules, requirements, and norms for quality management and health safety assurance systems among small and medium bakeries.
Design/methodology/approach: The literature research and the critical analysis of both, the national and foreign subject literature have been used as the research methodology.
Findings: The article presents rules, requirements, and norms for quality management and health safety assurance systems among small and medium bakeries. This group of businesses does not have the obligation of implementing or certifying specific systems. They are, however, implemented in order to increase the quality of the bread or reach a better market position. Also, the results of a 2022 study of 53 bakeries' implementation of individual quality management systems are presented in the paper. The study shows an important role of the implementation of coordinated systems in the increase of quality of bread. Theoretical considerations and the results of a questionnaire study allowed the author to discuss and explain why neither the TQM system nor the BRC standards were implemented in small- and medium-sized bakeries.
Practical implications: Practical implications include taking into account the indicated determinants that implementing the quality assurance system and assuring health safety in the light of increasing bread quality will be an important solution in making a number of decisions by managers and bakery owners in terms of strategic use of them.
Originality/value: Proper implementation of the rules for implementing the requirements and regulations regarding quality management systems and ensuring health safety on the example of small and medium-sized enterprises in the baking industry - allows you to build and maintain a long-term competitive advantage in small and medium-sized bakeries in the baking industry. The results of research on the implementation of quality management systems and ensuring the health safety of bread confirm the legitimacy of using integrated quality systems. They will have a fundamental impact in the long-term perspective of innovative management of bakery managers and owners.

Keywords: quality management systems, health assurance systems, TQM complex management system, small and medium enterprises, increase of bread quality.

Category of the paper: research paper.

1. Introduction

Bread constitutes the fundamental element of each Pole's diet, and when approached rationally, can serve an indispensable role of regulating one's gastric tract and satisfying the majority of an organism's daily energy quota (ca. 25-30%) (Dziwkosz, 2008; Gambuś, Litwinek, 2011). In Poland, bread has always been, is, and likely will long be the fundamental food product. Among all bakery product volumes, bread constitutes around 70% (Ambroziak, 2012).

In this context, issues related to bakery product quality are valid in a constant way, and different papers on the subject mainly focus on the impact of the entry material quality (Drozd, 2021). According to the author's knowledge, there are no mentions of implementing quality management systems and assuring health safety in the baking industry in the available academic sources. This research gap is mainly the effect of difficulties in collaborating with the companies that protect their in-house information.

In the light of food regulations, responsibility for health safety of food is the duty of the manufacturer or the company that introduces the product to the market[1]. Therefore, it is important for bakeries to abide by the quality norms that are part of quality management systems and assure health safety. Additionally, it is important for such companies to evaluate the systems in use (Drozd, 2021).

Bread, just like any other product, can be described by a set of quality features that reflect the consumer expectations (Balon, Dziadkowiec, Sikora, 2016; Frąś, Gołębiowski, Bielawa, 2006). The goal of delivering quality to consumers is to assure that quality requirements are delivered through a quality management system (Dobrowolska, 2000; Luning, Marcelis, Jongen, 2005). Such a system is a coordinated set of requirements that presents a specific structure of activities (Kijowski, 2004). Currently, the term is used in a variety of meanings, as a set, a combination or a connection of the elements of the set with specific relations (Hys, 2018).

In the food industry, the prevailing systems of assuring quality and ensuring the food safety are as follows (Karaszewski, 2005):

1. Good Manufacturing Practice – GMP, and Good Hygienic Practice – GHP.
2. Hazard Analysis and Critical Control Points analysis – HACCP and the Quality Assurance Control Point System – QACP.
3. Documents issued by the International Organization for Standardization – ISO.
4. The requirements of the British Retail Consortium – BRC and the international (German-French-Italian) International Food Standard – IFS.

[1] Food law is a set of international, EU, and local legal norms that regulate the production and sales of foodstuffs.

The requirements, rules, and regulations of the systems listed above will be presented in sections 2-5 below, and related to the baking industry.

2. GMP and GHP

The rules of Good Hygienic Practice, GHP, are strictly focused on all the aspects of hygiene in food production, in reference to personnel, rooms, transport, packaging, and ingredients. GHP encompasses activities that assure food safety. They ought to be taken into account and controlled at all stages of food production. In the past, only the finished product was scrutinised. Currently, control is applied to all stages of production, from ingredients and materials, through production and storage to the consumer purchasing food.

According to GHP, food products should travel only in one direction along the production chain. They should not reverse their progress nor cross paths with other processes. Individual parts of a manufacturing facility are to be split into dirty and clean sections. Other GHP rules apply to e.g.

- technical state of the buildings,
- designing buildings and machines with hygiene rules in mind,
- quality of technological water,
- proper disposal of waste water,
- proper collection and disposal of solid waste, including hazardous waste,
- order within rooms,
- personnel hygiene, including control of possibility of spreading diseases,
- company disinsection and disinfection.

The company's staff ought to undergo training in the hygienic requirements constituting GHP. Each company is required to establish their own GHP programme or instructions, which are the basis for the implementation of a HACCP system (Staszewska, 2002).

Good Manufacturing Practice, GMP, consists of activities that ought to be taken, and conditions that ought to be met, to ensure that food production results in food of proper health quality, in accordance with its intended consumption.

The general rules of GMP include the issues related to: machines and resources, hygiene of food production, requirements for ingredients, intermediary products, and finished goods, controls and inspections, record, protocol and documentation storage, and management.

In order to satisfy GMP, it is essential to take care of the proper technical state of the company, i.e. proper ventilation and lighting, location of production and warehouse machines. In warehouses for equipment, ingredients, and chemicals, it is imperative to ensure proper storage conditions and space, in accordance with the volume of the stock and finished goods that will be stored within these rooms.

The staff of a GMP-compliant company should undergo checks in the area of preventing infections of food. Equipment used in food production ought to be kept clean, which is assured by introducing procedures for washing and disinfection. Yet another important aspect is the permeation of insects, birds, and rodents into the facilities.

Each staff member of a GMP-complaint company ought to ensure, before starting work, that they have the necessary ingredients and half-finished products at their disposal, as well as whether the equipment they would start working with is in proper condition and clean. During work, staff ought to be observant and keep their workspace clean. Work should be undertaken in ways that do not lead to spoiling of the products, equipment, and rooms. If a staff member is unsure about how a task should be performed, they ought to ask their superiors or check relevant procedures and instructions for the task in the company documentation.

Following GMP assures proper control of the sanitary and technical state of equipment, machines, and rooms, and provides basis for the analysis of the parameters of the operations undertaken in the production process.

Good Manufacturing Practice, GMP, is a set of standards for industrial production, especially in food and pharmaceutic industries. GMP assures high quality and cleanliness of ingredients of a product, as well as complete control over the origin and quality of ingredients and the whole manufacturing process. The implementation of such practices raises the safety level of finished goods (Kołożyn-Krajewska, Sikora, 2010).

According to D. Kołożyn-Krajewska, GMP in food industry aims at shaping nutritional value, health safety, and organoleptic features of food. The main activities within GMP, undertaken by food manufacturers, are (Kołożyn-Krajewska, Sikora, 2019).

1. Maintaining required hygiene in natural environment.
2. Assuring proper conditions in the storage of equipment, chemicals, and foodstuffs.
3. Assuring proper technical condition of all the facility.
4. Preventive measures against insects and rodents.
5. Optimal location, lighting, and ventilation of manufacturing facilities and warehouses.
6. Managing water and waste.
7. Checking the health condition of staff members.

The goal of GMP is to assure the highest standards of hygiene in the workplace, assuring the quality of the finished product, and the unification thereof. GMP rules are a norm in branches of the industry where it is imperative to not allow for any pollution of the product, mainly in food and pharmaceutic industries. GMP starts with ingredient purchases, and proceeds through storage, production, and packaging, to the storage and sales of the finished product. It also encompasses the creation of numerous procedures that are related to the whole of the manufacturing process, i.e. equipment, staff, trainings, workplace, transport, maintenance, disinfection, etc. GMP assumes the use of adequate amount of resources at predefined stages of production and in accordance with an established procedure.

Good Manufacturing Practice encompasses activities that efficiently combine manufacturing procedures with control and oversight ones, and so is a system that defines manufacturing procedures, as well as control procedures that are developed and issued by institutions. It requires that a manufacturer develops of written procedures, or instructions for parts of the complete manufacturing process.

The fundamental difference between GHP and GMP is that the former mainly focuses on aspects of hygiene, while GMP encompasses the total range of production-related aspects. In order to trace the differences better, the author used the example of bread baking equipment, which are important for both GHP and GMP.

GMP focuses on the location of equipment, installation thereof, the technical state, maintenance, rules of operating in case of failures, etc. It is visible that all the factors are mainly serve the acceleration and improvement of production.

On the other hand, GHP dictates the materials for the construction of equipment and machines so that their clean state can be maintained easily and so that they do not react with the ingredients, the frequency of washing and disinfection of the individual equipment pieces and machines and with the use of what chemicals such operations are to be performed, etc. As can be seen, all the aspects are linked to the safety of food.

Because of intersections between GHP and GMP and numerous similarities between the practice systems, the companies that want their operations to be based on such practices ought to implement the two sets simultaneously (Turlejska, 2003).

GHP and GMP are rules of operation when manufacturing food, that serve to eliminate all the microbiological, chemical, and physical threats. The rules are compulsory in all the companies and are required by law.

3. Hazard Analysis and Critical Control Points analysis – HACCP and the Quality Assurance Control Point System – QACP

In the European Union, HACCP is a system that has been in power as of December 14, 1995, and introduced by the Directive 93/43 EEC of June 14, 1993 on the hygiene of foodstuffs. In Poland, the HACCP system has been introduced in January 1, 2004 in e.g. companies that imported and sold foodstuffs, excluding small and medium companies, and ratified with the May 11, 2001 law on health conditions of food and feeding. Companies that are subject to HACCP need to implement the system but do not need to certify it.

HACCP is a specific system of assuring safety of food (Drozd, 2022; Kołożyn-Krajewska, Sikora, 2010). It is a preventive system defining all the potential and actual risks for a consumer's health along the manufacturing process, be it biological, physical or chemical,

and preparing preventive measures for the emergence of these risks. If necessary, Critical Control Points (CCP) are established (Kowalska, Wierpachowski, 2008).

In the course of baking bread, all three types of health threats – physical, chemical and microbiological – can potentially arise (Staszewska, 2002).

Within the category of physical threats, we can enumerate foreign objects, dust, dirt, moisture, or overheat due to atmospheric conditions.

The second category of health threats are chemical threats, i.e. residual quantities of pesticides, microtoxins and metals that are harmful to health that reach the manufacturing process together with the ingredients. The threats internal to the manufacturing process are the residual quantities of chemicals for the maintenance of equipment and machines, forbidden additives, overdoses of permitted additives.

Among the three categories of risk, the microbiological threats are the most severe. Microorganisms are single-cell organisms that are invisible to the naked eye. They are found in the entirety of the human habitat. There is no object or a living being that would be free of the numerous microorganisms. Not all these organisms are harmful – there is a large group of microorganisms that are beneficial and are actively used in manufacturing processes, such as yeast, lactic acid bacteria, or some moulds.

Critical Control Points are based on the analysis of threats and present: place, ingredient or production stage where a health-relevant threat ought to be controlled. It is a necessary step to detect threats and minimise or eliminate them before a product reaches the consumers.

The HACCP system, unlike the previously used random check system of the finished product, is based on the controls within the manufacturing process starting with the ingredients and ending with the final product.

The idea of HACCP is to exchange the search for the faults of a product for the prevention of the emergence of faults. It is obvious that monitoring all the stages of a manufacturing process, including the ingredients, is not feasible. However, by defining CCPs and focusing on monitoring them, it is possible to prevent threats and take corrective measure in a timely manner (Sadowska,2000).

The fundamental premise behind the implementation of HACCP is to guarantee the safety of food. Food poisoning and infections are major threats to the health of the contemporary people (Turlejska, Pelzner, 2003).

The availability of safe food is a point of interest of not only the consumers; manufactures also ought to be interested in providing safe food. By implementing HACCP, the food manufacturer gives a guarantee that their food is safe to eat. It is of special importance in the light of the manufacturer's liability for damages caused by foodstuffs that violate conditions of health safety. A consumer gets a guarantee of their purchased food being safe. Therefore, the HACCP system meets the expectations of both the manufacturer and the consumer (Ładoński, Szołtysek, 2005).

A system which is broader than HACCP and encompasses the complete product quality assurance is QACP – Quality Assurance Control Point system. HACCP refers merely to the assurance of health safety and in case of implementing it, the company establishes Critical Control Points, CCPs. In QACP, control points are established and their parameters are defined with reference values. Therefore, the basic assumption of the system is its preventive character. However, its implementation is not obligatory. Specifically, the system takes into account the quality of primary production, especially of those ingredients that influence the quality of the finished product. The QACP standard covers the whole food production chain, starting from ingredients and proceeding to the final product consumers. However, the methods and procedures of QACP may be applied to individual sections of the manufacturing process. This instrument is one of the most efficient methods of quality assurance. QACP needs to be implemented as a system. For both systems, i.e. HACCP and QACP, the same methods and procedures are developed. However, QACP serves to assure quality from the viewpoint of the consumer, with focus on the sensoric and nutritional properties, while HACCP is related only to the assurance of food quality (Kołożyn-Krajewska, Sikora, Fabisz-Kijowska, 2001).

4. ISO

The International Organization for Standardization, ISO, unifies global norms in order to prevent technical barriers in international trade. The idea of a quality system based on ISO standards is in stablishing procedures that cover all the company activities and that define responsibilities. The adoption of ISO standards is voluntary.

In food manufacturing and processing, the most common ISO standards come from the 22000 and 9000 series of ISO documents.

The international management standards of ISO 22000 define rules for planning, implementing, and functioning, as well as oversight of, food manufacturing processes and derived processes, such as packaging of food products, storage of food, etc. The ISO 22000:2005 system (in Poland: PN EN ISO 22000:2006) is related to the management of food safety – it defines requirements for organizations in the whole food production chain (PN – EN ISO 22000-2006).

The family of ISO 9000 norms is based on the general rules of “describe what you do”, “do what you have described”, “prove that you have done what you have described”. In practice, all the important procedures need to be defined and established, and company performance must follow them and be controlled afterwards.

ISO 9000 norms are the basis for defining quality management and control systems. They are not intentionally focused on the safety but rather generally understood quality. The adoption and implementation of one of the ISO norm models requires defining and implementing a company's high quality standards and assuring their repetitive character (Grudowski, 2003).

The main differences between the ISO 9000 standards that define the scope and normative capabilities are:

- ISO 9001 is a norm assuring quality in companies involved in the processes of designing/ developing production, making implementations and installations, as well as providing services (Urban,2012),
- ISO 9002 is a norm for assuring quality in the manufacturing processes, implementations and installations, or services,
- ISO 9003 is a norm for assuring quality in the process of final inspections.

ISO 9000 is a set of quality norms that encompass: product testing, staff training, documentation, supplier relations and policies, as well as corrective measures (Grudowski, 2006). Upon the satisfaction of these norms, the manufacturer applies for a quality certificate and their activities are controlled by an ISO organisation. ISO auditors perform an overview of the company activities against the norms for an ISO applicant or in order to renew the certificate. When preparing for an ISO audit, types of activities whose improvement may lead to increased quality are defined (Fraś, 2001).

5. IFS and BRC international standard requirements

Food manufacturers are obliged to assure the health safety of their products, by e.g. implementing the mandatory GHP, GMP, and HACCP rules. They may additionally implement the ISO 22000 standard. However, retailers also require their suppliers to be certified according to IFS and/or BRC (Balon, Sikora, 2016).

Quality assurance and health safety systems are implemented in food manufacturing companies to achieve optimal conditions for food production that result in optimal quality but are also safe, such that will meet the customer requirements. In order to unify the requirements for quality and health safety of food, obligatory systems and programmes were introduced that guarantee safety and the meeting of specific quality parameters. However, in contemporary economy reaching and maintaining a competitive position on the market necessitate the implementation of more advanced standard. Growing popularity of voluntary systems developed according to the ISO 22000 norm, the International Food Standard (IFS), the British Retail Consortium (BRC) global norm on food safety, is caused by increased awareness and

requirements of all the stakeholders (such as collaborators, customers, suppliers). Both the IFS and BRC standards are applied to verify quality in food industry.

IFS is a standard dedicated to all food manufacturers and the participants in the food manufacturing chain, especially to retailers that sell food items in their chains and under their brand names. It is meant as a tool for regular, independent and objective assessment of food distributors. Food suppliers to e.g. large supermarket chains are evaluated according to IFS. The audit standards of suppler evaluation are related to the following areas (Popis, 2013):

- top management responsibility,
- quality and safety management system,
- resource management in the HR area,
- planning and production processes,
- measurements, analysis, improvements,
- food protection and external inspections.

BRC integrates the regulations of the ISO 9000 series standards, HACCP, and GHP/GMP, as well as defines other particular requirements that need to be met in order to guarantee the safety and required repetitive quality level of the final product (Nowicki,2010). The global BRC norm contains requirements for the manufacturing of food products, packages that protect the food, and storage and distribution of the goods. The standard was designed for food manufacturers that provide their products to retail chains under the chains' brand, however, retail chains use it to audit also other manufacturers.

6. Methodology

The way of implementing quality management and safety assurance systems was discovered through a questionnaire (Czernek, 2015) among 53 bakeries, 52 of which are located in the Pomeranian voivodeship, and one in the Warmian-Masurian voivodeship – however this single bakery also supplies its products to a major share of the Pomeranian area, including the Tri-City agglomeration and the city of Reda.

The baking industry is an integral part of the local internal market. The local market is the primary source of ingredients for the baking industry, as well as the primary sales area (Daniela, Mierzwa, Bartczak, 2017). The Pomeranian voivodeship was selected as the research area as it was most familiar to the author.

The questionnaire study, in the light of company intellectual property protection, cannot be limited to preparing a questionnaire, sending it to the recipients, and waiting for answers. In order to collect the data, multiple discussions needed to be held with bakery representatives. The author received 53 responses from the 113 identified bakeries in the Pomeranian area.

The small- and medium enterprise structure of the bakeries in 2022 looked as follows:

a) micro-enterprises, up to 10 staff - 41.5%,
b) small enterprises, up to 50 staff - 47.2%,
c) medium-sized enterprises, up to 250 staff - 11.3%.

Taking the above into account only in terms of small and medium enterprises, all small bakeries constitute 88.7% of the market, while medium-sized bakeries account for 11.3%. The structure of bread manufacturers in Poland as a whole was not known for the time. The REGON (national registry of enterprises in Poland) shows around 12 thousand companies that indicated production of bread and fresh bakery products at the end of 2020.

7. Methodology

The questions on GMP and GHP were asked to receive an overall picture of systemic quality management. The delivery of GMP and GHP is mandatory and is monitored, as well as audited internally and externally. Therefore, all the respondents confirmed the implementation of these rules.

Among the 53 responses, 15 have been certified according to HAACP, i.e. 28.3%. In small and medium businesses, which the researched bakeries qualified as, the certification according to HACCP is not mandatory – the only compulsory area is to implement HACCP rules.

The QACP system is not mandatory, however, it has been implemented by seven of the bakeries for their whole production chain. The standard encompasses the complete production chain, starting with ingredients and ending with the final product, however methods and procedures may be applied to parts of the process. QACP needs to be implemented as a system. The instrument is one of the most efficient quality assurance methods.

In food manufacturing and processing, quality systems according to ISO 9000 and 22000 are the most common. ISO 9000 certification was found in nine of the respondents, and three implemented ISO 22000. All on all, 11 bakeries, 20.8% of the study group, were certified according to ISO – international standards for food manufacturing aimed at quality and safety of bakery products. Neither of the two certificates are mandatory.

The IFS requirements, in the form of a certificate, were confirmed in three bakeries, i.e. 5.7%. They are mainly required by retail chains.

Among the researched companies, there have been none with a BRC certificate as well as none that were interested in the Total Quality Management (TQM) complex quality management concept.

8. Discussion

The concept of complex quality management is related to all the areas of activity of a company and makes a holistic picture of pro-quality activities of an organisation (Borys, 2013). Among all the bakeries researched in this study, 41.5% were microbusinesses that employed up to 10 staff, and 27.2% were small enterprises. In both these types of business, the owner plays the largest managerial role. Subject literature quotes three fundamental roles of the owner of a small company: entrepreneurial, managerial, and technical (Wasilczuk, 2013). TQM, on the other hand, necessitates the involvement of all staff members. According to the TQM philosophy, complex quality management is achieved through strategy, processes, training, motivating, involvement, tools, and resources (Skrzypek, 2000). Micro-, small- and medium-sized bakeries in Poland do not guarantee the above formalised management methods. These companies focus mainly on their technological process.

Both the IFS and BRC international standards are used to verify quality in food industry. Large retail chains use them as indicators for the selection of suppliers, including baking product suppliers (Nowicki,2010). Ifs and BRC are meant as regular, independent, and objective tools of food distributors. Meeting IFS requirements was confirmed with certificates in three of the respondents, i.e. 5.7%. Bakers were not interested in the BRC standard. The conversations held with bakery representatives proved that IFS is of greater interest to them.

9. Summary

Apart from nutritional functions, bread may also serve to improve one's health. This is the type of product a contemporary consumer is interested in (Dziwkosz, 2008). Harsh market competition is a current problem of bakeries. The increased social demands on bread quality necessitated the introduction of new systemic solutions in which quality is of strategic importance.

The study results in the implementation of quality management systems and health safety assurance systems for bread manufacturing confirm the legitimacy of the implementation of integrated quality systems.

Among all the requirements and rules of the individual systems that influence the increased quality of bread, are:

1. Good Hygienic Practice/GHP:
    - increased hygiene of bread production, especially that of ingredients, personnel, rooms, transport, and packaging.

2. Good Manufacturing Practice/GMP:
   - care of proper technical and sanitary conditions, such as lighting, ventilation, placement of equipment for production and storage, storage conditions, ingredient quality, complete control of the whole manufacturing proces,
   - maintenance of the required hygiene levels in the natural environment, as well as maintenance of water and waste water.
3. Hazard Analysis and Critical Control Points/HACCP:
   - defining the potential and actual health threats to the consumer in the production process: physical, biological, and chemical, and defining preventive measures. If necessary, defining Critical Control Points/CCPs.
4. Quality Assurance Control Point System/QACP:
   - defining control points and their reference parameters and values for defining product quality, i.e. bread.
5. ISO-based quality system:
   - defining and implementing company's internal high quality standards and assuring their repetitive performance.
6. IFS and BRC international certificates:
   - unification of requirements for quality and health safety in order to assure safety and the required repetitive quality level of the final product, i.e. bread.

The rules of the quality management systems that are not derived from law were also delivered with the bakeries that were in the study group, as seen below:

1. HACCP (certificate) 28.3% bakeries,
2. QACP (for entire production) 13.2% bakeries,
3. ISO (certificate) 20.8% bakeries,
4. IFS (certificate) 5.7% bakeries.

Also, one of the bakeries in the study group was certified for ecological production, and one had the "Quality/Tradition" certification.

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LITERATURE REVIEW OF CONTINUOUS DELIVERY: RESEARCH DIRECTIONS FOR CRITICAL INFRASTRUCTURE SOFTWARE PROJECTS

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Purpose: The purpose of this work is to draw future research directions on how to ease adoption of continuous delivery (CD) for business-to-business (b2b) critical infrastructure products. CD is a recognized software lifecycle management practice reducing go-to-market time, strengthening customer feedback loop, and improving product quality. Telecommunication networks, considered critical infrastructure, are sensitive to changes in delivery models.
Design/methodology/approach: Literature review was performed by combining bibliometric analysis and the own model gauging telecom software vendors' interest in shaping CD practices across the industry.
Findings: The research is skewed toward engineering practices excellence. Little is spent on the customer challenges. Transformation slowdowns are attributed to product teams.
Research limitations/implications: Some software vendors, especially smaller ones, may prefer not to publish the outcomes before validating them with the customers. This work looked at publicly available materials therefore not capturing the picture of internal corporate experimentation on continuous delivery.
Practical implications: Scientists should seek access to customer perspective. Sales, services, and business managers may be invaluable proxies of such information.
Originality/value: This work nudges the community to shift focus from R&D excellence to change management at customer interface, and to deal with CD model industrialization aspects.

Keywords: Continuous delivery, critical infrastructure, devops, agile, telecommunication networks.

Category of the paper: Literature review.

1. Introduction

Telecommunication networks are strategic for proper functioning of states, public safety organizations, enterprises, and citizens. COVID-19 pandemic emphasized the importance of critical communication infrastructure as digitization enabler. 5G, the fifth-generation mobile

broadband technology, introduces new services and use cases. For example, home broadband was the most appealing 5G application among 52% respondents surveyed in (The Mobile Economy 2021, 2021). Introducing novel services puts speed of experimentation in the center of business case modeling for communication service providers (CSP). Value hypothesis must translate to product capabilities with short go-to-market time to gain competitive advantage. System complexity requires all network segments (i.e., radio access, transport, core) to be adaptable to the changing business demand. Providing small, iterative, frequent product changes to customer is the merit of continuous delivery. The practice is widely used in business-to-consumer (b2c) space. Its principle has much in common with the culture of intelligent fast failures and reuses many techniques known from commercializing rapid innovations (Czerwinska-Lubszczyk et al., 2022). When we replace end user of digital product with business entity, the CD concept gets more sophisticated but still feasible to serve the go-to-market time requirement.

Networks fall under the classical, and legislative, definition of critical infrastructure. (Cybersecurity & Infrastructure Security Agency, 2020) identified 16 critical infrastructure sectors, telecommunication networks among them, which *are considered so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof.* (Presidential Policy Directive -- Critical Infrastructure Security and Resilience, 2013) called for actions to secure communications systems due to *the enabling functions they provide across all critical infrastructure sectors*. We found similar definition in (Communication from the Commission to the Council and the European Parliament - Critical Infrastructure Protection in the Fight against Terrorism, 2004). Regulatory requirements such as emergency call handling, network coverage, service availability, are all in the center of CSP operations. Commercial acceptance of major software change becomes highly restrictive process. This stands in opposition to continuous delivery concept as we know it from b2c products.

Network infrastructure is also at the forefront of companies striving for extreme automation and digitization. 4G and 5G allow building private networks for exclusive use by the enterprises. This trend prioritizes improved security and privacy for mission-critical communication.

The aim of this article is to review the studies which connect the realms of product engineering and managing its commercialization. At this point, it is hard to say if existing research base is enough to determine the recipe for industrializing CD concept in b2b environment of critical network infrastructure. In the next section, we will look at the research question supporting the goal. Next, the method will be presented describing repeatable data collection protocol, bibliometric analysis, and own model evaluating research activity of telecom software suppliers. The results will cover literature mapping and walkthrough of the most influential groups of literature. This will be completed by the analysis of research work affiliated with telecom software vendors. Discussion will highlight the focal points of the

analyzed literature set. Finally, we will point out limitations of this work and wrap up future research directions.

The originality of the material comes from looking at the scientific knowledge base through the prism of actors at the customer interface, i.e., stakeholders responsible for the ultimate delivery to the customer. Earlier literature studies focused on the applicability of CD models in product organizations.

1.1. Research question development

Continuous delivery is a long-established practice in software industry. Often, as in (Ståhl et al., 2017), it refers strictly to activities in research & development (R&D) department. Deployment to customer and release to end users happen afterwards (Johanssen et al., 2018) classified CD as the core element of continuous engineering. More holistic definition appeared in (Humble, Farley, 2010). The CD concept binds the phases of building, testing, and deploying, for the end goal of delivering software more frequently. Continuous delivery, whether defined as R&D process or a holistic delivery framework, is merged with technical, cultural, and management aspects of the product development organization.

RQ: We will ask to what extent the CD research invite non-engineering topics driving go-to-market strategies and operating models at the customer interface? This emerged from observing the disconnect between continuous delivery capabilities in product line, and the ability to commercialize such continuous value flow toward customer. Our context is the b2b nature of critical networks software.

2. Method

Bibliometric analysis was performed to cover large set of literature positions ranging in thematic scope (Donthu et al., 2021). Screening, inclusion and exclusion criteria, and data cleansing followed recommendations from (Barends et al., n.d.). Mapping and reporting, including use of tools, followed (Linnenluecke et al., 2020). The protocol was augmented with selecting publications affiliated with commercial software suppliers. This step, if executed in isolation, would have been highly biased and of little value. However, the goal was to verify if, and how, telco vendors invest in continuous delivery research. This method combined the realms of academic research and industry.

The search phrase had to be broader than the continuous delivery term to capture interlinked terms such as continuous release, deployment. Wildcards (*, $) are used to account for lexeme variations. Title, abstract, and keywords fields were analysed. Screening resulted in 9876 publications.

Timeframe was limited to last ten years (2012-2022). Oztemel & Gursev (2020) provided the synthesis of prior work, highlighting cloud computing as the key catalyst of new delivery models. Software-intensive projects and customer aspects were the focus thus software and customer phrases were explicitly included. Only proceeding papers, articles, and early access publications were filtered. Categories irrelevant for the study were excluded, leaving subjects of computer science, business, management, and operations research.

Table 1.
Data collection protocol

Web of Science		**Scopus**	
Search phase	**Dataset size**	**Search phase**	**Dataset size**
Initial screening			
("contin*s deliver*" OR "contin*s deploy*" OR "contin*s releas*" OR "contin*s exploration" OR "contin*s experiment*") (Topic)	4244	TITLE-ABS-KEY ("contin*s deliver*" OR "contin*s deploy*" OR "contin*s releas*" OR "contin*s exploration" OR "contin*s experiment*")	5632
Inclusion criteria			
2012-2022 (Year Published)	2649	PUBYEAR > 2011 AND PUBYEAR < 2023	3313
software OR customer (All Fields)	567	ALL (software OR customer)	1045
Document type: • Proceeding Paper, • Article, • Review Article, • Early Access.	566	Document type: • Conference Paper, • Article, • Conference Review, • Review.	1007
Language: • English.	561	Language: • English.	984
Exclusion criteria			
WoS Category NOT: • Computer Science (and all its subcategories), • Telecommunications, • Business, • Management, • Operations Research Management Science, • Engineering Multidisciplinary, • Multidisciplinary Sciences.	399	Subject area NOT: • Computer Science, • Decision Sciences, • Business, Management, and Accounting, • Social Sciences, • Multidisciplinary.	508
Merging and duplicates removal			
Data set size: 674			

Source: own work.

Web of Science and Scopus results were exported to BibTeX files, converted to xlsx format using the bibliometrix library of R Studio based on (Moral-Muñoz et al., 2020). Merging with duplicates removal was performed in R Studio. The output xlsx file was sent to biblioshiny for analysis and visualization.

The final WoS and Scopus queries, last row of Table 1, were modified by one more inclusion criterion to extract literature affiliated with major telecommunication vendors. The subset included publications associated with Ericsson, Nokia, Cisco, and Huawei. They are among the market leaders.

3. Results

The literature was dominated with conference papers (472 items), followed by articles in peer-reviewed journals (159 items). The ACM International Conference Proceedings Series along with The International Conference on Software Proceedings were the most used conferences, while The Information and Software Technology by Elsevir was the top peer-reviewed journal. Figure 1 presents the evolution of research space over time and its distribution across four major sources.

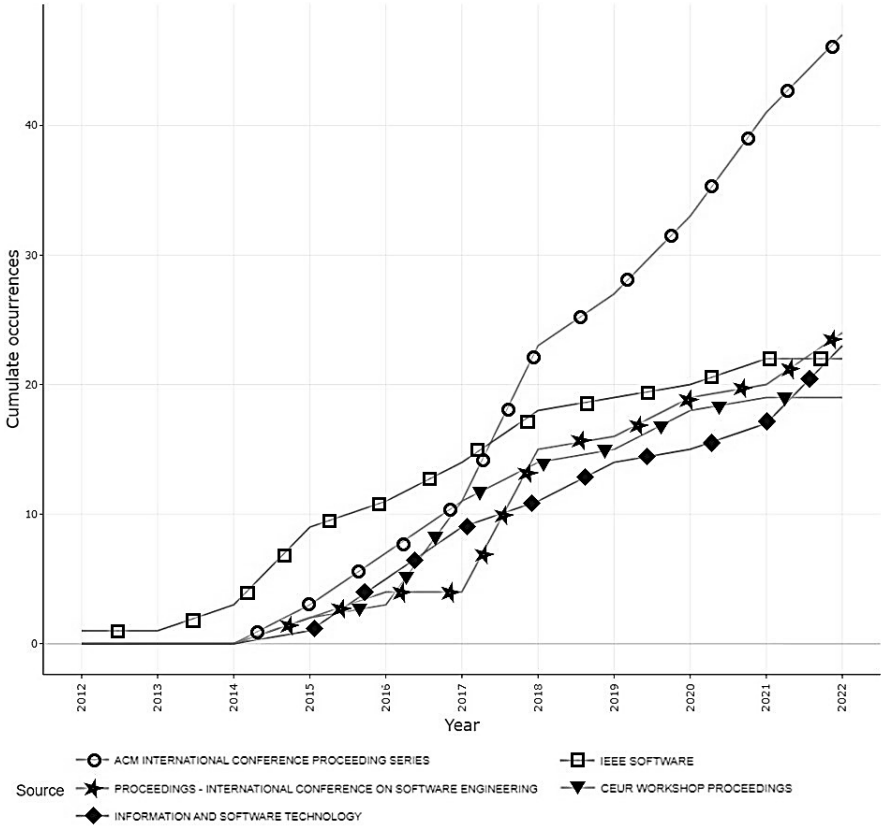

Figure 1. Major sources of continuous delivery literature.

Source: own work, biblioshiny software.

Jan Bosch, from Chalmers University of Technology, consistently co-authored high number of publications, most of which were the case studies with b2b and b2c companies. As illustrated on Figure 2, Helena H. Olsson was another key contributor and co-created much of the research with Jan Bosch. The two Swedish scientists leveraged proximity of large-scale software

organizations in automotive, telecommunication, and military defence sectors. The sequence of their most relevant work started with the Stairway to Heaven model (Olsson et al., 2012), the conceptual roadmap of transitioning software organization through the stages of continuous practices, from integration, to delivery, and experimentation. The EMFIS model proposed in (Martensson et al., 2017) defined a maturity assessment matrix. Its components were decided based on interviews with practitioners from automotive and telecommunication companies, Saab and Ericsson. An interesting detour from engineering practices was found in (Ståhl, Bosch, 2017). It proposed the Cinders framework which was the collection of recommendations for documenting, investigating, and communicating about continuous integration and delivery systems across the R&D organization. More recently, the group changed its focus to continuous experimentation practices. The HURRIER process in (Mattos et al., 2020) came from the case study in Ericsson. It provided actionable techniques in four groups of activities:

- Project management of incremental development in R&D organization resulted in better availability of the software product.
- Internal product verification ensured end-to-end quality.
- Early validation was restricted to single customer, carefully selected based on customer relationship.
- Final validation with multiple customers took place during gradual rollouts.

The HURRIER framework promoted early exposure to field issues and required customer feedback to be embedded in the process. It incentivized shorter cycles of continuous experimentation. Sceptics of such transformation should note that the case study took place in the R&D of 4G product, key system of critical network infrastructure. A holistic view, called the Controlled Continuous Delivery (CCD), was provided in (Dakkak, Bosch et al., 2022). It connected success probability of continuous delivery adoption with type of customer segment, and stage of product lifecycle. Only small group of innovators and early adopters was likely to embrace high-frequency continuous delivery. The CD practice was believed to be more business relevant in introduction and growth phase of product lifecycle. When product matured, or even declined (e.g., 3G), it became less appealing to push for short CD cycles.

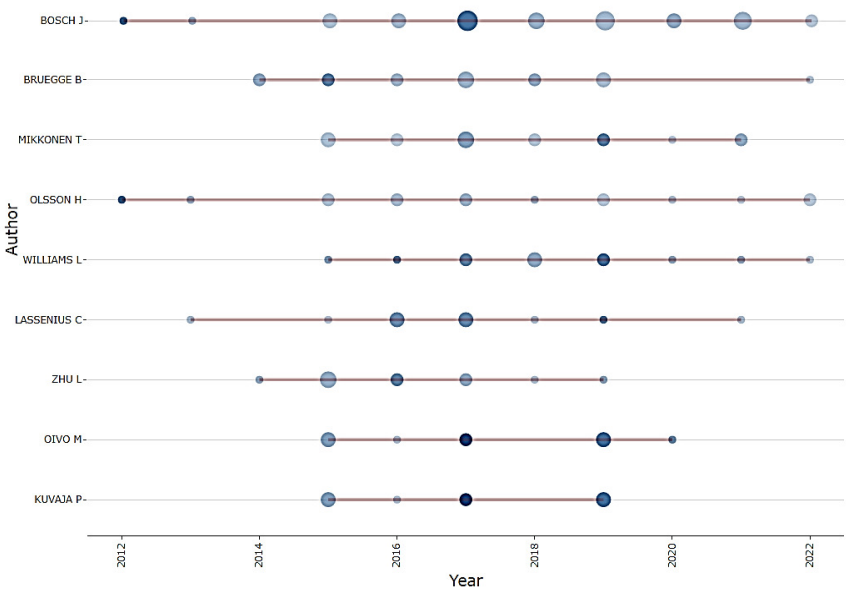

Figure 2. Publication intensity of the key contributors over time.

Source: own work, biblioshiny software.

The bulk of publications co-authored by Bernd Brügge was found less relevant in the b2b context. Higher education didactics, covered in (Alperowitz et al., 2016) and (Schmiedmayer et al., 2022), remains outside this review's scope but we should recognize its importance. Having young engineers experience CD way of working during student assignments, will likely ease CD adoption later when the graduates join companies or establish their own digital businesses.

Figure 3. Word cloud.

Source: own work, biblioshiny software.

A look at the word cloud on Figure 3 tells us that researchers see the DevOps concept closely related with CD. Its strong presence in the dataset deserves explanation. In (Debois, 2008), the author, by many considered the father of DevOps, called for a novel way of managing software projects by integrating infrastructure work (e.g., setting up the underlaying hardware) and operations work (e.g., supporting customer issues) into software engineering project. Today, popularity of the DevOps concept makes it more than obvious that there should be

a structured bond between development and operations. It was an emerging concept in 2008. (Leite et al., 2019) provided systematic literature review in four dimensions: people management, process and project management, product delivery, and engineering practices. The authors mapped multiple concepts associated with DevOps culture, walked through the toolset for achieving the required system architecture readiness, and pointed out implications to organizational management and operations research. The interlinking of DevOps and CD was evident in the definition developed by the researchers, i.e., understanding DevOps as collaborative and multidisciplinary effort which enables continuous delivery of high-quality software. (Claps et al., 2015) analysed not only technical but also social challenges when adopting CD. In that case study, the authors were convinced about the need for future research at the business level, to explore headwinds faced by customer during CD roll-out.

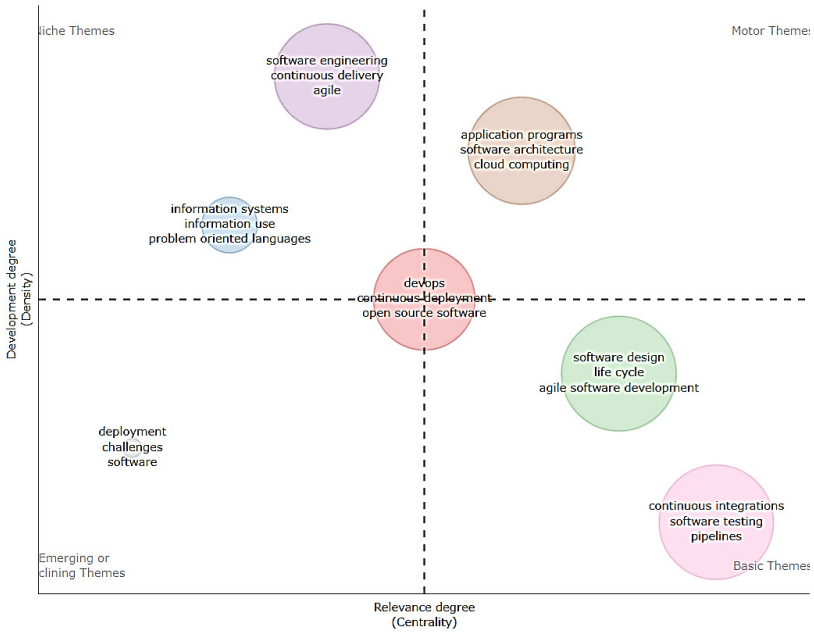

Figure 4. Thematic map of the degrees of relevance and development maturity.
Source: own work, biblioshiny software.

Figure 4 informs us about the relationship between thematic clusters, their relevancy and maturity. Centrality reflects the strength of relationships to other clusters. The higher centrality, the more relevant something is across the research space. There were three themes, with interaction to the rest of literature, stronger than the central devops cluster:

- Testing cluster made of continuous integration, software testing, and CI/CD pipelines.
- Design cluster with references to life cycle management, and agile project management.
- Architecture cluster including cloud computing, and software architecture.

The second dimension is the density which defines the strength of relationships within a thematic group. The higher density, the more developed and mature something is. The design and testing clusters were less mature (lower density) compared to the architecture theme as they presented more basic terms. We may think of them as enablers, therefore appearing in most of

the studies (high centrality). On the contrary, the architecture topic was classified as a motor theme because of its maturity (high density) and its relevance (high centrality). Software engineering cluster, including continuous delivery and agile, was the most developed group, but less relevant for the rest compared with devops cluster, including continuous deployment.

Twenty-nine publications were left after filtering for Ericsson-affiliated work. They were reduced to twenty after removing contextual duplicates i.e., follow-up studies which added nuance on top of the original work.

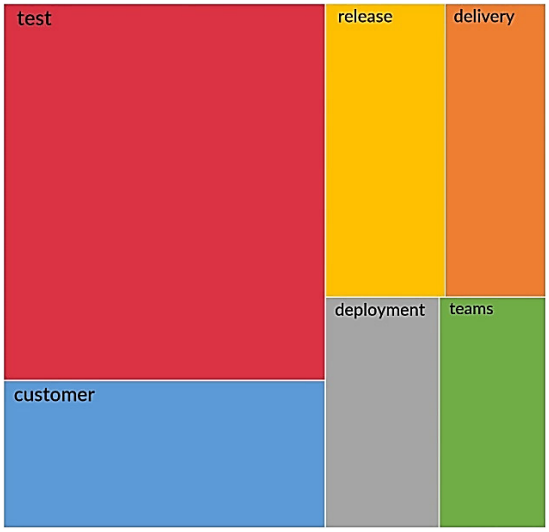

Figure 5. Heatmap of coding references in Ericsson-affiliated research.
Source: own work, NVivo software.

More than 60% of coded statements on **Błąd! Nie można odnaleźć źródła odwołania.** referred to testing, either exploratory with customer, or continuous integration. There was much focus on embedding exploratory tests in day-to-day R&D work by promoting session-based testing in development teams, and scenario-based testing with end users (Mårtensson et al., 2017). Not only it improved the understanding of requirements, but acted as a catalyst of frequent, short-cycle test rounds with customer.
That allowed cultivating continuous collaboration culture – important mindset element to start talking about continuous delivery. Publications related to managing testing activities created a sequence of proposals:

- The Cinders framework provided recommendations on documenting, investigating, and communicating continuous integration pipeline system across R&D (Ståhl, Bosch, 2017),
- The EMFIS model was a maturity model, evaluating state of continuous integration practices (Mårtensson et al., 2018). Any gap between developer's perception and process owner's assumption was especially valuable to the transformation leaders.
- The TAS model (Mårtensson, Ståhl et al., 2019) had its roots in a classical test pyramid. There are different stakeholders associated with each testing level (e.g., unit testing,

component testing, system testing). The model analysed their needs and recommended how to adjust stakeholder management with outputs from various test levels.

- The ExET framework (Mårtensson et al., 2021a) was about visualizing exploratory testing outcomes and driving the corresponding enhancements in large-scale software projects.
- The MaLET model (Mårtensson et al., 2021b) provided step-by-step guideline on improving exploratory testing through permission governance, competence development, results distribution, and collaboration.
- Finally, (Ståhl, Mårtensson, 2021) pointed out that the test automation cannot be seen as an end itself. The next level is to focus on the most strategic, impactful test suites, with continuous benefit-vs-cost evaluation. The authors recommended investigating corporate tensions which might hinder managing the organization in one direction.

Deep dive to coding references under *Teams* category, on **Błąd! Nie można odnaleźć źródła odwołania.**, tells us that *development* and *exploratory test teams* are the ones most covered by research. What follows next, i.e., *customer support team lead* and *cross-functional teams,* is the evidence of research efforts expanding into non-development areas.

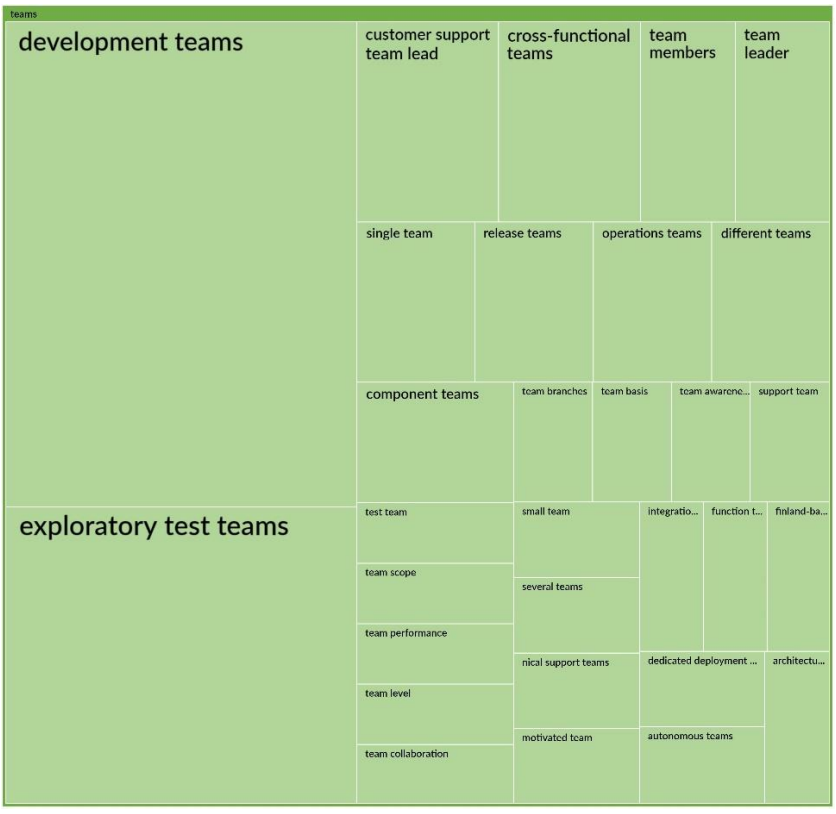

Figure 6. Heatmap of Teams codes in Ericsson-associated research.

Source: own work, NVivo software.

Table 2 presents the density of key coding references. Top five articles were the qualitative case studies performed at Ericsson. All except one were the interviews with practitioners.

Interviewees came from product line. In the most comprehensive campaign in (Mattos et al., 2020) the researchers interviewed customer solutions manager, specialist typically part of sales or pre-sales. All top five articles studied Radio Access Network product which is a common characteristic with the rest of Ericsson-affiliated literature. (Mårtensson et al., 2021a) provided the most mature structure of continuous delivery governance for all three mobile network generations, i.e., 3G, 4G, and 5G. It is also one of the few publications that augmented qualitative study with quantitative data. Performance indicators informing about CD process were analysed along with quality management metrics such as the number of defects at various development and delivery phases. According to the authors, customers willing to experiment with new features, early in the product lifecycle, had the highest chance of successful continuous delivery adoption. There were two other dimensions critical for CD transformation: risk management (e.g., managing deliveries in a limited low-risk network cluster, often called CD zone), and engineering excellence (i.e., development organization producing high-quality frequent software candidates for immediate delivery to the CD zone).

Table 2.
Number of coding references in Ericsson-affiliated literature positions

Item	Coding references					
	Customer	Delivery	Deployment	Release	Teams	Test
(Dakkak, Munappy et al., 2022)	33	2	8	10	5	1
(Issa Mattos et al., 2021)	19	1	8	10	3	7
(Mattos et al., 2020)	17	0	6	4	4	5
(Dakkak et al., 2021b) :	11	3	9	2	5	.5
(Dakkak, Bosch et al., 2022)	10	1	15	17	1	6
(Kasauli et al., 2017)	9	2	0	1	2	3
(Klotins et al., 2022)	8	15	1	5	0	13
(Dakkak et al., 2021a)	7	3	5	5	3	1
(Çalikli et al., 2018)	6	3	0	21	0	28
(Ståhl et al., 2016)	1	7	1	2	0	3
(Mårtensson, Ståhl, et al., 2019)	1	4	2	3	3	49
(Ståhl, Mårtensson, 2021)	1	3	3	3	0	29
(Ståhl, Bosch, 2017)	0	17	2	1	2	7
(Ståhl et al., 2017)	0	4	8	7	1	5
(Mårtensson, Stahl et al., 2019)	0	2	0	1	6	0
(Mårtensson et al., 2021a)	0	5	1	1	1	20
(Mårtensson et al., 2018)	0	4	2	3	9	21
(Mårtensson et al., 2017)	0	1	1	0	10	54
(Mårtensson et al., 2021b)	0	4	0	2	6	74

Source: own work.

Four articles were associated with Nokia Bell Labs, the telecom vendor's research arm. Two of them focused on security aspects during deployment phase (Martin et al., 2018; Combe et al., 2016). They analysed new attack surface introduced by deployment automation tools such as Docker, broadly used in CI/CD systems. Mijumbi et al. (2018) presented a model for predicting number of defects from the patterns of story point completion. Practitioners however may find such models too academic, and hard to apply in real-world software projects. Grohmann et al. (2019) proposed a machine learning model deriving application KPIs from

platform KPIs. While those topics brought value to R&D, they did not connect with customer or commercial aspects of continuous delivery.

4. Discussion

We studied large set of academic work on continuous delivery with steady inflow of new publications. Industry practitioners are supported with non-scientific literature as well as plethora of academic papers, often published in collaboration with business. Systematic analysis revealed most of the work to be centered around variants of continuous engineering practices: continuous integration, continuous testing, continuous experimentation, continuous delivery. When they are put in use in product development organization, they form iterative sequence of managing software production: building, testing, deploying, releasing, and delivering. Such value stream depends more on the R&D culture than organizational productivity. This is why the research was highly coupled with Agile methodologies and DevOps culture, while there was little to no connection with operational phenomena at the customer interface. Both Agile and DevOps are critical forces shaping product line organizations of today and enable adoption of CD. This work however is put in the context of b2b delivery of critical network infrastructure products. In this case, R&D organizations rarely deliver their output directly to customer, and they may have limited knowledge about operating their product in the field.

We saw the language of literature dominated by the terms familiar to product development managers and experts. This implicates that the insights were skewed towards engineering processes and R&D organizations. Table 3 provides an exemplary mapping, which I developed in the course of data analysis, to quickly gauge whether an article was anchored in product development topics (e.g. engineering practices) or in business aspects (e.g. pre-sales, sales, services, customer relationship management).

Table 3.
Product line (R&D) and business teams speak different language

	Product line	Business teams
Mindset	– Agile, – DevOps.	– Go-to-market strategy, – Value-based selling.
	– Engineering challenges (e.g., feature development).	– Customer opportunities (e.g., upselling).
Project management governance	– Continuous, – Program management, – OPEX & CAPEX planning.	– On-demand, – Project management, – Topline and sales margin quality.
Tools, systems	– Customer environment configuration, – CD pipeline.	– Type of customer environment, – Digital delivery.
Practices	– Requirements engineering (system engineers).	– Customer engagement (technical pre-sales).

	– New product introduction, – Fault management.	– Customer acceptance, – Care services.
	– Release, – Deployment, – Delivery.	– Planning services, – Deployment services, – Integration.

Source: own work.

In the analysis phase, we talked about multiple models for managing continuous engineering flavors in product development organization. Those, derived from in-depth interviews and case studies of b2b large-scale software companies, provide actionable frameworks for R&D transformation leaders to drive continuous delivery adoption, at least in product line.

RQ: to what extend does the concept of continuous delivery invite non-technical, non-technological aspects which drive the actual delivery to customer? This review shows that the continuous delivery concept is considered mainly an engineering practice. It is true for the wide set of literature as well as publications associated with critical infrastructure vendors. On the other hand, the state of CD in telecommunication software projects suggests we may need to do things differently, to drive its adoption. To build upon existing knowledge base, new research should ask how to connect product development organizations, already fluent in continuous delivery practice, with customer frontend. Most recent academic work starts shifting in this direction.

5. Summary

We reviewed the state of academic work on continuous delivery in the context of critical infrastructure. Telecommunication sector requires software products of high architectural complexity, consisting of many interdependent subsystems, delivered from software vendor to communication service provider in b2b relationship. We started with three dimensions of criticality in network infrastructure. Requirement for agility drives shorter go-to-market time in consumer segment, giving CSPs competitive edge with higher throughput, better voice call quality, and new 5G services. Public safety and regulatory institutions pay extra attention to network reliability (e.g., five-nines availability). Security and privacy are the key business themes for enterprises interested in private network solutions (e.g., factory automation, campus networks).

Number of publications dictated the use of bibliometrics technique. First, we looked at the relevant body of knowledge retrieved from Scopus and Web of Science. The second part was to deep dive to academic work associated with telecom software vendors.

We looked at the literature review output through the lenses of author's professional experience. The focus of academic community has been on excelling continuous delivery

practices in R&D. This is absolute pre-requisite to have product development capable of delivering high-quality software packages in short cycles. Handful of studies touched upon the processes associated with customer support, or product management. We concluded that engineering practices, increasing the chances of successful CD adoption, were comprehensively covered. Researchers may now pivot to specific types of software products (e.g., autonomous vehicles, intelligent electricity grids, telecommunication) and what it takes to enable continuous delivery in those b2b digitalization segments.

Future studies could develop in two directions. More questions about customer interface will be useful. That means targeting pre-sales, sales, market teams, and the corresponding practices, roles, organizations. Cross checking new findings with established opinions of the product development community could reveal gaps in end-to-end operating models.

Models and recommendations, which we discussed, were mostly based on case studies. Scientists with access to industry could increase the quality of research by employing qualitative methods such as in-depth interviews and focus groups. Quantitative analysis will require access to sensitive corporate data (e.g., installed base information, business value behind product features, go-to-market time). Data completeness, due to lack of systematic data collection mechanism in place, may limit its use. In this case, even partial data models could enrich studies which typically miss measurable outcomes.

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EVALUATION OF A3 TOOL IN THE PRODUCTION PROCESS

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Purpose: The purpose of the research is to verify the A3 tools in terms of its use for various production problems.
Design/methodology/approach: There is still little research on A3, so further research in this area is essential. Therefore, any additional research in this area is necessary. The research methodology results from the principles of using the A3 tool in enterprises. The A3 tool was used for various problems of the surveyed enterprises. One problem in the form of a case study is also shown: description of the problem related to the production process and the A3 tool was used.
Findings: The use of A3 tools in the direct contact production process was presented and evaluated six A3 reports that were carried out in three production companies over a period of 1.5 years. The findings are as follows: 50% of reports were successfully closed, objectives met and all actions performed on time. 33% of the reports showed moderate effectiveness, i.e. one of the criteria was not met. 17% are low-performing reports.
Research limitations/implications: More research into and refinement of the A3 tool is being considered in future research directions.
Practical implications: The presented results have an impact on enterprises. They allow for more holistic management and dealing with complex problems. Work is more standardized.
Originality/value: The value of the work is the assessment of the effectiveness of the A3 tool based on four criteria. The indicated and effectiveness assessment criteria also allow for a structured process of educating company employees in solving problems. The article shows the economic and business dimensions of the conducted research.

Keywords: A3 tool, case study, production process.

Category of the paper: Research paper.

1. Introduction

The A3 report constitutes a tool for solving problems of various range, and it can apply to many areas of the company business. The tool is based on Deming's PDCA cycle – plan, do, check and act with the purpose of an improvement. The report should be concise and contain the most important information derived from the analysis of the company's problem. Over the years, the report has undergone evaluations. Its format and PDCA steps have remained unchanged, while the form and notation itself differ depending on the sources or the needs of the enterprise. It is possible to upgrade the report to match the demand of a specific enterprise (Mydlarz, 2018). This can be seen in the examples of tests carried out using the A3 methods: A3 reports were included in the process improvement project in aircraft maintenance and repair operations (Chakravorty, 2009) and the possibility of using the search method and effective implementation of green innovations in the industrial transport of the company (Lenort, Staš, Holman, Wicher, 2017).

The key issue in the A3 report is to effectively go through the designated steps – find the root cause, eliminate it by means of appropriate means and supervise and correct it if necessary.

Today's manufacturing companies face many complex problems. However, the term problem should be understood here as the potential to improve staff skills, as well as eliminate losses, and thus gain a number of business benefits. In order to properly achieve the above benefits, it is most reasonable to use ready-made, effective solutions that guarantee an achievement of the intended goal. This is what the A3 tool allows for – it indicates the right way to proceed, assuming that the user understands each of the steps of the method. According to research (see Piasecka-Głuszak, 2014), the A3 tool is used by 47.22% of respondents. Almost half of them, i.e. 22.22% are large enterprises, followed by very large and medium enterprises.

The article focuses on the use of the A3 tool in an automotive company for a selected production problem. There was also a polemic on the effectiveness of the method, and in particular on the identification of certain practical principles that increase its success.

2. A3 as a narrative from problem to solution

The A3 tool was created at the Toyota factory. It owes its name to the size of a sheet of paper – A3 with dimensions of approximately 297 by 420 mm that includes all information about the problem that is reported: from the goal, compiled with the purpose of looking for the cause and introducing corrective actions as well as validating the implemented solutions. The A3 report was intended to be a clear checklist from the emergence of a problem to its

resolution, which indicates that it is a comprehensive tool. The A3 report is referred to as (https://leanpartner.pl/raport-a3/, 2022):

- a reporting table or a report using the PDCA cycle,
- a mental process occurring throughout the solution of a problem,
- an interaction between the owner of a problem and rest of organization aimed at solving the problem by adopting a common language and understanding.

Shook (2012) even mentions the process of managing through learning according to A3 rules. Thus, A3, in addition to the problem-solving function, has a much broader role, e.g.:

1. Developing employees' competencies – the activities emerging in the process often require the group to engage, analyze on an extensive scale, use common skills and cooperate in developing a satisfactory solution that meets the goal. It develops competences of discussion, compromise, broad view of the process and problem, imagination, presentations in projects and also work on data.
2. The A3 report provides information between people from the group solving the problem and other employees – managers, executives (Kołodziejczak, 2020; Żmigrodzki, 2021).
3. An important role is attributed to A3 tools in supporting knowledge-based design, including the creation of enterprise products (Mohd Saad, Al-Ashaab, Maksimovic, Zhu, Shehab, Ewers, Kassam, 2013).

The idea of a report emerged as a method that combines two important management processes: hoshin kanri (strategic management) and a problem solving aapproach. On the macro-scale of the enterprise, hoshin kanri leads to the setting of operational goals and activities in accordance with organizational goals of a higher order, on the micro-scale, at the individual level, the formalized process of solving problems offers an organization the possibility of continuous learning. The A3 process combines both of these scales (Shook, 2012, p. 3).

The structure of the tool is clearly defined. Figure 1 shows a sample A3 report. As you can see, it is divided into several sections, which is characteristic of this method. Each section and its number plays a key role in the method. By following the order of the digits, a suitable way of solving the problem is possible. The fields direct the user what to do in each step, allowing for free transition to the next tools such as 5why, process map or Ishikawa diagram.

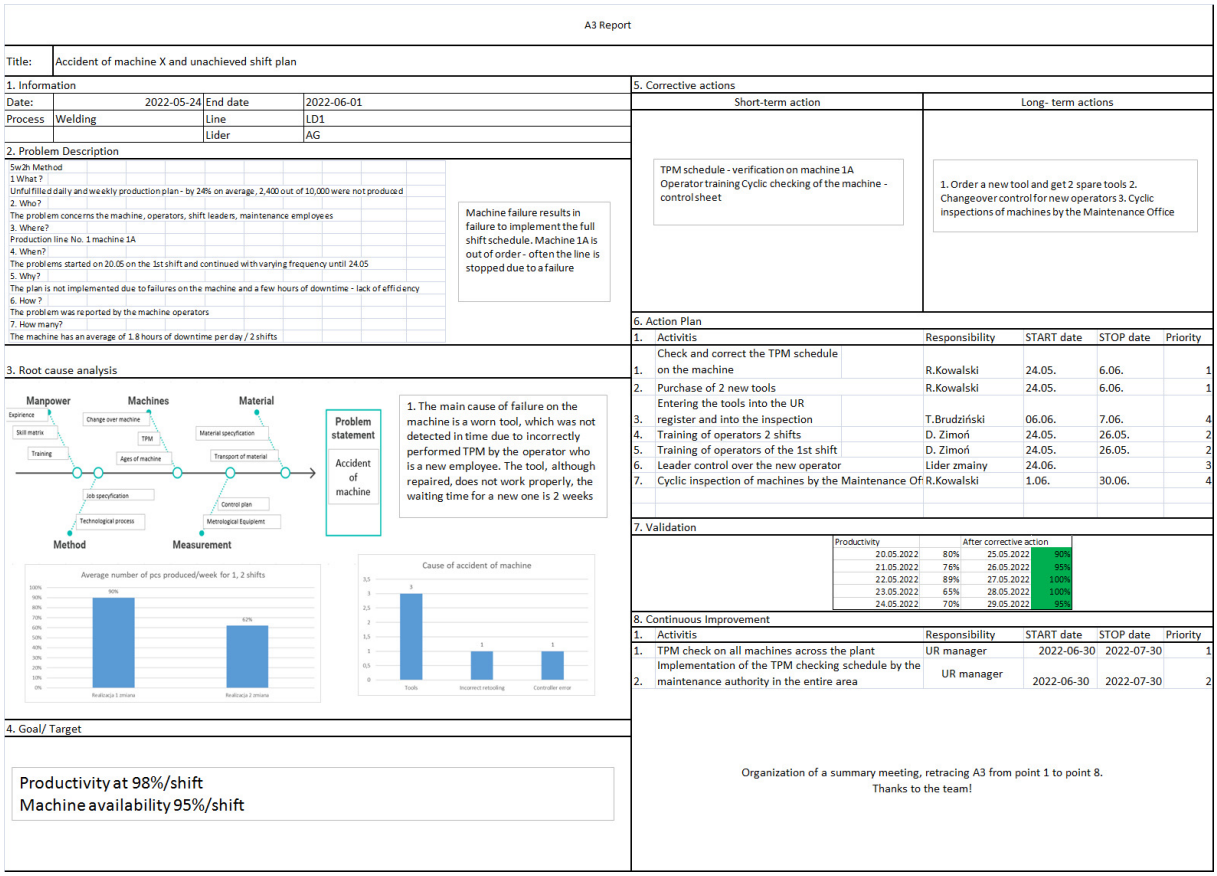

Figure 1. Example of the A3 report.

The steps in the A3 tool are the folowing (Dobrowolski, 2021; Mydlarz, 2017; Sobek, Jimmerson, 2004):

1. Information - i.e. the most important information about the examined problem in terms of: process, area, start date of A3 and the person of the leader.
2. Description of the problem – this is the information that the group has at the time of starting the activities – what, when, how a problem initiated happened, what are the outcomes of the problem. This step utilizes the 5W2H method.
3. Root cause analysis - one of the most important points in the report. All kinds of analysis and observations should be made in this section. Tools such as the Ishikawa diagram, 5why, process map, brainstorming are utilized for this purpose. The output from this section provides insight into the root cause of the problem, which, when properly identified and removed, offer the means to permanently overcome the problem.
4. Goal – as each project, activity serve a purpose, and this is also the case with the report. After defining the root cause, a goal should be set - measurable and clear for the whole group, often consulted with top management. The goal may eliminate the cause completely, but it is worth taking into account the cost of such elimination, often the focus is on bringing the problem to the lowest possible negative impact, because elimination is associated with a large financial outlay that the management may not be able to afford at the moment.

5. Corrective actions – both short - and long - term – both types of action should be implemented. Short - term actions, i.e. preventing the recurrence of a problem; the simplest available methods, which last for a short time, because they will be replaced by long-term actions - more expensive, requiring more organization and commitment, but they are effective and meet the previously set goal.
6. Action plan - tasks should be properly assigned and supervised. Therefore, in section six, there is a list for recording specific actions along with the planned implementation dates and the responsible person.
7. Monitoring - supervision of progress in the report, implementation of activities, updating statuses and progress towards the goal. Monitoring should be done by the A3 leader.
8. Improvement and conclusions – following the diagnosis of the actions that were implemented, it is time for revision and summary. The group asks itself questions about what has been implemented successfully and what needs improvement both in the implemented solutions and in joint work.

3. Application of the A3 tool in the production process based on a practical example

3.1. Production process problem description

The process consists in installing components inside a twin-tube shock absorber. A recurring problem led to considerable levels of scrap at the end of the process. The gasket applied to protect the interior of the shock absorber and does interface properly with each element, which affects the efficiency of damping during the operation of a shock absorber. The fault is irreversible, so losses are generated that cannot be repaired.

3.2. Application of the A3 method for the problem: high level of scrap cause by a defective gasket

The A3 methodology begins with a meeting attended by the staff affected by the problem – i.e. the region's manager, process and quality engineers, the leader of production, a maintenance worker and a third party, usually an employee from the LEAN department. During the initial meeting, the first two points from the A3 report were compiled – *Problem identification and description* – in this case it was: the level of scrap shown in the chart, photos with defects on the shock absorber, customer complaints and reports regarding the stalled production on the line due to incorrect gaskets. All information was recorded by application of the 5W2H tool. At the first meeting, a series of meetings and the time frame for A3 should also be agreed.

Then, a brainstorming session was carried out in the group was in order to answer the question: “What do you think causes damage to the gasket?”. All potential causes have been placed in the Ishikawa chart in appropriate places. The group then proceeded to GEMBA – the source of the problem – to write down the ideas that would come up while observing the process.

The following step involved categorizing the potential causes into three categories of impact: large, medium, and small. Later, it was checked whether the indicated causes are well protected from the point of view of the production system. The time of data collection and analysis usually takes the longest time among all steps.

Once we are familiar with the root cause or several causes responsible, the time has come is to define the goal. This is the right moment for this action, because on the basis of available analyzes it is possible to estimate whether the problem is large and how much resources it can consume. In this case, the goal was to reduce the monthly scrap to 0.02 per problem – faulty gasket and zero reported complaints from the customer. The root cause turned out to be an non-conforming tool applied in the machine. The tool was purchased several years ago. The problem was not detected because the machine was operating properly, no errors were noted in the system, and what's more, TPM (Total Productive Maintenance) was performed suitably, i.e. one of the elements of lean manufacturing, whose task is to ensure maximum availability and efficiency of the production equipment owned (machines and devices). Introducing a new range of shock absorbers, seemingly similar to others, the tool required modifications and changes in the parameters of the machine. In the subsequent stages, on short and long term actions need to be performed. The following short-term actions have been identified:

- short-term production halt of the parts listed on the assortment that included the gasket,
- operator training with regard to the adequate TPM on the machine,
- reporting all problems on the specific machine that was used to install the gasket.

Long-term actions include designing and purchasing the correct tool, adding a new program to the machine and installing sensors that provide a warning in the future in case the tool does not fit in a given shock absorber model. Changes have also been performed to the documentation for new launches in order to check and confirm that all parts of the machine are compatible with the specific shock absorber. The process engineer and the maintenance engineer were identified as responsible for the original analysis. The dates completion and have been identified and responsible individual agreed. The implementation of the longest task was estimated at 4 months.

Until the completion of the final task, the schedule of short-term actions was followed. The team leader met on a weekly basis to check the condition of the machine and the verify the progress of the operators. The leader monitored and communicated to the team the implementation of the goal, which indicated a decreasing trend in the amount of scrap and a 0 level of complaints counting from the moment of implementation of the action. After 4 months, a new tool and sensors were installed and training was carried out.

Finally, the assumed goal was achieved. A point of checking the operator's knowledge regarding the damaged gasket, causes and actions taken, as well as TPM verification, was added to the layered audits.

The last step was a final meeting with attending the top managers where a summary was offered to the whole team, based on the A3 report, so that the story with the gasket could be traced and the path the team took to achieve the assumed goal. Each step in the project was recorded in the A3 report by the leader (Król, 2021).

4. Evaluation of effectiveness of A3 tool in the process of problem solving

4.1. Evaluation criteria

The application of the A3 tool for the problem specified above turned out to be the correct approach – as the goal was achieved, and the problem was successfully solved. However, this is not always the case. During the process of solving a problem with A3, we may have to do with many obstacles, such as in the case when the problem that is too complex, a solution that consumes too many resources – it is unprofitable, the staff fluctuations occur. The effectiveness of the A3 report in the problem-solving process can be considered in the following categories:

- establishing the root cause,
- goal fulfillment,
- implementation of the action plan,
- problem solution within a given period.

From a business point of view, these are the four key tasks in the A3 method.

1. Establishing the root cause is defined on the basis of binary criterion: 0-1, i.e. “YES” or “NO”. When it is known that the root cause has been found – in such a case after the corrective, long-term actions are introduced, the goal is fulfilled – the problem should never appear again.
2. Goal fulfillment – it is defined as – “yes” or “no”, i.e. also the criterion: 0-1; specific information should be given as to why the objective has not been met.
3. Implementation of the action plan – defined as “yes”, “no”, as well as “partly achieved”, i.e. – 0.1 or 0.5. There are two cases of implementing a partial plan – the profitability of actions or external factors over which no one has any influence. The final decisions are most commonly carried out by the chief managers, as they base their decisions on reliable data prepared by a team headed by a report leader. The action plan directly affects the implementation of the goal.

4. Solving the problem within a given time frame – it can be defined as "yes" or "no", which also uses the binary criterion: 0–1. Often the implementation depends on external subjects, therefore the time of resolution may be postponed. If A3 cannot be completed in time, this should be supported by specific reasons.

Table 1 presents details of the effectiveness of the A3 report, taking into account all the criteria along with external risk, such as: lack of availability of raw materials on the market, closing of companies that support the infrastructure in a given enterprise, low profitability from operations, staff changes affecting the implementation of the goal established in the report (Sułkowski, Wolniak, 2013).

Table 1.
Criteria of effectiveness of A3 report

Criteria of effectiveness	YES (1)	NO(0)	PARTLY(0.5)
Establishing root cause	1		
Goal realization	1		
Implementation of action plan	1		
Solving the problem in a given time frame	1		
Total	4		
Total in %	100%		

4.2. Evaluation of effectiveness of A3 report for high scrap level caused by the faulty gasket

A summary of the evaluation criteria can be found in Table 2. Table 2 presents the details of the effectiveness of the A3 report method for the problem analyzed earlier: high level of scrap generated by the faulty gasket installed in the shock absorber.

Table 2.
Effectiveness of A3 report

Method effectiveness	
High effectiveness	100% - 80%
Modertate effectiveness	79% - 50%
Low effectiveness	below 50%

The requirements specified in the report were fulfilled, short - and long - term activities were executed within the agreed time frame, without major complications from the outside and the management's disapproval of profitability. However, in most cases there are major or minor issues involved. Table 3 evaluates six A3 reports that were carried out at three manufacturing companies over a period of 1.5 years. The ranks of the problems as well as the goals were varied.

1. A3 P3/P4 – two A3 reports related to high failure rates of machinery at two different production centers. An attempt was made to solve the problem using method A3, due to the complexity of the problem. Failures occurred at unique moments of operation, regardless of who operated it and what assortment was produced (serial production). The failure rate led to a decrease in productivity, and thus unmet customer orders – and the resulting losses that were generated. The group working on the issue included individuals directly involved in the process as well as engineers and specialists from the maintenance department. A3 followed two paths – the problem required immediate action as well as the complete elimination of the root cause, which had to be found. In P4 the problem was revealed to be so complex that the production was moved to another machine, for which the workshop immediately added tools for a specific assortment. Thus, the occupancy on the next machine was too high, work was started on weekends, as a result, 100% of the production plan was not provided at the output. It was one of the key actions to stem the problem. The root cause could not be estimated to a 100% extent since the machine was so old and worn that the external service was unable to clearly determine the reasons responsible for so many failures in various places on the machine. The management decided to purchase a new machine, but the waiting time after the pandemic and the long waiting time for parts turned out to be long: 3-4 months of machine production and time for validation and training. As a result, all steps A3 were performed, the involved team worked to resolve the problem, but the machine could not be restored to its original state. The production plan could not be implemented even in 70%, which resulted in the cancellation of orders and a financial penalty imposed on the company. In A3 stage P4, the assumed action plan was implemented, while the project was postponed due to parts that had to be re-designed and ordered. Ultimately, the production plan was generated, failures were removed and normal productivity was restored.
2. A3 P2 – in this case of A3 analysis, the problem was related to the high level of quality errors that were revealed at the stage of final inspection on the assembly line. The project started in a standard way: the team was assembled, data collected, the Ishikawa diagram was produced and the area with the greatest impact was determined, followed by the stage of verifying the points indicated in the Ishikawa diagram began. The main reason was the lack of repeatability of the operations performed on the assembly line. After presenting the results of the first analysis and brainstorming in the team – what actions need to be taken, the management stopped A3 when it was already known at this stage that it was necessary to purchase new software to supervise the operator's work and force a specific step to be taken. As this turned out to be a very expensive project, the company could not afford such an expense. The documentation and the A3 report were saved, activities were suspended until further notice.

3. A3 P5/P6. The reports related to less serious problems than the above, they were a related to a need to decrease the level of scrap on a given range of products. Finally, the problems turned out to be eliminated quickly – as the root causes were: low awareness of operators, mainly foreigners - lack of records in the training matrix (what the training of new employees should look like), lack of complete documentation in different languages and a new foreman who did not control the level of scrap. The activities were limited to training, supervision over employees who do not speak fluent Polish, in some places substitute employees were needed. As a consequence of this, they increased their skills in the skill matrix. The foreman was given clear guidelines on their responsibilities. The action plan was divided into smaller tasks with a relatively short execution time, not everywhere it was possible to complete the tasks on time. In particular, where provisions standardizing the process were added – approvals had to be gained from all departments and corrections were to take a long time, but it is necessary according to ISO 9001.

In summary: where the goal is achievable (the company can afford various solutions, is open to new technologies, implement changes) A3 constitutes a very suitable tool. The problem arises when, in the analysis, the root cause turns out to be a big problem that the company is unable to ”overcome” issues such as lack of resources, inexperienced employees, reluctance to a different concept, etc. A3 is executed correctly, according to the assumption, but it cannot be rated high when the goal cannot be achieved. Often the work that needs to be done in connection with the analysis of facts, observations, meetings, supplementing the report turns out to be partly a waste of time - the only benefit is to obtain data and draw conclusions – the root cause, but the problem will not be solved, it has not been implemented purpose.

Table 3.
Effectiveness of A3 method - evaluation

Reports	A3 P1	A3 P2	A3 P3	A3 P4	A3 P5	A3 P6
Effectiveness of methodology	100%	25%	88%	63%	75%	88%

Figure 2 presents the details of assessment of the effectiveness of the A3 tool based on 6 reports prepared over 1.5 years for 3 different companies. 50% of reports were successfully completed, assumptions were met and all action plans were executed on time. 33% of the reports showed moderate effectiveness, i.e. one of the criteria was not met. Most often, these were not performed all activities or exceeded the time of task implementation, most often for external reasons. On the other hand, 17% reports were performing poorly. These were those in which the root cause was not found correctly, and thus the problem was not solved correctly (the goal was not met), despite the fact that the long - and short-term action plan was met.

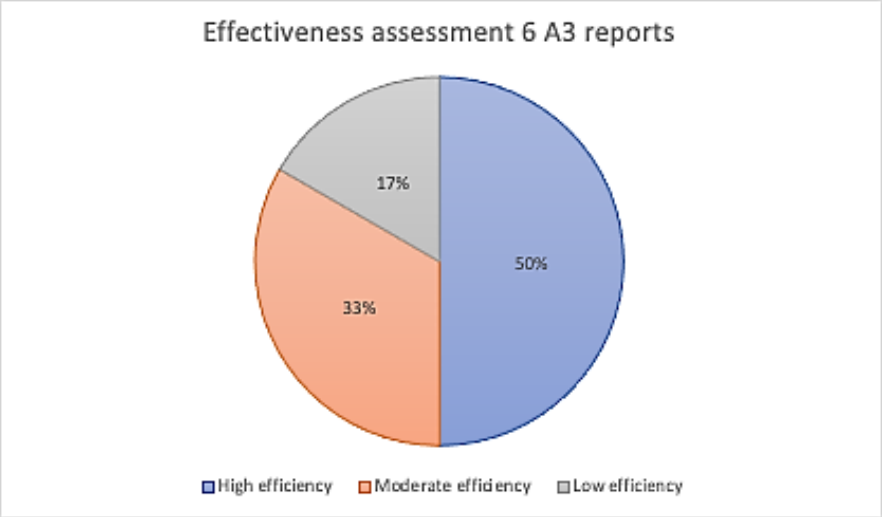

Figure 2. Assessment of effectiveness of A3 report in per cent.

5. Conclusion

The article reported the study concerned with introducing the principles of using the A3 tool, and presented a problem faced by a company that was solved using this tool. The assessment of the effectiveness of the tool formed an important element of the article. Therefore, the effectiveness of the implemented changes can be said if the progress is properly monitored. The effectiveness of the action should be visible in process indicators. Achieving an improvement in a short time does not prove anything - only the improvement of the process parameters in the longer term may indicate that the changes actually brought the expected result and translated into an improvement in the quality of work (the so called *Voice of the Process*) (https://3iconsulting.pl/blog/raport-a3/, 2022). This will also allow you to build a learning organization and present the resulting project in teams as part of the Lessons Learned process. This leads to the A3 template being useless without thinking (Flinchbaugh, 2012). The strength of the A3 report comes from the mindset required to implement A3 (Sobek, Smalley, 2008). Understanding thinking according to A3 offers the means to investigate the tool broadly and promote actions based on adequate procedures that include its use. The indicated and discussed effectiveness assessment criteria also allow for a structured process of educating company employees in solving problems.

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MARKING OF ESCAPE ROUTES IN MINING EXCAVATIONS – RESULTS OF PILOT TEST

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Purpose: The publication cancers one of problems related with safety in mining industry - the marking of escape routes in mining excavations. A review of literature on the subject and applicable legal regulations and standards, and authors' study on the subject covering use of color-lighted signs created by them are presented.
Design/methodology/approach: Literature studies were conducted: 1) to identify methods and findings in researches on marking of escape routes, described in scientific publications; 2) to define the requirements set out in legal acts and standards. The field study of the marking of escape routes was carried out in a training mine gallery in which there are conditions reflecting the real ones in underground mining excavations. The observations and questionnaire research were conducted during a training of a group of 20 professional mine rescuers. The following variables were set for the experiment: distance (5, 10 and 15 m), color (white, green, blue, red), shape (square, arrow).
Findings: The article presents the results of pilot test in the field of the marking of escape routes in mine excavations. Different colors and shapes of the signs, and different distances of observation were taken into account. White color was found best to assure signs detectability but least appropriate if shape identification is required. Red and green colors were indicated as recommended if the shape identification is the evaluation criterion.
Research limitations/implications: The research was dedicated to the underground mining industry, but can be adapted to other working sites where the evacuation takes place in similar conditions (lack of visibility and smoke).
Practical implications: The research revealed among others that: 1) Polish regulations do not imply detailed rules as regards signage of escape routes in underground coal mines, which gives floor for development of new concepts and designs, 2) it is possible to propose color-lighted signs for effective marking escape routes in underground coal mines.
Originality/value: The publication contains the original results of pilot test in the field of the marking of escape routes in mining excavations, and they can be addressed to persons managing mining plants and managers of mining supervision authorities.

Keywords: safety, evacuation, escape routes, underground mining, mine rescue.

Category of the paper: research paper, general preview.

1. Introduction

Depending on a hazard that occurred at a workplace, evacuation might be necessary. Proper marking of escape routes with signs indicating the way and exits is crucial for effective evacuation and thus saving people's health and lives. Design (features) of signs used and their placement are among factors that affect wayfinding during evacuation. Visibility of signs has to be assured in all foreseen conditions, including poor light, lack of light, presence of smoke.

Signs dedicated for marking of escape routes are classified as 'safety signs', and the later ones are covered by regulations, standards and guidelines at national, European and international level.

Standardization of safety signs is a subject of: ISO 7010:2019 (introduced in European Union as EN ISO 7010:2020, in Poland as PN-EN ISO 7010:2020) in which safety signs for the purposes of accident prevention and fire protection are prescribed; ISO 3864-1:2011 and ISO 3864-3:2012 in which relevant design principles (applicable also for developing new safety signs) are established. The assumption followed by the standards developers was that when there is risk to people, both under ordinary circumstances (e.g. carrying out work in conditions typical for a given workplace) and during emergency situations (e.g. occurrence of fire), providing safety information that relies as little as possible on the use of words, contributes to people's safety due to quick understanding of the information conveyed (PN-EN ISO 7010:2020, Introduction). In these standards, the following definition of 'safety sign' (established in ISO 17724:2003) is applied: a sign giving a general safety message, obtained by a combination of a color and geometric shape and which, by the addition of a graphical symbol, gives a particular safety message.

In standard ISO 16069:2017, rules regarding location of safety signs are established. E.g., following the rules, low evacuation signs are placed on the floor or slightly above the floor, while high evacuation signs are placed at the ceiling height or no less than 1,8 m from the floor level.

Obligation of employers to provide safety signs where hazards cannot be avoided or adequately reduced by preventive measures or procedures used in the organisation of work is established by a directive on the minimum requirements for the provision of safety and/or health signs at work (Council Directive 92/58/EEC). In Poland, obligation to use safety signs is stated in a regulation on general occupational health and safety regulations (Rozporządzenie Ministra Pracy i Polityki Socjalnej z dnia 26 września 1997 r. …). According to §6 of this regulation, places in the workplace where there are hazards to workers should be marked with visible colors or safety signs in accordance with the requirements set out in Annex 1 of this regulation and in the Polish Standards. Examples of the requirements established in the Annex are:

- safety signs (classified into groups: prohibition, warning, mandatory, escape and information signs) should be used as permanent signs (§4),
- escape routes, properly market with signs, have to be provided covering all rooms of the building where workers may be present, allowing workers to escape quickly to an open space (§9),
- safety signs should be placed: 1) taking into account the line of sight, 2) directly at the place where a hazard exists or in the immediate vicinity, 3) at the entrance to area where a hazard exists (§9),
- the place where safety signs are located should be well lit, easily accessible and visible. If the signs are located in a place with insufficient daylight, the place should be illuminated by electric light or signs made of or covered with a material having the ability to emit light after the removal of the light source should be used (§9).

As regards escape routes, according to standard PN-N-01256-5:1998, they can be marked: 1) only with photoluminescent evacuation signs, 2) only with illuminated evacuation sings or 3) with use of both types of signs. Photoluminescent signs are suitable for areas with a regular source of light, as the light will 'charge' the signs. Illuminated signs are recommended in areas where escape routes at which there is no daylight or artificial light for extended periods (therefore charging of photoluminescent material wouldn't be secured). In the same standard also other rules to follow during placement of safety sings on escape routes are provided. The signs should preferably be placed at a height of 150 cm from the ground. If the signs are above the escape route, they should be placed at a height of at least 200 cm, perpendicular to the direction of movement of the people being informed about the direction to the exit of the escape route. If this requirement is not met, signs of an extra size should be placed. Signs placed low should not be more than 40 cm from the floor. Additional marking - allowed by the standard - that can be introduced on the escape route, are yellow-black stripes made of phosphorescent material. Black and yellow striped tape, as well as underlays of phosphorescent material can, among others, facilitate the identification of doors in rooms and on escape routes, provide information on the direction of evacuation or mark obstacles on the road (constrictions, depressions, pillars).

Each evacuation action is individual. There might be a variety of combinations as regards conditions and situations, human reactions, behaviours and abilities (psychical and cognitive) (Chan et al., 2012; Duarte et al., 2014; McClintock et al., 2001; Wang et al., 2021; Zijlstra et al., 2016, Grodzicka et al., 2022). This makes proper marking of escape routes more challenging than it might seem, and thus the issue has become a subject of many researches.

The publication presents an experiment concerning the marking of escape routes in underground excavations along with the implications from the research. The experimental research was preceded by literature studies on the marking of escape routes. Specially designed mining excavations (lack of visibility, smoke conditions) were used for the research – a training mine gallery located in the Central Mining Rescue Station S.A. in Bytom (CSRG). Literature

studies were conducted to identify the methods applied in studies regarding evacuation route markings and their findings, described in scientific publications, the requirements contained in applicable legal acts and recommended technical standards.

2. Signage of escape routes – overview of researches on the subject

Researches on signage of escape routes include among others: experiments in real conditions or sites imitating them, e.g. (Fujii et al., 2020; Galea et al., 2017; Jiang, F et al., 2020; Kim et al., 2022; Ronchi et al., 2018); experiments with use of VR, e.g. (Chen et al., 2020; Guilei, 2020; Huang et al., 2021; Kubota et al., 2021); collecting data with use of eye-tracking solutions, e.g. (Chen et al., 2020; Guilei, 2020; Huang et al., 2021; Ding et al., 2022); collecting data with use of a questionnaire, e.g. (Chan et al., 2012; Galea et al., 2017; Galea et al., 2014; Xie et al., 2012; Ronchi et al., 2016); application of mathematical models, e.g. (Huang et al., 2021; Liu et al., 2011; Yuan et al., 2018; Yuki et al., 2005; Wan et al., 2021; Zhang et al., 2017). As regards the sites for which the studies are carried out, these include among others: buildings – corridors, e.g. (Jiang et al., 2022; Kim et al., 2022; Huang et al., 2021; Ding et al., 2022; Wong, Lo, 2007; Olander et al., 2017); tunnels, e.g. (Ronchi et al., 2018; Xie et al., 2012; Higgins et al., 2015; Fridolf et al., 2013); public spaces, e.g. (Galea et al., 2017; Chen et al., 2020; Wan et al., 2021; Zhang et al., 2017; Jeon et al., 2019; Zeng, 2011). Findings of the studies – among others - establish what signs (type, design) should be used; in what way the signs should be installed (located); how the way in which escape routes are marked affects evacuees' actions, behaviours and evacuation speed (Guilei, 2020; Huang et al., 2021; Kubota et al., 2021; Xie et al., 2012; Yuan et al., 2018; Wong, Lo, 2007; Jeon et al., 2019; Bae et al., 2021; Filippidis et al., 2006; Fu, Liu, 2020; Fu et al., 2019). As regards the signs, there were mainly two types used in the studies: showing emergency exit and showing in which direction to go to the emergency exit. Modified versions of the standardized signs, were used in some of the studies. Smoky conditions are taken into account in studies described e.g. in the following papers (Fujii et al., 2020; Kim et al., 2022; Ronchi et al., 2018; Yuan et al., 2018; Yuki et al., 2005; Fridolf et al., 2013; Jeon et al., 2019). Further, some of the papers on the subject are discussed in a more detailed way.

According to (Guilei, 2020), the best way for placement of exit signs to maintain their quick discovery and identification is at the height of 1 m on the front of the observer's line of sight. In (Bae et al., 2021), height of vertical installation of a sign ranging from 30 cm to 270 cm (with interval of 30 cm) and its observation carried out at 10 m distance was a subject of a study regarding signage at a T-type indoor intersection, and the signs considered were arrows indicating direction: left and right. Decision-making time (DMT) was the criterion of comparison. It was found that the highest DMT was for low installation location, and to obtain

good results the sings should be installed higher than 120 cm on the same horizontal side as the arrow direction, and more than 210 cm in the middle of the wall in any other case. Research presented in (Huang et al., 2021) revealed that hanging sings had lower perception rate but at the same time also lower average perception time than wall signs. As it is stated in (Filippidis et al., 2006), the horizontal observation angle should not exceed 85^0 , otherwise the sign will be practically invisible.

Authors of (Jiang et al., 2022) focused on design of evacuation signs. They carried out experiments - in reality and with use of MR (Mixed Reality) - covering emergency evacuation at a corridor (T-junction type) to find out: 1) what kind of signs are best in terms of attracting attention of evacuees and 2) what are relations between design of evacuation signs and evacuee's decisions regarding escape activities. Each type of experiment (i.e. in real and in virtual world) consisted of 5 sub-experiments – separate for 5 types of evacuation signs that were used. The signs had different features (background-foreground): black-green, green-white (3 variants: with and without flashing, and with a red X-mark – to indicate that escape in given direction is prohibited), red-white. Evacuation signs with a black background, green foreground and flashing lights were found as most effective in terms of providing guidance to evacuees. A reverse use of the same colors, i.e. green background and black foreground of sign was proposed in (Chen et al., 2020). The other combinations of colors for safety signs examined in this study were (background-foreground): red-white, yellow-black, and blue-white. The experiment was carried out with use of VR and eye-tracking.

Typically, evacuation signs inform in which direction and through which exit to go. The message conveyed is positive ('do it this way'). In papers (Olander et al., 2017; Olander, 2015) the focus is on emergency exit signs aimed at dissuading evacuees from using a particular exit door. The data were collected with use of a questionnaire. It was found that a good way to obtain an effective dissuasive sign is to negate its positive counterpart. In the research, adding a red LED X-mark across the whole sign was applied. Also adding red flashing lights next to the sign (in immediate proximity) was found as effective solution to increase its effectiveness. Affecting the considered urgency by the red color was provided as the explanation. In the study mentioned earlier – in the paper (Jiang et al., 2022), two dissuasive signs were also used. They obtained relatively low scores. As the cause, it was indicated that – as opposed to the dissuasive signs used in the experiment - generally people encounter the standard evacuation signs (in buildings and other places) and that transmits into natural understanding and acceptance of their meaning. Implementation of a negative sign was also one of elements covered by a study presented in (Galea et al., 2017). The findings proved that it is possible to design a dissuasive sign that in a clear way indicates that an exit route can no more be used. Four designs of negated signs were proposed, out of which one was found clearly understood by 92% of respondents (sample 311 persons). The following percentages were obtained for the other three sign designs - respectively – 83% (sample 312 persons), 63% (sample 311) persons, 78% (sample 295 persons).

Positive effect of adding of flashing lights to a sign was also supported by studies presented in (Ding et at., 2022; Ronchi et al., 2016; Nilsson, 2009; Yasufuku et al., 2017; Nilsson et al., 2005). Adding dynamics to a sign by incorporating flashing components was also a subject of research in (Galea et al., 2017; Jiang et al., 2022; Ding et al., 2022; Galea et al., 2014; Fridolf et al., 2016). For the application of flashing in signage system, its positive impact on evacuation was demonstrated. As regards color to be used, green – being commonly associated with guidelines, actions etc. that contribute to safety – is suggested. An experiment on participants' associations regarding colors, in context of emergencies presented in (Nilsson et al., 2005) covered several colors: green, red, orange, yellow, white and blue. The findings confirmed considering green as related with safety, and red – as related with danger. For the other colors it was concluded that in case of white and blue no distinctive associations were identified, while for orange and yellow association with warning was indicated. Adding of a lighting installation to a signage system to reduce or overcome problem of low or lack of visibility of signs was also a subject of research presented in (Cosma et al., 2016). In the studies, LED stripes, giving green light were used and located along the evacuation routes in smoke conditions in railway tunnels. Experiments (carried out with use of VR) confirmed that such solution has positive impact on way-finding.

A critical review of studies carried out on relations between visibility of emergency signs and walking speed in smoke-affected areas is presented in (Fujii et al., 2020). In the research, mostly Japanese researchers' publications are covered, including those dating back to 1970s, e.g. (Jin, 1970). In the same paper the authors present their own experiment within which measurements of walking speed under different conditions in an experimental corridor (resembling building corridors) were carried out. The conditions were varied by combinations of the following parameters: 1) presence of a lit emergency exit sign (installed or not), 2) smoke density (four levels), and 3) lighting (ceiling lights switched on or off). Ten men and ten women, aged 21-25 years, with no mobility or vision limitations participated in the experiment. The used exit sign complies with ISO 7010:2019. In total 130 tries (realizations of the procedure established for the experiment) were carried out. A thorough analysis of the data collected and conclusions are presented in the paper. E.g. the study revealed that: 1) for smoke density of 1,5 l/m in an illuminated corridor, the walking speed was higher when the lit emergency exit sign was installed, 2) for each smoke density the walking speeds in a corridor with the installed sign were lower under conditions of no illumination. The study confirmed that the higher smoke density, and the higher distance from the sign, the lower its visibility is, which is more distinctive under no illumination.

Authors of (Yuki et al., 2005) raised that when evacuation is carried out because of fire, not only lighting and obscuration by smokes affect visibility of emergency signs, but also another phenomena - adhesion of smoke both to the signs (their surface) and to the sources of light. They also proposed a calculation model of target luminance in fire-smoke taking into

account smoke adhesion and argued that its application should contribute to better designs and planning as regards exit signs addressed for evacuation in case of fire.

General conclusion related to the studies discussed above is that there is no ‘best solution’ as regards signage of evacuation routes. Each of the researches was carried out in an individual way in terms of a combination of: objectives and criteria, methods, locations and evacuation's circumstances. In addition to individual circumstances at the area for which signage system is to be developed, while selection of signs and their location on the evacuation routes, it has to be taken into account that each sign is a part of the whole es-cape system that has to be effective, which was raised by authors of (Fu et al., 2020). Another conclusion is that a number of researchers proved that implementation of own ideas as regards design of signs and their installation may bring good results as regards evacuation.

In underground coal mines, fire may be caused by a number of causes, including shortcomings in safety culture (Stańczak, Kaniak, 2021). During evacuation from fire-affected areas – similarly as in case of surface sites (e.g. buildings), tunnels (e.g. road tunnels, subway tunnels) – lighting conditions (including darkness) and smoke that affect visibility of signs are also present. However, it should be underlined that in a coal mine, the marking of evacuation routes is addressed to a very specific group of evacuees, i.e. coal miners and mine rescuers. There is little publicized as regards marking of evacuation routes particularly in underground coal mines.

3. Marking of evacuation routes in underground coal mines

The two main methods used to aid evacuees in coal mines are: signage and lifelines.

Coal mines signage evacuation routes in a variety of ways. Typically, metal boards with textual and/or graphical (e.g. an arrow) information are used. As Meij (Meij, 2020) raises, use of signs is a cheap way to effectively inform on evacuation routes in good visibility conditions. In smoke, their visibility deteriorates, which is even worse if the signs are not properly cleaned from dust, smoke etc.

A lifeline (Figure 1) is a line on which there are mounted spatial objects that are a tac-tile signal – e.g. cones, spheres, and cylinders that can be felt with the hands and recognized in darkness. These objects and their configurations have concrete meaning as regards giving instructions that direct/guide evacuees (Meij, 2020; Onifade et al., 2022; Badura et al., 2017; Badura, Musioł, 2015; Gaab, 2019).

Figure 1. A lifeline installed in a coal mine roadway.

Source: CAB Lifeline.

A condition for effective use of lifelines is locating them ('reaching them') by evacuees, which might be difficult to meet when visibility is low e.g. because of smoke, or in darkness (Gaab, 2019; Martell et al., 2020). An experiment (in a dark, smoked laboratory chamber) to find out whether use of self-illuminating lifeline can be a solution to this problem was presented in (Martell et al., 2020). In addition to a traditional lifeline, three color variants of self-illuminating lifeline were used: red, green and blue, and tested in terms of: 1) visibility, 2) color recognition. Based on the study, the red color was rejected – the red-lighted lifeline was detected only in 6,66% of trials. Blue color was found the best in terms of visibility (100% of cases), but the color identification was relatively poor (6,67% of the cases). The green-lighted lifeline was detected in 90% of cases, and the color was recognized in 36,67% of the cases. The traditional rope was missed (not found in the smoky conditions) in all the cases.

4. Marking of evacuation routes in underground coal mines – legal background

Lifelines are mandatory in coal mines in the USA, which is laid down by §75.380 of federal regulation (Code of Federal Regulations. Title 30…), while there is no mention on them in European directive (Council Directive 92/104/EEC). According to the federal regulation, there are five types of tactile signals on lifelines: directional cones (indicating the direction to go outside), a coil to indicate a refuge chamber, two sets of double cones to indicate a self-contained, self-rescuer (SCSR) cache, two directional cones in a row to indicate a branch line, and a ball to indicate a personnel door. The fireproof cord of a lifeline has to be also marked with reflective material every 25 ft (7,62 m). Lifelines are not a subject of regulation in the European Union.

In the USA, signage of escape routes is also a subject of the federal regulation (Code of Federal Regulations. Title 30…) provisions of which (§ 57.11051, § 75.380) indicate in that easy to notice and read signs must indicate escape ways in a clear way. In the European Union, according to Council Directive 92/104/EEC (point 9.7), the sings used to indicate emergency routes and exits have to comply with Council Directive 92/58/EEC. Provisions of the later directive state in particular that a safety color of signs providing this kind of information

(i.e. escape routes and exits) is green. To inform about danger and prohibited actions, red should be used.

In Poland, a regulation (Rozporządzenie Ministra Energii z dnia 23 listopada 2016…) provides general requirements for familiarizing employees with information on hazards, the designation and marking of escape routes, the organization of rescue and first aid. § 475 states that escape routes should be determined by the mine operations manager and properly marked and equipped with a system allowing identification of the direction of withdrawal in case of lack of visibility. None of the provisions states that requirements established by Polish Standards should be followed when marking escape routes.

5. Method

A study on the applicability of lit signs for marking of evacuation routes where dark-ness and smoke are present was carried out. The research included an experiment within which participants observed sample lit signs in conditions imitating smoked coal mine gallery and expressed their opinions on their visibility related with the color and shape. The observation was carried out at 3 distances from the sign: 5 m, 10 m, 15 m. The opinions were collected with use of a questionnaire. In the questionnaire, a 5-point Likert scale was used. By assigning a score, respondents expressed how strongly they agree with the statement, that the given sign in the particular color is highly visible. Also talks regarding the perceived visibility of the signs in terms of shape identification took place, however these did not have a form of a structured interview.

The experiment was carried out in a training gallery of the Central Mine Rescue Station (CSRG) in Bytom (Figure 2). The site was equipped with a smoke generator Antari FT-100 Fogger, dedicated for fire training.

Figure 2. A training gallery in which the experiment was carried out.

The research sample included mine rescuers employed in specialist fire-fighting unit at the Central Mine Rescue Station. They are involved in rescue actions, also in heavy smoke, in coal mines. Nowadays there are 24 mine rescuers in the unit and 20 of them participated in the experiment.

All the rescuers taking part in the tests had valid health examinations and work permits. No one in the group had a visual impairment.

In the experiment, 8 signs were used. They were made of a LED tape (1 cm wide) formed to the desired shape – a square or an arrow, attached to a rectangular board in white color. The tape was equipped with a remote controller that enables changing colors. In the experiment the following colors were used: white, green, red, blue. Additionally a stand with a bright, yellow rectangle was prepared, further called ‘reference stand’. During the experiment it was used as a reference to show that the site of experiment was actually filled with smoke. The sizes of the signs and the reference stand are shown in Figure 3. The unit used is mm.

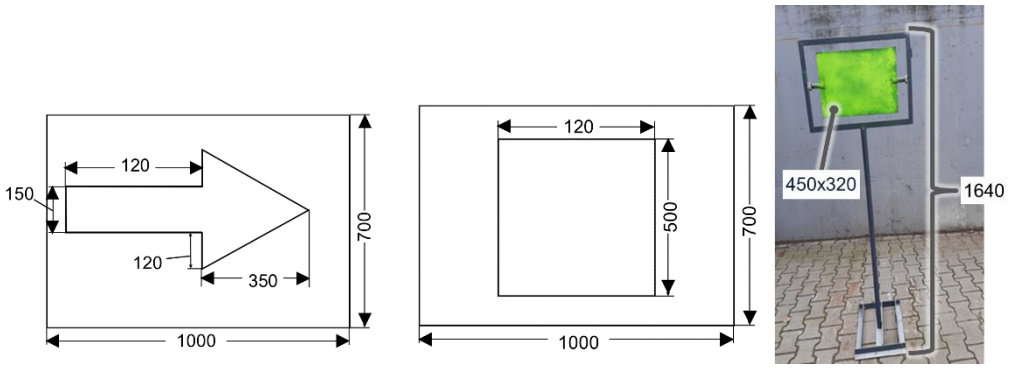

Figure 3. Measures of signs and reference stand.

The distances from the observation point were measured and marked (Figure 4).

Figure 4. Marking distances of observation.

A graphical characteristics of the site where the experiment took place is presented in Figure 5. The board with a lit sign was placed directly on the tape conveyor that has height of 1 m.

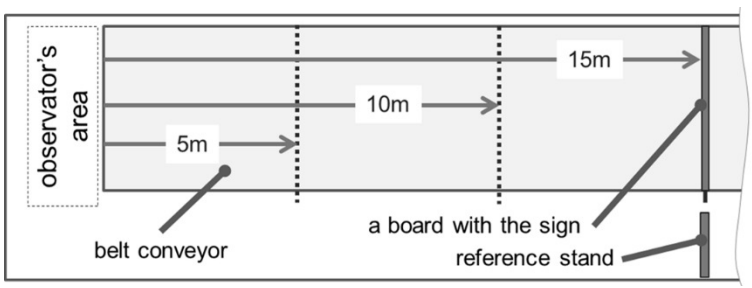

Figure 5. Site at which the experiment was carried out – graphical description.

There were two stages of the experiment – one for the square shaped sign and one for the arrow shaped sign. Each stage was carried out according to the following procedure:

1. arrangement of the ‘reference stand’ and of a sign, at 5 m distance from the point of observation (Figure 6); once the arrangement was ready, the LED tape on the sign was switched on to make sure that it works properly and then it was switched off;

Figure 6. Arrangement of a sign and the reference table (view for the blue color variant).

2. entering by a rescuer to the research site and taking place in the observation point;
3. filling the gallery with smoke;
4. switching the light off;
5. switching on the LED tape of the sign and changing its color (with use of a remote controller); all the colors considered are subsequently selected, and each color is switch on and observed during 5 seconds;
6. switching the light on and gathering opinions on the visibility of the sign in each color, at the current distance.

The procedure was repeated for each distance separately.

6. Research results

In Figures 7-9, photos taken during each observation of the square shaped sign are presented, and similarly for the arrow shaped sign – in the Figures 10-12. It should be underlined that the image captured by a camera and the image captured by human eye are not identical. Opinions expressed by the rescuers regarded the visual observation of the lit signs.

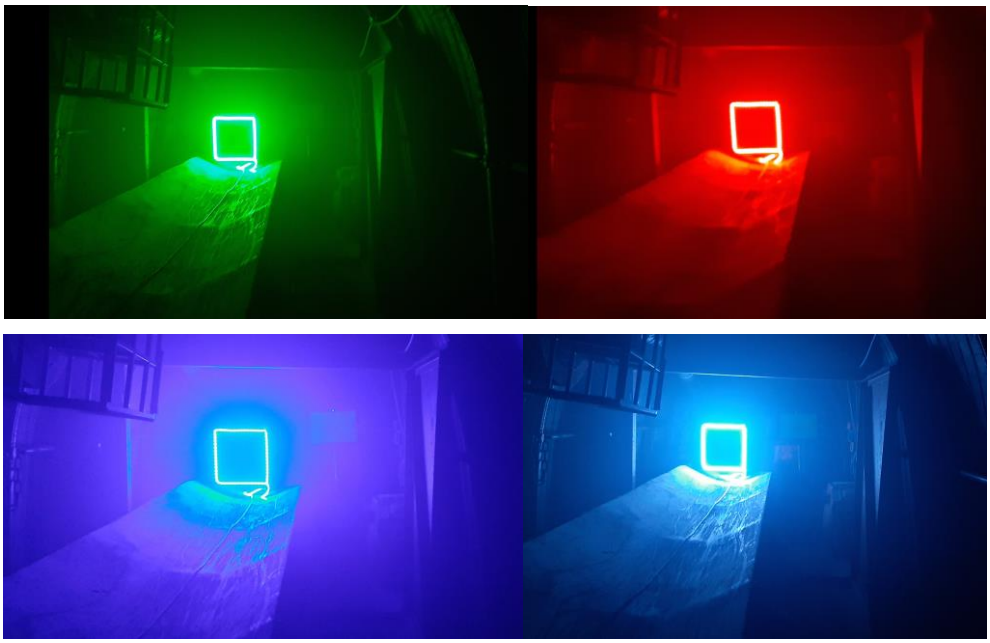

Figure 7. Observation of the square shaped sign, a the distance of 5 m.

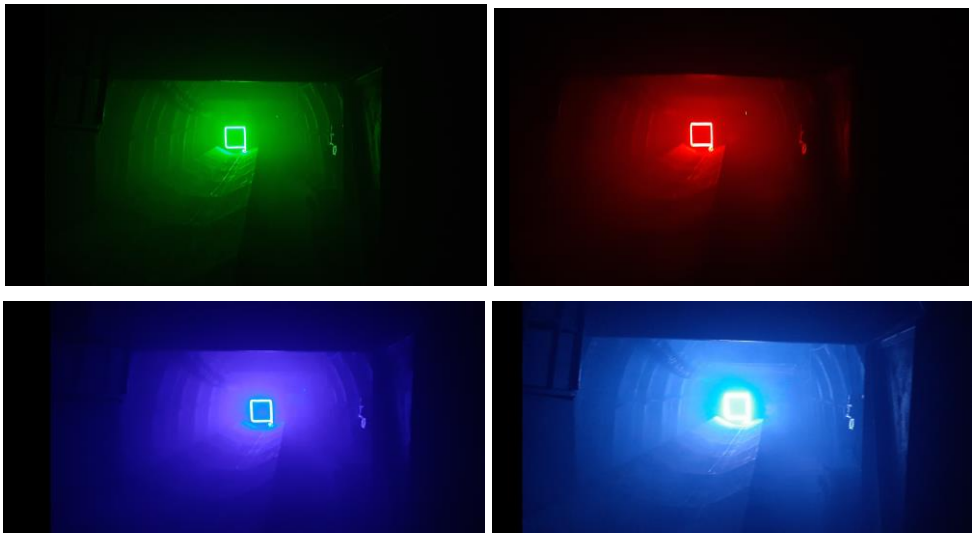

Figure 8. Observation of the square shaped sign, a the distance of 10 m.

Figure 9. Observation of a square shaped sign, a the distance of 15 m.

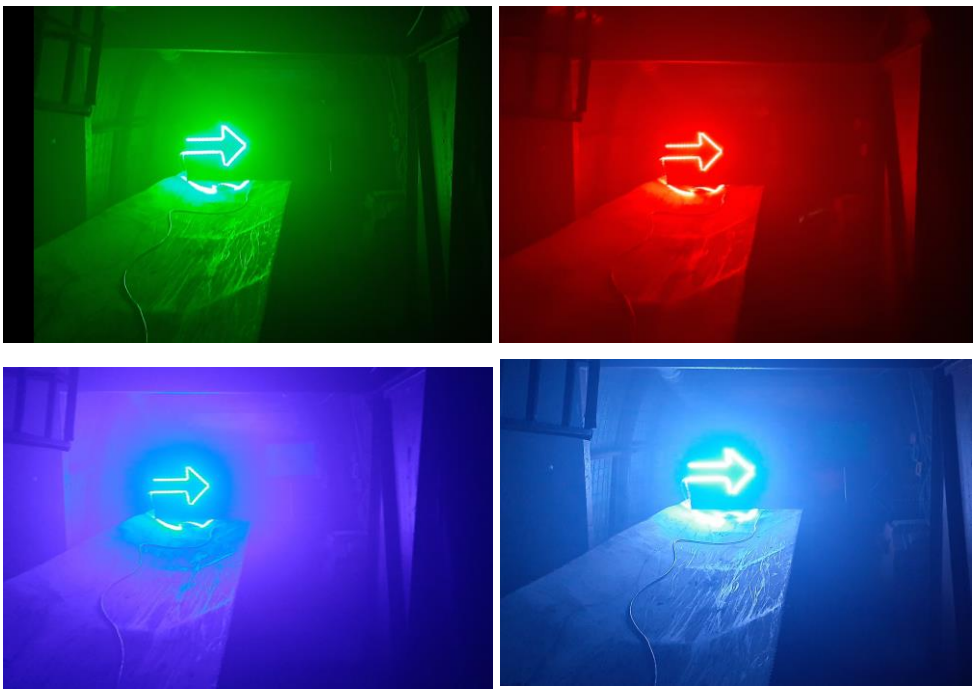

Figure 10. Observation of the arrow shaped sign, a the distance of 5 m.

Figure 11. Observation of the arrow shaped sign, a the distance of 10 m.

Figure 12. Observation of the arrow shaped sign, a the distance of 15 m.

The answers regarding visibility of the square shaped sign are summarized in the Table 1.

Table 1.
Answers obtained for the square shaped sign, taking into account color and distance

DISTANCE	COLOR	SHAPE: SQUARE				
		Answers*				
		1	**2**	**3**	**4**	**5**
5 m	green	0	0	0	0	20
	red	0	0	0	2	18
	blue	0	0	2	4	14
	white	0	0	0	0	20
10 m	green	0	0	2	6	12
	red	0	2	4	4	10
	blue	4	6	4	4	2
	white	0	0	0	0	20
15 m	green	2	6	6	4	2
	red	4	8	6	2	0
	blue	6	10	2	2	0
	white	0	0	0	2	18

*1 – definitely no, 2 – rather no, 3 – no opinion, 4 – rather yes, 5 – definitely yes.

For the rescuers standing at the distance of 5 m from the ‘square’, the sign was highly visible, regardless of its color. However, in case of the blue color, there were answers (10%) indicating no opinion. At the distance of 10 m, the answers were more differentiated. The best visibility was found for the white color – all the respondents assigned the highest score. The visibility of the blue color was considered as worst. Only 30% of rescuers positively assessed visibility of this color, but only 10% assigned the highest score. 50% of respondents did not consider the sign as properly visible, and 20% had no opinion on the subject. The visibility of the red color was rated positively by 70% of the respondents, no opinion was declared by 20% of respondents and there was a negative opinion given by 10% of respondents. For the green color, visibility was positively assessed by 90% of the respondents. At the distance of 15 m, the visibility was positively assessed only for the white-lighted square. The worst visibility was indicated for the blue color - 80% of the respondents expressed a negative opinion. In case of the red color, the majority of the respondents (60%) also negatively assessed its visibility, and 30% of the respondents declared no opinion on the subject. The green color was not definitely classified as properly or insufficiently visible - there were 30% of positive answers, 40% of negative answers.

The rescuers also expressed the following general opinions and impressions:

- at each of the distances considered, the square shape is visible in all colors, however its sharpness is not the same,
- red color darkens the gallery,
- white is the most visible color and it additionally illuminates the excavation.

Answers regarding visibility of the arrow shaped sign are summarized in the Table 2.

Table 2.
Answers obtained for the arrow shaped sign, taking into account color and distance

DISTANCE COLOR		SHAPE: SQUARE				
		answers*				
		1	2	3	4	5
5 m	green	0	0	0	0	20
	red	0	0	0	2	18
	blue	0	0	2	4	14
	white	0	0	0	0	20
10 m	green	0	0	2	6	12
	red	0	2	4	4	10
	blue	4	6	4	4	2
	white	0	0	0	0	20
15 m	green	2	4	6	6	2
	red	4	6	8	2	0
	blue	6	8	4	2	0
	white	0	0	0	1	19

*1 – definitely no, 2 – rather no, 3 – no opinion, 4 – rather yes, 5 – definitely yes.

For the distance of 5 m, the rescuers gave the same answers as for the ‘square’ sign. At the distance of 10 m, the visibility of the blue color was negatively assessed by 50% of the respondents and positively assessed by 30% of them. The visibility of the red color was evaluated positively by 70% of the respondents, and negatively – by 10% of the respondents. Both in case of the red and blue color, 20% of the respondents declared having no opinion. The green color was found properly visible by 90% of the respondents.

At the distance of 15 m, the blue color was the least visible – 70% of the respondents gave a negative opinion, and only 10% found its visibility as proper (however no highest score was indicated). Visibility of the red color was negatively assessed by 50% of the respondents and positively by 10% of them. In case of the green color, the numbers of negative and positive opinions were equal – 40% of the respondents. The visibility of the white color obtained the highest scores – no negative or ‘no opinion’ answers were given.

For both shapes, i.e. square and arrow, the rescuers also expressed the following general opinions and impressions:

- at each of the distances considered, the shape is visible in all colors, however its sharpness is not the same,
- red color darkens the gallery,
- white is the most visible color and it additionally illuminates the excavation (the conveyor and possible obstacles in the way were visible).

What should be also underlined, the high visibility of the white color was found by the rescuers as unexpected and surprising.

7. Discussion of the results

Obligations of an employer regarding the rules of conduct to cope with hazards to health and life in the working environment are defined by law and standards, at national and higher (e.g. European, international) levels.

In Poland, these obligations are established both by general law - created by the Labor Code Act (Ustawa z dnia 26 czerwca 1974 r. …) and executive acts, and by the industry law, like e.g. the Geological Law and Mining (Ustawa z dnia 9 czerwca 2011 r. …) and executive acts - in the mining industry. Among these obligations, there is the use of safety signs. Detailed regulations regarding safety signs are defined in formal standards.

In the applicable standards, safety signs are classified. The type of a safety sign depends on its purpose. According to the PN-EN ISO 7010:2020 standard, there are: signs indicating evacuation route, location of safety equipment or safety facility, safety action (E); fire equipment signs (F); mandatory action signs (M); prohibition signs (P); warning signs (W). A similar classification of signs is contained in the series of standards PN-N-01256: signs for fire protection; technical fire protection means sings; evacuation signs; information signs; warning signs; prohibition signs; mandatory signs. Within each class, safety signs have a consistent design.

Based on the analysis of the requirements defined in the PN-N-01255:1992 standard and the PN-N-01256 series of standards, conclusions regarding the relation between the purpose of a safety sign and its design – geometric shape and safety color used can be drawn. The geometric shapes are divided into the following groups: circle – to indicate prohibition, obligation, triangle – for warning, rectangle and square – to provide information with description. Safety colors used are as follows: green (safety – in context of evacuation, first aid etc.), yellow (warning of danger), blue (obligation), red (prohibition, stopping, fire protection).

Based on the analysis of the requirements set out in the PN-EN ISO 7010:2020 standard, it can be concluded that safety signs for evacuation (evacuation signs) have a square shape, a green background and a white graphic symbol (e.g. emergency exit, direction arrow, evacuation assembly point, escape ladder, evacuation chair).

The review of Polish regulations revealed that they do not imply detailed rules as regards marking of escape routes in mining excavations, which gives floor for development of new concepts and designs for it.

As the literature research shows, there are two basic directions of solving the problem of evacuation in the mining industry, in underground working environment (lack of visibility, smoke conditions): marking (safety signs and colors) and rescue equipment (safety lines) used in mining excavations, e.g. (Badura, Musioł, 2015; Badura, Grodzicka, Musioł, 2017; Gaab, 2019; May, 2020; Martell et al., 2020; Onifade et al., 2022). As regards the escape routes

signage, the researches described in the scientific publications show among others that it is possible to propose color-lighted signs for effective marking escape routes.

Based on the comparative analysis of safety colors and safety signs according to the current international standard PN-EN ISO 7010:2020 and detailed national standards PN-N-01255:1992 and PN-N-01256 series, two following two basic variables and values for them were considered during design of signs to be used in the experiment carried out in the training mine gallery in CSRG: shapes of figures (rectangle, square, circle, triangle, arrow), colors of figures (green, red, blue, white, yellow). Findings from scientific publications review and technical capabilities (training gallery equipment, type of LED tape) were also taken into account while designing the signs as well as when defining the procedure for carrying out the experiment. Finally, the following variables were adopted for the practical study on the marking of escape routes in mining excavations: shape of the tested figure (square, arrow), color of the tested figure (green, red, blue, white), observation distance (5 m, 10 m, 15 m).

Summarizing the respondents' feedback from observation of the colors, the following was found:

- At 5 m, the visibility of all colors was comparable and high (positive rating by at least 90% respondents).
- At 10 m, the visibility decreased for blue color (positive opinion of 30% of respondents) and for red color (positive opinion of 70% of respondents), remained high for green color (90%) and remained unchanged for white color.
- At 15 m, visibility of blue color and red color decreased to low level - positive opinion expressed by 10% of respondents, acceptance of green color also decreased, however positive opinion was expressed by 40% of respondents for arrow shape and 30% - for square shape, and visibility of white color remained high (acceptance by 100% of respondents, for both shapes).

Therefore, the higher the distance was, the more differentiated perception of visibility of green, red and blue colors was – it decreased. A the same time, the visibility of the white color was high, at all the distances.

Taking into account ability to see a lit sign in smoky conditions in a mine gallery, use of white color is the best choice, while use of blue – the worst. However, for white color, an effect of blurred shape was observed, which was particularly distinctive at 10 m and 15 m distances. The phenomena of perceived decrease in sharpness of the sign was more intensive for the arrow (that is a more sophisticated shape than a square).

Application of both lit signs in white and in red or green seems a good solution for marking evacuation routes in a mine gallery. White lit signs should be used to mark main points on the escape route. Being visible from a long distance in a smoke, they enable to identify in which direction to move. Meaning of such signs is defined mainly by their color, and their shape should be very simple. In case of lit signs, the shape of which has to be unambiguously and correctly identified to understand their meaning, like e.g. an arrow showing a direction, red or green color should be applied.

8. Summary

When an evacuation takes place, easiness of wayfinding affects evacuees' safety. Escape routes have to be marked in a way that guarantees their identification in conditions that affect visibility, like blackout or smoke. Related obligations, rules and recommendations are formally set out in applicable regulations and standards. Following them does not guarantee most effective evacuation, due to a variety of circumstances in which the evacuation takes place. Literature research shows that finding best solutions as regards marking of escape way is a subject of a number of studies covering among others: own de-sign of signs; placement of signs; application of flashing lights and illumination. Many of the studies presented in the papers prove that it is possible to develop own ideas - also as alternative to the solutions that comply with regulations and standards - that bring good results.

As regards marking of escape ways in underground coal mines, there are separate regulations, which was shown for the USA, European Union, and – at national level – for Poland. In Poland, provisions of the regulation that set out rules for marking of escape routes do not imply use of safety signs defined in the Polish Standards, which opens window for implementation of a variety of solutions meeting one mandatory requirement – providing effective aid to evacuees in any possible conditions, including lack of visibility.

Authors of this paper carried out an experiment focused on perceived visibility of lit signs in different colors (white, green, blue, red), in smoky conditions, in a mine rescue training gallery. Observation was carried out at three distances from a sign. Two shapes of different complexity were used: a square and an arrow. The shapes were formed with use of a LED tape, on a white board. The rescuers taking part in the experiment found white-lighted signs most visible and blue-lighted signs least visible, in case of both shapes. However, red or green color was indicated to apply if identification of the shape would be the criterion of assessment. Usability of the research results does not limit to underground coal mines.

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DETERMINANTS OF THE CHOICE OF PETROL STATIONS BY MICRO AND SMALL ROAD TRANSPORT ENTERPRISES IN THE PODKARPACKIE VOIVODESHIP

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Purpose: The aim of the research will be indicate the main and secondary factors determining the choice of petrol stations by micro and small road transport enterprises, whose registered office is located in the Podkarpackie Voivodship. The essence of the research problem will boil down to answering questions about the main and secondary factors determining the choice of petrol stations by micro and small road transport enterprises in the Podkarpackie Voivodeship. Detailed questions will concern the indication of differences when choosing a supplier, taking the criterion of the size of enterprises, owned fleet of vehicles or geographical scope of operations. Therefore, the subject of the study is the retail market of transport fuels, and the subject of the research are micro and small road transport enterprises located in the Podkarpackie Voivodship. The area of research is the determinants of the choice of petrol stations by the surveyed enterprises.

Design/methodology/approach: The research procedure will run through the following stages: 1) indicating the topic, purpose and scope of the research; 2) determination and definition of evaluation criteria; 3) construction and development of the interview form; 4) selection of the database of road transport enterprises; 5) selection of the test sample; 6) measurement; 7) interpretation of the obtained results; 8) final conclusions; 9) dissemination of research results.

The research method used is a direct interview. The measurement will be carried out on the basis of an interview form. For the purposes of the research, areas of assessment were indicated, i.e. the initial criterion, form of cooperation and selection determinants.

Findings: The implementation of the topic and purpose of the research allowed to indicate the determinants of the choice of petrol stations by micro and small road transport enterprises, whose headquarters are located in the Podkarpackie Voivodeship. It should be emphasized that the presented research is the second stage of the research process, the main purpose of which is to indicate the scope and form of cooperation of a retail supplier of liquid fuels with a micro and small road transport company in the Podkarpackie Voivodship. The stages of its implementation include: determining the attributes of the commercial offer of the petrol station network in the analyzed region; an indication of the determinants of the choice of a supplier of liquid fuels by the surveyed enterprises; determination of the extent to which the commercial offer of the petrol station network addressed to micro and small road transport enterprises in the Podkarpackie Voivodship reflects the real needs of the market.

Originality/value: In this article, the actions taken to achieve the progress of scientific knowledge led to the expansion of knowledge in the discipline of management and quality science in the area of trade systems, their organization and management. The research focused on the areas that have and will have an impact on improving the competitive position of road transport enterprise.

Keywords: customer, liquid fuels, transport.

Category of the paper: Research paper.

1. Introduction

In the past, road transport constituted a significant part of the Polish transport system and was one of the largest sectors of the Polish economy. In the Podkarpackie Voivodship, the share of road transport in the structure of goods and passenger transport remained at a high level. A large group of road transport enterprises had their seat in the voivodship. Their structure is largely composed of micro and small entities. These were usually business units with a limited number of vehicles at their disposal. Due to the subject/subject of transport and the available transport technology, the scope of transport services provided by them was varied. Sometimes they also offered other services not related to transport. A significant part of these entities carried out mainly local or regional transport. In the structure of the rolling stock owned by enterprises, the vast majority were vehicles powered by petroleum fuels.

In the past period, the retail market of transport fuels in the Podkarpackie Voivodeship is characterized by high flexibility. Strong competition from domestic and foreign entities translated into the price offer and non-price conditions. The basic attributes of the petrol station's commercial offer addressed to micro and small enterprises include: personalization of the offer, limited access to the terms of cooperation, wide range of services provided, time availability of services, integration of the transport process, personalization of tasks, speed of establishing cooperation, dispersion of points, supra-regional importance offers (Jedynak, 2023).

In Poland fuel prices were not regulated by the President of the Energy Regulatory Office. They were determined on market terms. The structure contained fixed elements, i.e. excise tax, fuel surcharge and emission fee, as well as variable elements, i.e. VAT, margin and net price (Frączek, Kaliski, Siemek, 2013). In addition, their final level is influenced by the size of local needs and the scale of competition between suppliers. In the past period, due to the high level of transport fuel prices on the market, a significant share of their purchase costs in the cost structure of road transport enterprises was recorded in the country (Annual, 2023).

In response to the above issues, it was assumed that the purpose of the research would be to identify the determinants of the choice of petrol stations by micro and small road transport enterprises, whose headquarters are located in the Podkarpackie Voivodship.

Its implementation will take place through: 1) establishing the current state of knowledge in the scope of the discussed issues; 2) description of the test method; 3) measurement; 4) presentation of final conclusions. The research method used is a critical review of the literature on the subject and a direct interview.

It should be emphasized that the presented research is the second stage of the research process, the main purpose of which is to indicate the scope and form of cooperation of a retail supplier of liquid fuels with a micro and small road transport company in the Podkarpackie Voivodship. The stages of its implementation include: determining the attributes of the commercial offer of the petrol station network in the analyzed region; an indication of the determinants of the choice of a supplier of liquid fuels by the surveyed enterprises; determination of the extent to which the commercial offer of the petrol station network addressed to micro and small road transport enterprises in the Podkarpackie Voivodship reflects the real needs of the market.

2. Theoretical basis

The word transport enterprise can be considered from the point of view of representatives of various scientific disciplines (Koźlak, 2018; Wall, 2002). In subjective terms, it is an organizational unit consisting of a network of related and cooperating functional and task departments as well as human work. In material terms, an enterprise is defined on the basis of the means of production at its disposal (i.e. buildings and structures, means of transport, other technical devices and materials used in their operation, including fuels and energy). However, in the functional approach, transport enterprises are understood as a set of tasks related to the preparation, implementation and settlement of the transport process (Mendyk, 2009; Koźlak, 2008; Grzywacz et al., 1989; Tarski 1974).

Assuming the criterion of employment and annual revenues, a transport enterprise can be divided into four groups, i.e. micro, small, medium and large. A micro-enterprise is an economic entity employing fewer than 10 employees, a small enterprise employing fewer than 50 employees (Dz.U. z 2004, nr 173, poz. 1807). In the literature on the subject, a further division of transport enterprises includes, among others: phases of the flow of material goods, degree of specialization, geographical scope of activity, capital structure, ownership sector, type of ownership, forms of ownership, legal forms or degree of resources involved (Jedynak, 2022; Budzyński, 2013; Krawczyk, 2011; Dz.U. z 2007, nr 251, poz. 1885).

Within the organization of a transport enterprise, the basic and auxiliary subsystems are commonly indicated. One of the areas of support for transport processes is the fuel and energy subsystem. It covers both the supply and consumption spheres. The entity structure of the

supply subsystem consists of the department and positions responsible for the purchase and supply of individual energy carriers and their suppliers (Jedynak, 2022).

In the literature on the subject, the word supplier can be considered in various cross-sections. In practical terms, a supplier is an organizational unit that offers and delivers to recipients, independently or by ordering an external entity, appropriate tangible goods and services being the subject of their manufacturing or commercial activity, in accordance with previously agreed purchase conditions (commercial offer) (Ahlqvist, 2020; Gelderman, 2020; Jedynak, 2022; Dubisz, 2003). In the literature on the subject, two groups of methods are indicated for evaluating and selecting a supplier. The first method is carried out using a survey, the so-called audit. The second are Taxonomic Methods, which include the Point Method, the Point-Graphic Method, the Graphic Method, the Indicator Method or the AHP Method (Brzeziński, 2006).

The implementation of the supplier evaluation and selection process includes both the preparation phase and the implementation phase. The literature on the subject indicates criteria for evaluating suppliers, i.e. delivery time, supplier reliability, its readiness and flexibility, and delivery efficiency. In addition, the offered price and product quality are taken into account. Due to their importance, they are commonly divided into primary and secondary criteria. Assuming the nature of the supplier assessment, quantitative and qualitative criteria are indicated. The adopted criterion, regardless of its type, requires a detailed definition. Indicators and meters are commonly used for this. The impact of individual criteria on the purchase decision varies. Therefore, it is important to determine their importance by adopting an appropriate weighting (Jedynak, 2022; Budzyński, 2016; Krawczyk, 2011; Bendkowski et al., 2011; Dworecki et al., 2005; Górski, 2004).

3. Methodology

Subject of research: Determinants of the choice of petrol stations by micro and small road transport enterprises in the Podkarpackie Voivodship.

Its main objective will be to indicate the main and secondary factors determining the choice of petrol stations by micro and small road transport enterprises, whose registered office is located in the Podkarpackie Voivodship.

The essence of the research problem will boil down to answering questions about the main and secondary factors determining the choice of petrol stations by micro and small road transport enterprises in the Podkarpackie Voivodeship. Detailed questions will concern the indication of differences when choosing a supplier, taking the criterion of the size of enterprises, owned fleet of vehicles or geographical scope of operations.

Therefore, the subject of the study is the retail market of transport fuels, and the subject of the research are micro and small road transport enterprises located in the Podkarpackie Voivodship. The area of research is the determinants of the choice of petrol stations by the surveyed enterprises.

In terms of the state of knowledge, taking into account the achievements and experience of the researcher, the following research hypothesis was formulated, i.e. the fuel price is the main factor in the choice of filling stations by micro and small enterprises. The importance of non-price factors varies with the geographic scope of the business and the size of the fleet of vehicles at disposal.

The stages of the research procedure include: 1) indicating the topic, purpose and scope of the research; 2) determination and definition of evaluation criteria; 3) construction and development of the interview form; 4) selection of the database of road transport enterprises; 5) selection of the test sample; 6) measurement; 7) interpretation of the obtained results; 8) final conclusions; 9) dissemination of research results.

The research method used is a direct interview. The measurement will be carried out on the basis of an interview form. For the purposes of the research, areas of assessment were indicated, i.e. the initial criterion, form of cooperation and selection determinants. The adopted areas were defined by means of measures. The interview form is included in Table 1.

Table 1.
Interview form: Determinants of the choice of petrol stations by micro and small road transport enterprises in the Podkarpackie Voivodeship

GROUP	TESTED PARAMETER		DESCRIPTION			
Entry Criterion	I.1	Does the enterprise use the services of petrol stations?	A	□ Yes		
			B	□ no (please do not complete the rest of the questionnaire)		
	I.2	Enterprise type:	A	□ micro (less than 10 people)		
			B	□ small (from 10 to 49)		
			C	□ other (please do not complete the rest of the questionnaire)		
	I.3	Type of business activity:	A	□ road transport		
			B	□ freight forwarding		
			C	□ other		
	I.4	Object of transport and/or handling:	A	□ transportation of passengers		
			B	□ transportation of goods		
	I.5	Number of vehicles available:	–	□		pcs.
	I.6	Type of vehicles available:	A	□ bus (up to 24 seats),		pcs.
			B	□ coach (over 24 seats)		pcs.
			C	□ van up to 3.5 t (GVW)		pcs.
			D	□ truck up to 12 t (GVW)		pcs.
			E	□ truck over 12 t (GVW)		pcs.
			F	□ truck tractor/or specialist truck		pcs.
			G	□ car		pcs.
			H	□ other vehicles		–

Cont. table 1.

	I.7	Geographic scope of activity:	A	□ local (district, commune)
			B	□ regional (Subcarpathian Voivodeship)
			C	□ interregional (the area of the Podkarpackie Voivodeship and neighbouring provinces)
			D	□ national
			E	□ continental (Europe)
			F	□ global
	I.8	Type of fuel used:	A	□ diesel
			B	□ motor gasoline
			C	□ LPG
			D	□ CNG
			E	□ Electricity
			F	□ Other
Form of Cooperation	II.1	Do you use the services of only one petrol station?	A	□ Yes
			B	□ No
	II.2	What type of petrol stations does the enterprise use?	A	□ station networks (e.g. Orlen, Moya, BP, Shell, etc.)
			B	□ independent stations (private owner)
	II.3	Is there permanent cooperation with the station/stations (e.g. on the basis of a fuel card, individual contracts, etc.)?	A	□ yes
			B	□ no
	II.4	Does the enterprise use a fuel card system (e.g. UTA, DKV, Eurowag, E100, etc.)?	A	□ yes
			B	□ no
Determinants	III.1	**The importance of price** when choosing a petrol station:	A	□ is of primary importance (most important)
			B	□ on par with non-price conditions
			C	□ of secondary importance, below non-price conditions
	III.2	Basic **non-price factors** when choosing a petrol station: ** indicate max 3*	A	□ transaction conditions (e.g. collective invoice, deferred payment date, etc.)
			B	□ an electronic internet platform (e-bok) and a mobile application
			C	□ petrol station services (e.g. truck parking, car wash, repairs, gastronomy, etc.)
			D	□ geographical scope of the commercial offer
			E	□ number of petrol stations and their location
			F	□ position and importance of the operator on the market
			G	□ other
	III.3	As part of **the financial service of the transaction**, the following are of fundamental importance when choosing a supplier: ** indicate max 2*	A	□ payment method (non-cash/cash)
			B	□ form of payment security (deposit, promissory note, etc.)
			C	□ electronic invoices
			D	□ summary invoice for a given period
	III.4	As part of access to **e-bok and the mobile application**, the following are of primary importance when choosing a supplier: ** indicate max 2*	A	□ access to transaction history
			B	□ access to e-invoice
			C	□ the ability to personalize the card and purchase limits
			D	□ quick payment
			E	□ the possibility of paying road and parking fees
			F	□ access to navigation and maps

Cont. table 1.

	III.5	As part of **the services provided at stations**, the following factors are of primary importance when choosing a supplier: * *indicate max 2*	A	□ store
			B	□ car park/car park of truck
			C	□ catering services
			D	□ hotel services
			E	□ car repair
			F	□ car was
			G	□ other

Source: own study.

4. Empirical Results and Discussion

For the purposes of the research process, the electronic database Panorama Firms (https://panoramafirm.pl) was selected. It was used to select enterprise for research and establish contact details. Micro and small road transport enterprises located throughout the Podkarpackie Voivodeship were indicated (in total, they covered 21 out of 25 poviats). The location structure of the surveyed enterprises is shown in Figure 1.

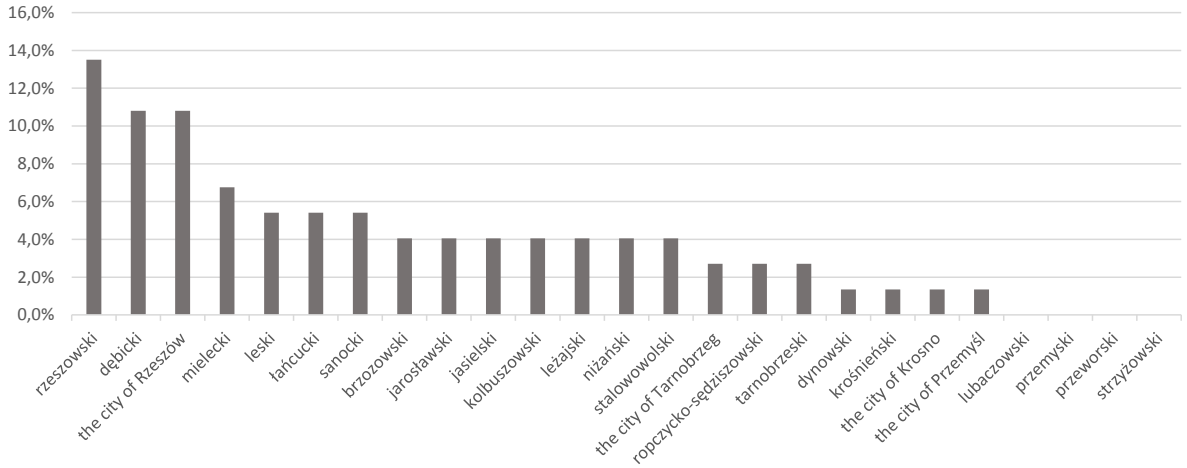

Figure 1. Geographical structure of the surveyed enterprises (by poviat).

Source: own study.

The interview was conducted mainly by telephone (87% of the surveyed respondents). The remaining part of the measurement was carried out by using the Interview Form posted and made available to enterprises on the Google.pl website (http://www.google.pl) in the Forms tab. The research was conducted in March 2023. More than 35% of the respondents who were contacted offered a response. In total, data was obtained from 84 enterprises that met the established criteria.

The measurement results in the area of *Initial Criterion* are presented in Table 2.

Table 2.
Measurement results in the area of Initial Criterion

TESTED PARAMETER		MEASUREMENT										
		Total answer		I.2		I.5 (number of vehicles			I.6			
		pcs.	%	A	B	1	2-5	<5	A-B	C	D	E-F
I.1	A	79	94,0	49	27	19	21	38	20	7	18	40
	B	5	6,0	1	1	0	0	2	1	0	1	1
I.2	A	55	67,1	54	0	18	22	14	18	4	15	21
	B	27	32,9	0	27	0	1	25	5	2	4	20
	C	0	0,0	0	0	0	0	1	0	0	0	0
I.3	A	75	75,8	49	24	18	19	36	18	7	18	39
	B	14	14,1	6	8	1	2	12	3	0	2	11
	C	10	10,1	9	1	4	4	2	5	0	2	3
I.4	A	16	19,8	12	4	7	3	6	8	0	5	4
	B	65	80,2	39	24	11	18	35	15	7	13	36
I.5	–	882	100,0	338	543	19	82	787	288	54	126	509
I.6	A	88	10,0	38	50	1	4	83	62	0	19	19
	B	109	12,4	60	49	0	5	104	80	0	4	25
	C	96	10,9	41	55	2	20	79	37	12	18	55
	D	60	6,8	23	37	0	4	57	14	12	19	33
	E	199	22,6	54	145	4	17	178	51	3	32	134
	F	252	28,6	82	167	4	20	228	16	14	24	215
	G	70	7,9	32	38	8	11	51	25	11	8	26
	H	10	1,1	8	2	0	3	7	3	2	4	2
I.7	A	12	13,3	11	1	7	3	2	12	0	0	0
	B	11	12,2	7	4	1	4	6	11	0	0	2
	C	7	7,8	4	2	2	1	3	0	7	1	0
	D	19	21,1	14	3	4	4	11	0	0	19	4
	E	40	44,4	21	19	5	11	23	2	0	4	40
	F	1	1,1	0	1	0	0	1	0	0	0	1
I.8	A	74	77,1	46	26	14	20	39	17	7	16	41
	B	14	14,6	12	2	6	4	4	7	2	4	2
	C	7	7,3	6	1	4	2	2	4	1	2	0
	D	1	1,0	0	1	0	0	1	1	0	0	0
	E	0	0,0	0	0	0	0	0	0	0	0	0
	F	0	0,0	0	0	0	0	0	0	0	0	0

Source: own study.

On the basis of the collected results, it was established that 94.0% of the surveyed respondents used the services of petrol stations. The remaining part has its own distributors, and thus was interested only in wholesale purchase of liquid fuels.

Among the surveyed entities, 67.1% were micro enterprises, and 32.9% macro enterprises. The main type of their activity was road transport (a total of 75.8% of the surveyed respondents) in the field of freight transport (80.2%). In addition, these enterprise also provided other services, sometimes not related to logistics. Taking into account the geographical scope of the conducted activity, the largest group among the surveyed respondents were continental enterprises - 44.4% and domestic enterprises - 21.1%. The share of enterprises operating only in the Podkarpackie Voivodeship amounted to 25.5%.

In the structure of the rolling stock owned by the surveyed enterprises, the share of vehicles for cargo transport was 68.8%, and passengers 30.3%. The largest group consisted of trucks over 12 t and road tractors and/or specialized tractors (51.1% in total). However, assuming the

criterion of their size, 23.7% of the surveyed respondents had 1 vehicle, 26.2% had 2 to 5 vehicles, and 50.0% had more than 5 vehicles. The main type of fuel used in enterprises was diesel oil (77.1% of the surveyed respondents). In addition, because of the passenger cars owned, petrol and LPG (21.9% in total).

The measurement results in the area of *Form of Cooperation* are presented in Table 3.

Table 3.
Measurement results in the area of Form of Cooperation

TESTED PARAMETER		MEASUREMENT										
		Total answer		I.2		I.5 (number of vehicles			I.6			
		pcs.	%	A	B	1	2-5	<5	A-B	C	D	E-F
II.1	A	16	19,3	12	4	5	6	6	8	1	5	3
	B	67	80,7	42	23	14	17	34	15	6	14	38
II.2	A	54	62,8	34	19	8	15	31	11	7	10	32
	B	32	37,2	23	8	6	11	15	12	1	7	14
II.3	A	48	59,3	26	21	9	14	24	7	5	10	29
	B	33	40,7	27	5	10	8	15	14	2	9	11
II.4	A	34	43,0	17	17	3	8	23	3	2	4	27
	B	45	57,0	34	9	15	13	16	17	5	15	12

Source: own study.

Based on the collected data, it was established that the majority of respondents (80.7%) use the services of many suppliers of transport fuels. 62.8% refuel vehicles at fuel stations included in the network. The increase in the importance of independent operators was noted in the case of the number of owned vehicles up to 5 or the range of operations conducted only in the Podkarpackie Voivodeship.

Among the surveyed enterprises, 59.3% cooperate with petrol stations on the basis of permanent contracts. In the case of micro-enterprises, this indicator amounted to 49.1%, and to small enterprises - 80.8%. Its size was also influenced by the number of vehicles available to enterprises. In the case of having 1 vehicle, 47.4% of respondents cooperate on the basis of permanent contracts, 63.6% in the range of 2-5 vehicles, 61.5% over 5 vehicles. However, taking into account the geographical range of transport services provided in the group of local and regional enterprises, this indicator remained at a low level and amounted to 33.3%. Its highest value was recorded for continental and global enterprises, 72.5% in total.

To the question addressed to the respondents *Do I use the fuel card system covering various fuel stations in cooperation*, 43.0% gave an affirmative answer. Small enterprises (65.4% of the surveyed respondents) and continental and global enterprises (69.2% in total) were mainly interested in this form of cooperation.

The measurement results in the area of *Determinants* are presented in Table 4.

Table 4.
Measurement results in the area of Determinants

TESTED PARAMETER		MEASUREMENT										
		Total answer		I.2		I.5 (number of vehicles			I.6			
		pcs.	%	A	B	1	2-5	<5	A-B	C	D	E-F
III.1	A	53	67,1	35	16	11	16	26	15	3	14	25
	B	23	29,1	16	7	7	7	9	6	3	2	14
	C	3	3,8	2	1	1	0	1	1	0	1	1
III.2	A	46	26,9	29	16	8	16	22	10	5	11	26
	B	11	6,4	10	1	3	3	5	2	1	3	5
	C	39	22,8	29	9	12	10	16	11	3	10	20
	D	17	9,9	10	7	2	4	11	3	0	4	13
	E	37	21,6	22	14	9	12	17	10	3	5	20
	F	12	7,0	7	5	3	2	6	4	1	3	5
	G	8	4,7	4	4	0	3	5	0	0	2	6
III.3	A	50	46,3	36	14	12	16	22	12	3	11	28
	B	7	6,5	6	1	3	2	2	2	1	0	5
	C	20	18,5	14	6	4	6	10	8	2	5	10
	D	31	28,7	17	14	5	10	16	5	3	7	18
III.4	A	28	30,4	15	13	7	4	17	8	1	4	17
	B	20	21,7	13	7	5	6	9	4	2	5	11
	C	8	8,7	4	4	1	3	4	2	0	0	6
	D	15	16,3	12	3	6	3	6	6	1	4	6
	E	17	18,5	13	4	2	8	7	3	0	4	13
	F	4	4,3	3	1	0	2	2	2	1	0	2
III.5	A	18	14,6	11	7	5	3	10	10	1	3	6
	B	42	34,1	28	12	10	11	21	6	3	11	28
	C	16	13,0	11	5	4	4	8	6	0	3	8
	D	0	0,0	0	0	0	0	0	0	0	0	0
	E	5	4,1	5	0	3	1	1	1	0	2	3
	F	29	23,6	22	7	7	8	13	8	3	8	12
	G	13	10,6	8	5	4	5	4	4	1	0	8

Source: own study.

On the basis of the collected data, it was established that regardless of the size of the enterprise's fleet of vehicles or the geographical range of the services provided, the price is of fundamental importance in the selection of a supplier of transport fuels (67.1% of the surveyed respondents). Also, a significant number of enterprises assessed the importance of the price on an equal footing with other terms of the transaction (29.1%). The importance of price when choosing a supplier is shown in Figure 2.

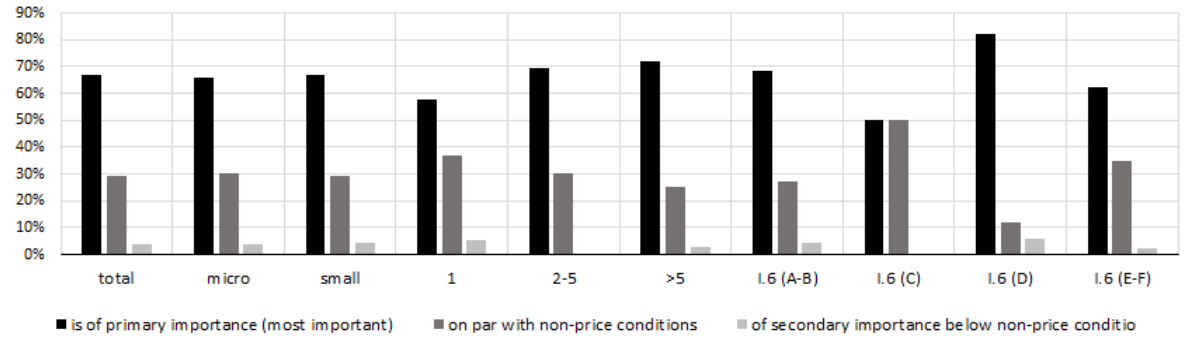

Figure 2. Measurement results: *Importance of price when choosing a fuel supplier.*

Source: own study.

As far as non-price factors are concerned, the most important among the surveyed enterprises were transaction conditions (indicated by 26.9% of the surveyed respondents), petrol station services (22.8%) and the number of petrol stations and their location (21.6%). In the case of small enterprises with more than 5 vehicles and operating outside the Podkarpackie Voivodeship, the importance of the factor of the geographical scope of the commercial offer was increasing. On the other hand, the secondary non-price factors include, above all: access to e-bok and the mobile application or the position and importance of the operator on the market. The importance of non-price factors when choosing a supplier is shown in Figure 3.

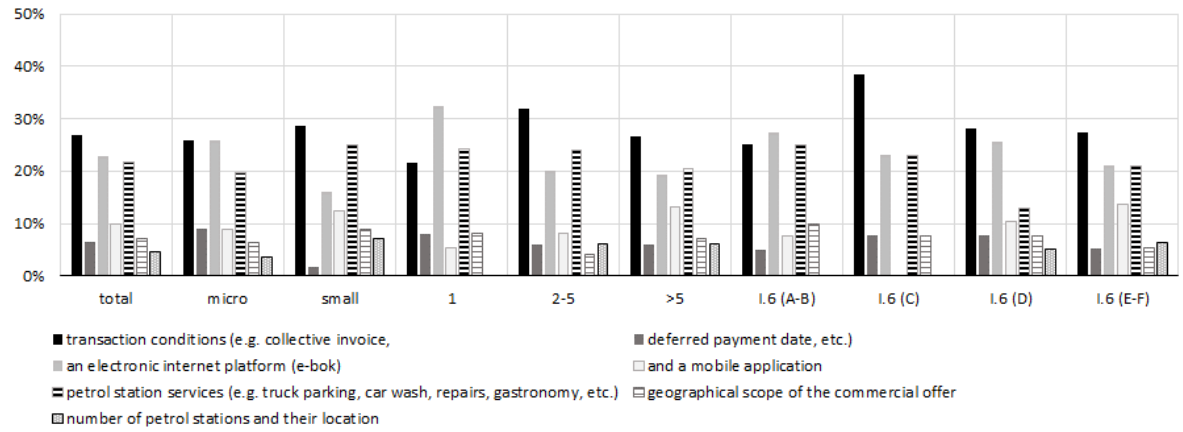

Figure 3. Measurement results: *Basic non-price factors when choosing a petrol station.*

Source: own study.

As part of the financial service of the transaction, the form of payment was of primary importance (indicated by 46.3% of the surveyed respondents), a collective invoice for a given period (28.7%) and an electronic invoice (18.5%). A secondary factor was the form of payment security. The importance of financial transaction support when selecting a supplier is shown in Figure 4.

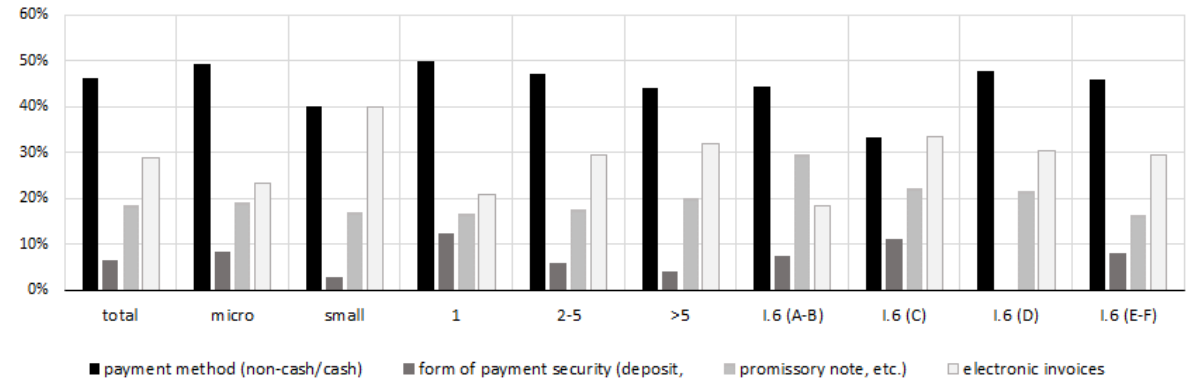

Figure 4. Measurement results: *As part of the financial service of transactions, the following are of primary importance when choosing a supplier.*

Source: own study.

Among the important factors related to the access and functionality of the e-book and the mobile application, the following were indicated: access to the history of sales transactions (indicated by 30.4% of the surveyed respondents) and access to e-invoices (21.7%). Additionally, the ability to pay road and parking fees (18.5%) and fast payment (16.3%) were also important. The importance of individual factors changed depending on the size of the enterprise, the fleet of vehicles owned or the geographical scope of the business. The importance of access to e-bok and the mobile application when choosing a supplier is shown in Figure 5.

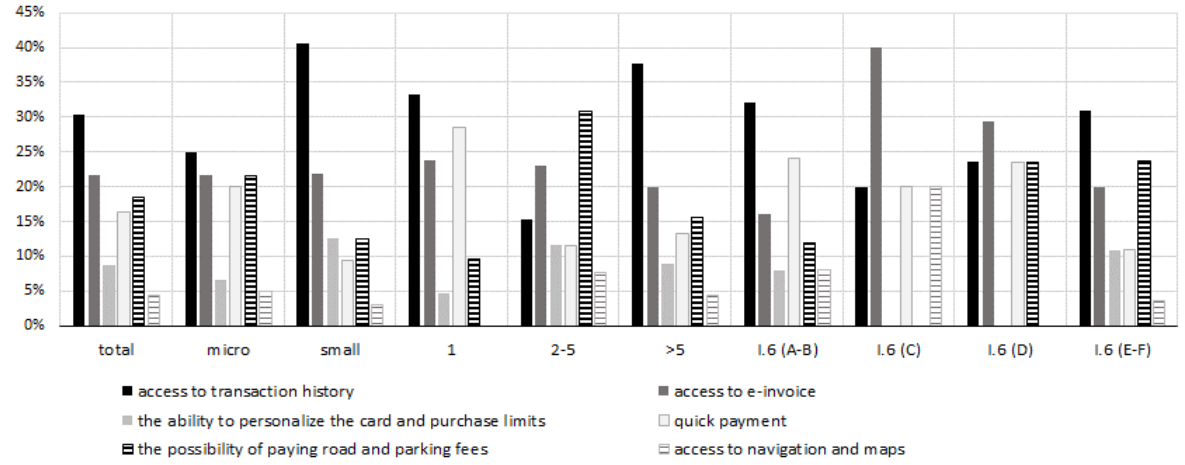

Figure 5. Measurement results: *As part of access to e-bok and the mobile application, it is of fundamental importance when choosing a supplier.*

Source: own study.

In the structure of services provided at petrol stations, the following were important: car park/TIR car park (indicated by 34.1% of the surveyed respondents) and car wash (23.6%). Other factors were secondary. The exceptions were enterprises providing their services only in the Podkarpackie Voivodeship, where the shop (28.6%) and the car wash (22.9%) were of primary importance. The importance of services provided at petrol stations when choosing a supplier is shown in Figure 6.

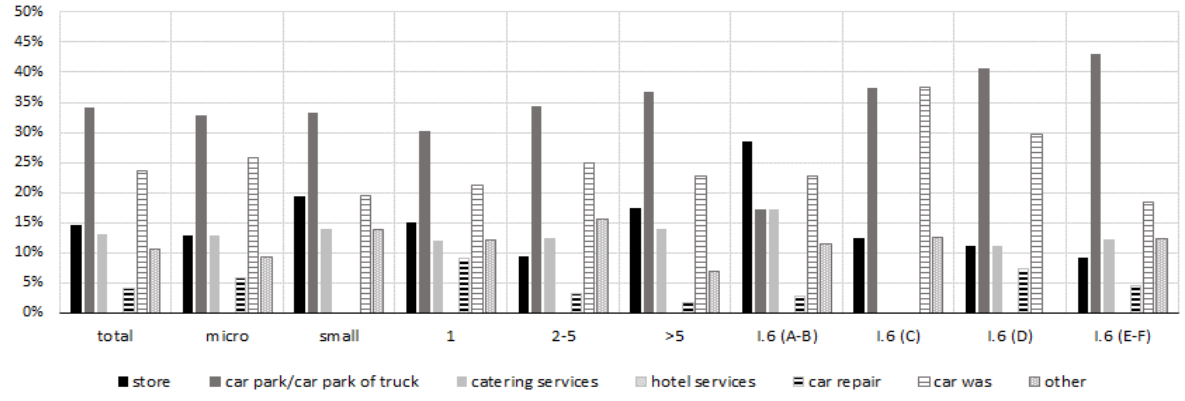

Figure 6. Measurement results: *As part of the services provided at stations, the following are of primary importance when choosing a supplier.*

Source: own study.

5. Conclusions

On the basis of the collected data and their analysis, the following factors determining the choice of petrol stations by micro and small road transport enterprises with their registered office in the Podkarpackie Voivodship should be indicated:

- dispersed purchase, the majority of surveyed enterprises (i.e. 80.7% of respondents) use the services of various petrol stations,
- linking the purchase, a significant part of recipients (i.e., 62.8% of the surveyed respondents) fill up their vehicles at petrol stations included in the commercial network,
- permanent form of cooperation, enterprises prefer cooperation with petrol stations based on permanent contracts (i.e. 59.3% of the surveyed respondents), the importance of a permanent form of cooperation changes depending on the size of the enterprise, the number of vehicles owned or the geographical scope of the activity,
- the main factor in the choice of petrol stations by the surveyed enterprises is the price (67.1% of the surveyed respondents),
- non-price conditions were a secondary factor in the choice of filling stations by the surveyed enterprises, in their structure the most important factors were: transaction conditions (including the form of cash and non-cash payment and a collective invoice for a given period), service stations (including car park/car park truck and car wash) and the number of petrol stations and their location,
- traditional form of cooperation, the surveyed enterprises did not show much interest in the possibility of using e-bok and access to the mobile application,
- In the case of the primary and secondary factors for the selection of service stations by the surveyed enterprises, the criterion of the size of the enterprise, the fleet of vehicles owned or the geographical range of the services provided does not indicate significant differences.

To sum up, the implementation of the topic and purpose of the research allowed to indicate the determinants of the choice of petrol stations by micro and small road transport enterprises, whose headquarters are located in the Podkarpackie Voivodeship. The adopted research hypothesis was confirmed. In the article, the actions taken to achieve the progress of scientific knowledge led to the expansion of knowledge in the discipline of management and quality science in the field of commercial systems, their organization and management. The research focused on areas that have and will have an impact on improving the competitive position of a road transport company. It should be emphasized that the presented research is the second stage of the research process, the main purpose of which is to indicate the scope and form of cooperation of a retail supplier of liquid fuels with a micro and small road transport company in the Podkarpackie Voivodship.

The main limitations and weaknesses in the implementation of the topic and purpose of the research include obtaining data from the surveyed enterprises. It should be recalled that only over 35% of the respondents who were contacted offered a response. And the measurement concerned enterprises located in 21 poviats from 25 Podkarpackie Voivodships. The main reason for the respondents' refusal to participate in the research was their time constraints. This has rarely been the reluctance of companies to share data. In addition, a major limitation in contact with the enterprise was the outdated contact details contained in the electronic database. However, what significantly enriched the research process was direct contact with the respondent. This gave the opportunity to obtain not only answers to the formulated questions, but also their justification.

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THE ROLE OF GENDER AS AN INDEPENDENT DETERMINANT OF ENTREPRENEURSHIP (EVIDENCE FROM POLAND)

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Purpose: The issue of gender in analyzes concerning entrepreneurship is part of numerous items, most of which focus on showing the worse situation of women, often equated with discrimination. Qualitative analyzes are often directly linked to a clear predominance of men in the population of entrepreneurs. This study is of a theoretical-cognitive nature. By emphasizing the prevailing gender discrimination, structural inequalities, and lack of consensus within the scientific community, the article contributes to the ongoing discussion on women's entrepreneurship and the challenges they face. The quantitative nature of the study aims to determine the ratio of women to men engaged in entrepreneurial activities during the social, economic, and political changes that have taken place in Poland over the past three decades. The research problem was embedded in the conception of natural differences between the number of women and men as entrepreneurs wherein the criteria of sustainable development, with convergent entrepreneurial intentions of both sexes.
Design/methodology/approach: The study is theoretical and cognitive in nature. The article uses statistical tools in benchmarking and regression to present a quantitative pattern of entrepreneurship in Poland. The quantitative analysis was preceded by a review of the literature.
Findings: The obtained results indicate that the quantitative structure of the self-employed in terms of gender is quasi-constant. The dominance of men in the population of entrepreneurs does not change over time, and it remains in constant relative relation to the number of women entrepreneurs, regardless of changes in the external environment. Similar arrangements apply to entrepreneurs' decisions regarding liquidation, suspension, and resumption of economic activity.
Research limitations/implications: The completed study has limitations related to the adopted time limit of the public reporting system. Research limitations are also present in quantitative terms that ignore the context.
Practical implications: In practical terms, they constitute a considerable incentive to revise the formulated EU development strategies and the programs implemented as part of public policies that influence the Polish economy. he obtained results are part of the literature that undermines the effectiveness of interventionism, in this case related to the creation of preferences for women.

Social implications: The gender issue in entrepreneurship is important. However, too often these issues are presented in public debate, where the arguments are belief, not science. The article is an important voice in current global discussions on inequality, including discrimination.
Originality/value: The obtained results are supplemented by quantitative research on entrepreneurship, considering the gender of the entrepreneur. The applied research approach in the area of quantitative material and statistical tools is innovative.

Keywords: Entrepreneurship, Gender, Small businesses, gender-balanced entrepreneurship, Self-employed, Business activity.

Category of the paper: Research paper, Literature review.

1. Introduction

By highlighting the need to reframe the concept of gender equality and questioning the effectiveness of existing solutions, the article contributes to the global discourse on promoting women's entrepreneurship and sustainable development. The article deals with the analysis of entrepreneurship in Poland, understood as taking up and running a business on one's account in the context of gender. The subject of the research is the number of self-employed people in the years 1992-2021 and the number of applications submitted to the Central Register and Information on Economic Activity (CEIDG) in the field of starting, suspending, resuming, and terminating business activity in the period June 2019 - January 2022. The adopted lengths of series time limits result from the limitations of public registers and allow capturing the identified relationships from the perspective of systemic changes. Thorough economic reforms initiated in Poland in 1989 had a relevant impact on the national economy. The transformations include the pre-accession period and then membership in the European Union. The background for the collected statistical material is the diverse external environment of enterprises.

Research issues linking gender with entrepreneurship are discussed in the extensive literature on the subject, focused mainly on the determinants of entrepreneurial attitudes and the participation of women in this area. The identified deficit of women running or managing business entities is a fact. Irrespective of the qualitative assessment of this state, the conducted analysis does not give grounds to claim that the share of sexes in the population of natural persons leading business activity changes significantly, and the totality of activities undertaken in this area is convergent in the population of women and men in the perspective the past three decades. Structural differences do not change despite the launch of numerous aid programs included in, among others, European funds, as well as public support launched in crises, such as the COVID-19 pandemic.

The inclusion of gender equality in the SDGs is a motivation for research on female entrepreneurship (Fuentes et al., 2019; Fernández-Guadaño, Martín-López, 2023). However, sustainability cannot be equivalent to strictly quantitative equality. It is significant to capture gender disproportions and look at them in a dynamic system. This perspective allows us to look at the share of women in the population of self-employed people in terms of (or) the assumed effectiveness of implemented public programs based on the assumption of the existing discriminatory inequality.

The conducted analysis proves that despite a sharp quantitative disproportion between the number of women and men starting a business activity, relations in other decisions related to the formal status of the enterprise show a significant strong positive correlation. Those means that the intensity of individual entrepreneurial activities over time is gender neutrality.

2. Literature review

Entrepreneurship is the driving force behind economic growth in any country. The article uses a classic approach to entrepreneurship. In this approach, entrepreneurship is an entrepreneur, i.e., a person who, using appropriate features, is the creator of economic activity (Say, 1960). One of the attributes of entrepreneurship is the creation of new business entities, with micro-enterprises being of particular importance (Iaroslav et al., 2021; Sutter et al., 2019; Si et al., 2020; Gupta et al., 2020). Entrepreneurship is as discovery and exploiting profitable opportunities (Shane, Venkataraman, 2000) in the domain of small enterprises (Kassicieh et al., 2002; Katila et al., 2012).

The gender perspective has been present in the scientific literature of entrepreneurship for many years. One of the most frequently discussed issues is the functioning of enterprises managed by women and the motives for entrepreneurial activities (Corrêa et al., 2022; Kumar, Das, 2019; Ramadani et al., 2022; Sarwar et al., 2021; Sitaridis, Kitsios, 2017; Villanueva-Flores et al., 2021; Welsh et al., 2021). In all the available studies, one can notice a clear dominance of the perspective of gender discrimination in the context of the relatively worse situation of women compared to economically active men. A key issue is the lack of balance in the number of businesses run by women and men. The overrepresentation of men in the population of entrepreneurs is identified by many researchers as a problem of structural inequalities with a strong connotation of unsustainable development and discrimination (Achtzehn et al., 2023; Chatterjee et al., 2022; Halilem et al., 2022; Setyaningrum et al., 2022). Researchers of this trend point to "an entrepreneurial identity gap." The gap includes numerous stereotypes limiting women's activity in self-employment through persistent gender norms in entrepreneurship. (Crane, 2022; Elliott et al., 2022; Siivonen et al., 2022). On the other hand, researchers indicate that quantitative disproportions are natural differences, and structural

inequality is inscribed in the external environment and does not have to be related to discrimination (Mandel, Rotman, 2021; 2022). The lack of scientific consensus indicates a cognitive niche. Scientists prove the exact opposite hypotheses. While some point to similar entrepreneurial intentions of women and men (Avnimelech, Rechter, 2022), the same development aspirations and no differences between the intrinsic motivation of male and female entrepreneurs (Meyer et al., 2022), others argue that they are different (Ramadani et al., 2022). At the same time, there is a lack of research focusing on women's motivation for entrepreneurship and determining whether women who decide to launch a business have different profiles (Llados-Masllorens, Ruiz-Dotras, 2022). Researchers relying on quantitative and qualitative analyzes indicate a problem in confronting the assumption of incomparable sets (women entrepreneurs vs. men entrepreneurs), which may lead to incorrect conclusions (Halilem et al., 2022; Henry, Levis, 2023).

In Poland and other European Union countries, the Gender Mainstreaming policy was actively promoted and adopted by the European Commission in 1997. This strategy assumes the need to take actions aimed at reducing discrimination between women and men in the labor market, assigning the same social value, equal rights, and equal access to financial resources to both sexes, creating opportunities to choose a life path without the limitations of gender stereotypes, recognizing the differences between the lives of women and men resulting from different needs, experience, and gender priorities. In this sense, the overrepresentation of men in the population of people forming the ownership bodies of enterprises results from multifaceted discrimination against women, including numerous barriers to entry into entrepreneurship. In this sense, the overrepresentation of men in the population of people forming the ownership bodies of enterprises results from multifaceted discrimination against women, including numerous barriers to entry into entrepreneurship.

Women in the population of entrepreneurs require rethinking about a consequence, redefining the concept of gender equality, which too often is identified with equality having only a mathematical dimension. Paradoxically, the times of uncertainty that the COVID-19 pandemic is part of may contribute to the verification of concepts promoted over the years and solutions introduced on their basis in public policies (Afshan et al., 2021; Ayatakshi-Endow, Steele, 2021; Stephens et al., 2022). The issue of gender inequality in entrepreneurship, combined with the unnatural overrepresentation of men in the population of entrepreneurs, is still clearly present in science, the media, and politics. That, in turn, is associated with the identified ineffectiveness of many solutions used in this area, including financing new companies from the non-repayable and repayable public and private funds (Chhatoi, 2022; Costa, Pita, 2020) and the search for new solutions in this area (Clayton, 2023).

Systematically conducted quantitative analyzes of entrepreneurship over the years allowed us to build new theories and patterns. The period of uncertainty creates fundamentally new conditions for starting and running a business. Academic literature indicates the fear factor as an essential indicator limiting the entrepreneurial activity of potential and newly established

entrepreneurs (Li, 2011; Morgan, Sisak, 2016). The new field of research fits into the cognitive problem of identifying differences or lack thereof in the entrepreneurial intentions of men and women. A permanent monitoring of the quantitative structure of entities of the national economy, considering the relational analysis, is necessary from the perspective of each country (Jegorow et al., 2021). Creating patterns and identifying emerging deviations in the structure of the population of enterprises, apart from the scientific and cognitive dimensions, is significant from the perspective of the entrepreneurial states concept.

3. Methods and data

Quantitative data necessary for the conducted analysis come from public registers. The reference system is data on the number of self-employed people from 1992 to 2021, divided by gender. The reference system of the analysis is data on the number of self-employed people in the years 1992-2021, broken down by gender. The subject of detailed analysis is a time series covering the number of applications submitted to CEIDG from June 2019 to January 2022. The adopted conditional time limit is the publication of data in public registers. The analyzed applications have four categories: establishment, resumption, suspension, and liquidation of an enterprise. An acceptable generalization of this research is the assumption that the subject of the research concerns micro-enterprises.

In the population of natural persons conducting business activity in Poland in January 2023, 99.07% (2022: 99.03%) were entities employing up to 9 persons, i.e., meeting the definition of a micro-enterprise (2023: 3.53 million out of 3.56 entities; 2022: 3.41 million out of 3.45 million entities). The share of micro-enterprises in total domestic private business entities is 97.38% (2022: 98.65%). In turn, natural persons conducting business in all domestic enterprises constitute 71.21% of entities (2022: 71.27%), of which in the general population of micro-entity they account for 72.94% (2022: 73.08%). The main research problem focuses on the answer to the question: Does the propensity to register new companies, suspend operations, resume, and finally liquidate, regardless of the differences between the sexes, show relatively constant proportions over time? This approach is based on incremental analysis unrelated to the motivation inherent in entrepreneurship, treated as a separate scientific discipline. It also meets the criterion of a strictly economic approach (Smith et al., 2021). The following hypotheses serve to achieve the research objective:

H1: The change in the number of self-employed people over time is similar in the population of women and men, with a relatively constant difference.

H2: The number of enterprises operating on the market and those newly registered is not related to the sex of the entrepreneur.

H2_1: The difference between the number of enterprises registered by women and men is relatively constant.

H2_2: The difference between the number of business activities suspended by women and men is relatively constant.

H2_3: The difference between the number of resumed business activities by women and men is relatively constant.

H2_4: The difference between the number of enterprises deregistered by women and men is relatively constant.

H3: The COVID-19 pandemic has a similar impact on the entrepreneurial decisions of women and men.

H3_1: The COVID-19 pandemic significantly slowed down the registration of new enterprises in the category of both sexes in the initial phase, and this process was not permanent.

H3_2: The COVID-19 pandemic in the initial phase significantly increased the number of suspended business activities in the category of both sexes, and this process was not permanent.

The analytical tools of this study are limited to a set of those that allow the identification of statistically significant differences in the accepted categories of entrepreneurial activity undertaken by women and men based on the number of applications submitted to CEIDG in monthly periods (t-test). Regression and correlation were used in the comparison by gender.

4. Results and discussion

Increasing the number of women numerous in the self-employed population is one of the main goals of the political strategy of Gender Mainstreaming adopted by the European Commission in 1997. With Poland's accession to the EU, Poland implemented numerous subsidy programs to eliminate defined development differences, including the promotion of individual entrepreneurship and support for women recognized as a disadvantaged group in the labor market. The actions taken included, among others: projects addressed to women planning to start a business. At the same time, numerous other programs and social campaigns addressing the issue of discrimination against women in the labor market were implemented, aimed at eliminating the existing differences and barriers. Meanwhile, science provides evidence that the entrepreneurship of women and men is a subject that is exploited unilaterally and used as an element of political struggle, to the detriment of the activity of both. This situation leads to the enforcement of specific legal solutions and the promotion of behavior that would meet the criterion of so-called political correctness (Szczepankiewicz, 2006).

Gender equality is a fundamental right of EU Member States and a prerequisite for achieving sustainable and inclusive growth. This issue is a recognized area of policy action enshrined in the EU Treaties and the EU Charter of Fundamental Rights. The EU is gradually

integrating gender equality policy into all other EU policies. Encouraging women to start a business with the support of public funds and the so-called European Funds are implemented in successive long-term financial programs. The Gender Mainstreaming concept is currently in the Gender Equality Strategy 2020–2025. Transferring this political approach to the next decades with ensuring public funding requires evaluating the programs implemented. In this context, it should be considered whether the differences in the number of self-employed women and men need to be changed and whether the existing disparities should be linked to discrimination. It should also be considered whether the support intended to increase the participation of women entrepreneurs in the economy in the forms implemented so far is appropriate. At this point, attention should also be paid to the low effectiveness, regardless of gender, of many subsidy programs implemented. The failure of interventions financed from public funds has been empirically verified in scientific analysis (Jegorow, Przyłuska-Schmitt, 2022).

4.1. Self-employed in the working population in 1992-2021

The data presented by the Central Statistical Office indicate that the number of self-employed people has decreased over the last three decades (by 14.3%) (Figure 1). In the case of men, the decrease was 2.1%, while in the case of women, the change reached 32.5%. The changes in the last decade of the 20th century (men) and the first decade of the 21st century (men and women) had a powerful effect on the values of these indicators. However, while in the case of men, their share among the self-employed increased slightly in the first two decades of the 21st century, in the case of women the trend was reversed and there was a decrease of 22.2%.

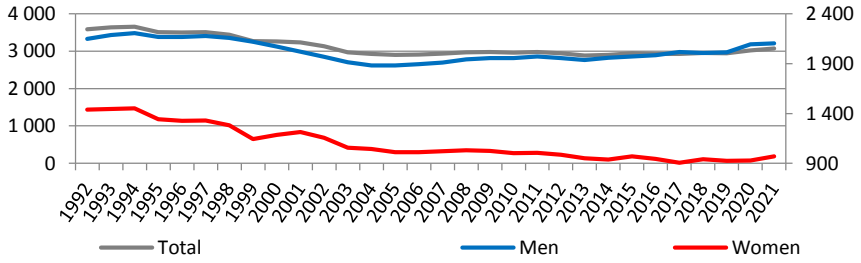

Figure 1. Self-employed in thousands.

Source: own study.

The analysis of the dependence of the number of self-employed women and men for the shortened time series (2001-2021) shows a little negative correlation coefficient, which is statistically insignificant (Pearson Correlation -0.238; $p = 0.299$; $N = 21$). Statistically significant, however, is the relationship covering the entire time series 1992-2021 (Pearson Correlation 0.752; $p < .001$; $N = 30$). A clear and positive correlation between the number of self-employed women and men indicates a relatively constant relationship between these measures over the past three decades. At the same time, the statistics recorded in the last decade of the 20th century have a significant impact.

In 1992, the population of self-employed men was 49% larger than that of women. Currently, this ratio is 117%. Three decades ago, women accounted for more than 40% of self-employed people, but now they are less than 32%. This relationship is downward, determined by a linear trend, which results from linear regression, where the independent variable is time (Table 1). The projected decrease in the share of women in the self-employed population is at the level of 0.3 p.p. y/y (B) (in absolute terms, a statistically acceptable linear regression model indicates a decrease exceeding 18,000 y/y). The correlation is negative and very high: -0.973 (Beta). At the same time, changes in the share of women in the population of entrepreneurs show slight volatility over time: 7.526% (CV).

Table 1.
Summary of Regression Model – women in the group of self-employed people[a,b]

I. Model Summary	**R**	**R Square**	**Adjusted R Square**	**Std. An error in the Estimate**	**Durbin-Watson**
	0.973	0.946	0.944	0.638	1.473
II. ANOVA	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Regression	201.494	1	201.494	494.291	0.000
Residual	11.414	28	0.408		
Total	212.908	29			
III. Coefficients	**Unstandardized**		**Standardized**	**t**	**Sig.**
	B	Std. Error	Beta		
Constant	635.812	27.023		23.529	0.000
Year	-0.299	0.013	-0.973	-22.233	0.000
IV. Residuals Statistics	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Coefficient of Variation**
Predicted Value	30.683	39.366	35.025	2.636	7.526%

Note. a. Dependent Variable: Woman; b. Predictors: (Constant), Year.

Source: own study.

The population of self-employed people among working people is not the same as the number of entrepreneurs active on the market. Comparing data on the number of entities of the national economy by legal form from January 2012 and 2022, respectively, it turns out that although the total number increased by almost 25%, it was with clearly different intensity in individual legal categories. The increase in self-employed people in the general population reached 20% in the last decade. At the same time, the number of companies increased by almost 50%, with the most significant increase in the category of commercial companies, i.e., by over 85%.

At the same time, the number of companies increased by almost 50%, with the most significant increase in the category of commercial companies, i.e., by over 85%. The most significant increase, reaching 136%, took place in the case of foundations. In the case of associations and social organizations, the increase amounted to almost 30%. The decrease took place in two categories: state-owned enterprises and cooperatives. The presented statistics are

justified by the changes in the Polish economy, in the natural search for solutions leading to the reduction of fixed costs of running a business.

4.2. Self-employed by gender - comparative analysis (June 2019 - January 2022)

The definite advantage of men in the self-employed population directly translates into a clear advantage in all categories listed in CEIDG (Table 2). On average, men set up over 80% more enterprises per month than women, while the liquidation rate is 60% higher in the case of the analyzed relationship. These indicators combined with the fact of almost 117%. The predominance of the number of enterprises run by men compared to women is not a good prognostic of all activities aimed at increasing women's entrepreneurship. The quantitative predominance of registrations of new entities combined with a relatively lower share of liquidations of existing enterprises to their total number indicates a higher survival rate of enterprises run by men.

Table 2.
Group Statistics

	Sex	Mean	Std. Deviation	Coefficient of Variation [in %]	Std. Error Mean
Suspension	Men	16,001	5,199	32	919
	Women	8,812	3,283	37	580
Resumption	Men	8,093	2,216	27	392
	Women	4,263	1,862	44	329
Termination	Men	8,507	2,935	35	519
	Women	5,302	1,956	37	346
Assumption	Men	15,086	2,284	15	404
	Women	8,369	1,377	16	244

Source: own study.

Differences in the individual four analyzed self-employed activities, divided by gender, should be considered a direct consequence of more than twice as many men running a business. These differences are statistically significant (Table 3).

Table 3.
Independent Samples t-Test

	Levene's Test for Equality of Variances		t-test for Equality of Means (Equal variances assumed)				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Suspension	2.838	0.097**	6.614	62	0.000*	7,189	1,087
Resumption	0.510	0.478**	7.486	62	0.000*	3,830	512
Termination	2.117	0.151**	5.140	62	0.000*	3,204	623
Assumption	5.208	0.026**	14.244	62	0.000*	6,717	472

Note. ** The criterion of equality of variances is met for Sig.>0.05; *Test is significant at the Sig.<0.001 level (2-tailed).

Source: own study.

The results of the correlation analysis based on four pairs of activity categories of the self-employed, considering the sex of entrepreneurs, indicate a very strong positive statistical relationship (Table 4).

Table 4.
Estimated correlation coefficients among sex (N = 32; Jun-19 – Jan-22)

CC	Suspension	Resumption	Termination	Assumption
a.	0.882**(.000)	0.948**(.000)	0.997**(.000)	0.884**(.000)
b.	0.665**(.000)	0.730**(.000)	0.842**(.000)	0.540**(.000)
c.	0.819**(.000)	0.885**(.000)	0.954**(.000)	0.716**(.000)

Note. CC - Correlation Coefficient, a. Pearson Correlation, b. Kendall's tau_b, c. Spearman's rho. **. Correlation is significant at the 0.01 level (2-tailed).

Source: own study.

The graphical presentation of the time series of the four characteristics, broken down by the sex of entrepreneurs, confirms a very strong statistical relationship and a relatively constant difference in individual reporting categories (Figure 2). The identified dependence combines a quasi-permanent relation of the number of decisions related to making, running, and liquidating economic activity, broken down by gender.

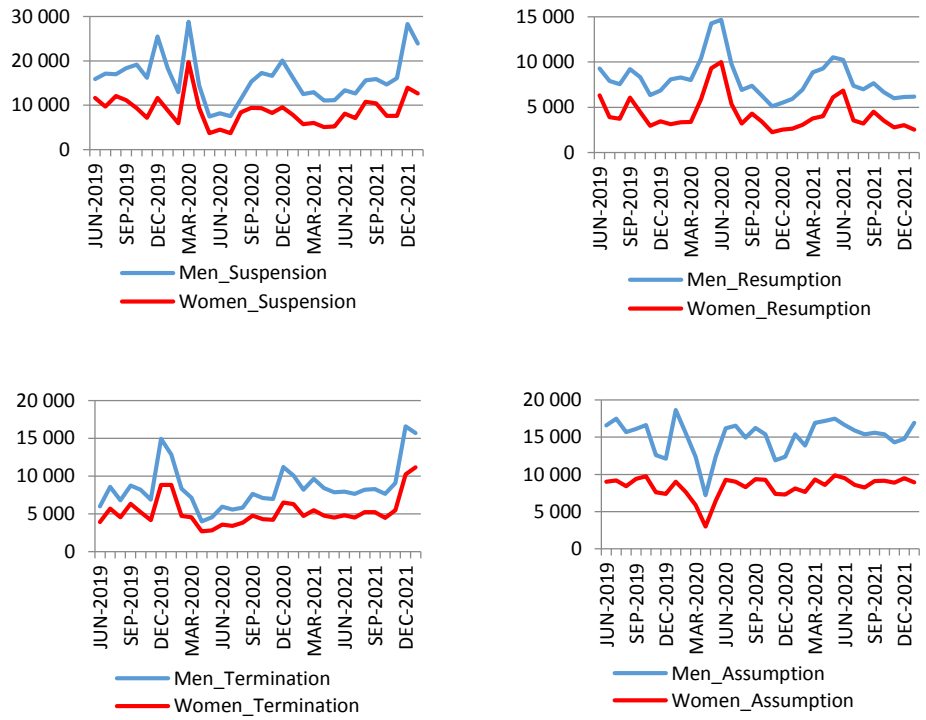

Figure 2. Self-employed in thousands.

Source: own study.

In Poland, only one in three sole proprietorships lead by a woman. The identified convergence in the intensity of entrepreneurial decisions in the four analyzed categories monthly, broken down by gender, was not disturbed by the outbreak of the COVID-19 pandemic. Although self-employed people made decisions different from the pattern built based

on data from periods characterized by a relatively stable external environment of enterprises (Jegorow et al., 2021; Jegorow, Przyłuska-Schmitt, 2022), these changes had the same return and similar intensity in the case of women and men. Other researchers analyzing the issue of women's entrepreneurship in the same period, but in the qualitative dimension, also did not identify gender differences (Kogut, Mejri, 2022).

In March 2020, entrepreneurs submitted the largest number of applications for suspension of business activity. The fewest applications for registration of new enterprises were in 2012-2021. On the other hand, in May and June 2020, the largest number of applications for the resumption of economic activity was submitted. These anomalies were incidental in nature and were not postponed to subsequent months as in previous years. The quantitative dimension of the population of self-employed entrepreneurs during the COVID-19 pandemic has not changed in a way that indicates the negative effects of the pandemic. Entrepreneurs' decisions did not differ by gender. However, it should be emphasized that the quantitative analysis does not exhaust the research field but also indicates problem areas. The number of active enterprises cannot be directly related to their financial condition. Therefore, the obtained results do not negate the findings of other researchers that the relative calmness of undertaking entrepreneurial activity and running companies has been seriously disturbed by the COVID-19 pandemic, especially in the case of the smallest enterprises (Parnell et al., 2020); Ratten, 2020; Cucculelli, Peruzzi, 2020; Endris, Kasssegn, 2022; Liguori, Pittz, 2020; Nasar et al., 2021). At this point, one should consider the numerous, diverse national aid programs that quite strongly inscribe contemporary entrepreneurship into public policies, and thus the requirement of great caution in generalizing conclusions.

The overrepresentation of male entrepreneurs is a feature that characterizes economies around the globe. However, this does not mean that "business and entrepreneurship are certainly a monopoly on men" (Crane, 2022; Setyaningrum et al., 2022). Over the last three decades, the share of women among the self-employed in Poland has been systematically decreasing. This happened regardless of the economic, social, political, and cultural transformation, the implementation of numerous subsidy programs, including those financed from EU funds, and dedicated exclusively to women interested in starting their businesses. A lack of a quantitative increase in the share of women in the population of entrepreneurs, in the context of the state aid granted, should be associated with an incorrect diagnosis based on recognizing quantitative disproportions as a discriminatory problem.

The European Parliament resolution of 3 May 2022 on achieving economic independence for women through entrepreneurship and self-employment (2021/2080(INI)) indicates that starting and running a business in the EU is a complex issue due to different bureaucratic requirements and procedures and administrative. However, these problems are different for men and women. Barriers to women's entrepreneurial activity include gender stereotypes that indicate gender segregation. On this basis, numerous calls were formulated to support women interested in starting a business, ultimately striving for quantitative sustainability.

5. Conclusions and reflections

Differences in the number of female and male entrepreneurs in Poland are quasi-constant, regardless of economic, social, political, and cultural changes determined by the perspective of the past three decades. In the post-transformation period in Poland, the number of self-employed people decreased, including a higher decrease in the population of women. The identified proportions should therefore be seen as natural.

The conducted analysis proves that the share of individual activities in starting, running, and liquidating businesses is similar in the population of women and men. That happens although the presence of women in business is much smaller. Decisions regarding the functioning of enterprises change clearly over time monthly, but these changes have a very similar intensity in the case of both sexes. Thus, we conclude that the decisions taken are not related to the gender of the entrepreneur. The positive verification of this hypothesis was confirmed by the results obtained during the COVID-19 pandemic. This context also creates added value as evidence of the lack of a noticeable impact of the pandemic on the quantitative structure of the population of self-employed people.

The obtained results are supplemented by quantitative research on entrepreneurship, considering the gender of the entrepreneur. The completed study has limitations related to the adopted time limit of the public reporting system. This fact indicates a relatively new field of knowledge in the Polish socio-economic space. Research limitations are also present in quantitative terms that ignore the context. The combination of these two areas opens an important and needed research field. The research concept is new, determined by access to source data. When indicating prognosis, and desirable research directions, it is necessary to consider extending the study to other economies to generalize the results obtained or to indicate that entrepreneurship has national borders. It is also worth considering the latest statistics in subsequent analyses, including global instability identified with time.

Based on the EU's public policy guidelines, it is desirable to apply to balance the number of female and male entrepreneurs, even though the gender of Schumpeter's entrepreneur does not matter in the contribution to economic growth. This analysis does not confirm that the number of female entrepreneurs in Poland increased after the accession to the EU, despite many projects already implemented, financed, or co-financed from public funds. The EU's new financial perspective for 2021-2027 re-implements the implementation of many assistance programs for women interested in starting a business. It is worth considering whether their above-average support paradoxically leads to discrimination against men. The efficiency of public spending is also becoming a problem.

After the outbreak of the COVID-19 pandemic, 2022 brought another shock - a military conflict between Russia and Ukraine, which shook the global economic system. Unimaginable for most societies of the civilized world, the humanitarian drama is a disgraceful example of the weaknesses of the systems, alliances, and agreements created over the years. Parallel to strictly military activities, there is an economic war in international trade and

internationalization, in which Poland plays quite a heavy role. Individual negative entrepreneurial consequences in this situation are inevitable. The extent of these effects will be possible to estimate in subsequent studies, including those using the quantitative structure of enterprises, considering the gender of owners. However, today, the time of war verified the approach to women's and men's treatment of the traditional approach to gender. Concepts of equality gave way to a need to involve men in the war, to secure women with their children and other dependents, as was the case, for example, with on the territory of Poland.

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THE ROLE OF ENVIRONMENTAL FUNDS IN SPENDING ON AIR PROTECTION IN POLAND

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Purpose: In the context of the climate crisis, one of the most pressing challenges the international community faces consists in actions aimed at reducing air pollutant emissions in the world. The objective of the study was to determine the role of voivodeship funds in disbursing funding for air protection in Poland.
Design/methodology/approach: The study used statistical methods and the desk research method, which involves analyzing and processing data from existing sources. The analyzed data concerned the number of applications and signed contracts, the value of signed contracts and transferred funds under programs implemented by voivodeship environmental protection funds and water management. The study pertained to the 2018-2020 period. As for the Clean Air Programme, the study surveyed 2018-2021.
Findings: The study confirmed a significant role the voivodship funds perform in the disbursement of funding on air protection initiatives. Since 2018, voivodeship funds for environmental protection and water management have been increasingly performing the distributive function. By executing own actions concerning air protection between 2018-2020, they faced fewer challenges than the one posed by the joint delivery of such an extensive programme as the Clean Air Programme with the National Fund.
Research limitations/implications: A limitation of the study is the inclusion of data on the programmes implemented only by 12 voivodship funds. Therefore, future studies should be extended to include data from all funds and cover further periods of implementation of air quality programmes by these institutions. However, with regard to the evaluation of factors influencing environmental efficiency, future studies may take into account other variables in the analysis of correlations, both in terms of environmental effects and socio-economic variables.
Originality/value: The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds, and their role in and responsibility for the implementation of air protection programmes. In addition, the study contributed to the expansion of empirical research with the analysis of environmental effects of the Clean Air Programme.

Keywords: climate funds, air protection, funds for environmental protection and water management.

Category of the paper: Research paper.

1. Introduction

Climate change is a prominent phenomenon observable in all parts of the world. Hazards it brings about do not exclusively pertain to the natural environment. They also affect social, territorial and even economic domains. In recognition of the need to counteract the negative consequences of climate change, various financial mechanisms are established to support activities and projects concerning the mitigation of and adaptation to climate change. In the context of the current climate crisis, one of the most pressing challenges the international community faces in connection with climate protection consists in the delivery of actions aimed at reducing air pollutant emissions in the world. Air pollution encompasses all gaseous, liquid and solid (particulate matter) fractions which are not natural components of air, or whose content in the air is higher than the natural one. Air pollution and climate change are closely interrelated. Greenhouse gases retain heat in the atmosphere and translate into global warming. An example of efforts made concerning the reduction of air pollutant emissions is the strategy adopted by the European Commission – climate neutrality by 2050, which assumes that the European Union's economy will be the first in the world to achieve climate neutrality by 2050 (Climate neutrality, 2019), becoming a kind of beacon for others. The implementation of commitments made by individual member states concerning the establishment of a zero-emission economy will not be an easy task. According to a report by IQAir (2021 World Air Quality Report, 2021), a global air quality monitoring company, out of 6,475 cities surveyed in 117 countries, merely 222 met the standards for the volume of PM2.5 in the air set by the World Health Organization. The results of the report are therefore very alarming, especially with regard to health issues and human life. In connection with the foregoing, it is crucial that the international community intensifies actions aimed at the mitigation of and adaptation to rapidly progressing climate change.

One of the most vital components of actions regarding climate change is to provide the necessary financial support originating from both public and private sources. With this purpose in mind, funds dedicated to environmental protection are established in order to finance programmes and projects aimed at combating climate change. In this article, climate funds financing activities and "air protection programs" implemented by voivodeship environmental protection and water management funds were examined.

Among the most significant functions of climate funds are the redistributive and fiscal functions. The functions performed by climate funds therefore consist, on the one hand, in the collection of funds and, on the other hand, in their distribution (Zdanukiewicz, 2012). In the literature of the subject, merely a narrow field of research is devoted to climate funds. Among the main streams of research, the following can be enumerated: legal and institutional dimension of climate funds (Kalinowski, 2020; Caldwell, Larsen, 2021; Bowman, Minas, 2018), effectiveness of their operation (Omukuti et al., 2022; Bhandary et al., 2021; Cianbiao

et al., 2019) as well as their social perception (Hugel, Davies, 2020; Bhandary, 2021a; Begum, Mahanta, 2017).

According to Carfora and Scandurra (2019), climate funds enable countries to enter the path of sustainable energy development. However, in order for this to actually happen, it is necessary to enhance the effectiveness of mobilization and administration of public and private funds for climate protection purposes (Bhandary et al., 2021).

Research on public, national climate funds is rare (Prasad, Sud, 2019). In Poland, studies on climate funds are available (Rabiega et al., 2022) which discuss priority programmes and actions related to climate protection. As far as air protection is concerned, reports of non-governmental and monitoring organizations are drafted (Adamkiewicz et al., 2021) which assess anti-smog activities implemented in the framework of priority programmes and projects, and which form recommendations for prospective actions. In Poland, there is a lack of research on the role of public climate funds in disbursing funding under climate protection programmes and projects[1].

The objective of the article is to determine the role of voivodeship funds in disbursing funding for air protection in Poland. Therefore, the following research questions were posed: Has the pool of finances at the disposal of the voivodship funds earmarked for public actions concerning air protection increased? What is the outlook upon the voivodship funds' disbursement of public funding on tasks executed jointly with the National Fund for Environmental Protection and Water Management (NFEP&WM) regarding air protection in Poland? What are the environmental effects of the Clean Air Priority Programme? In order to establish answers to the above questions, the desk research method and statistical methods were employed. The data analysis was conducted on the basis of information made available by the NFEP&WM and the VFEP&WM.

The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds, and their role in and responsibility for the implementation of air protection programmes. In addition, the study contributed to the expansion of empirical research with the analysis of environmental effects of the Clean Air Programme.

The present article is organized as follows: Section 1 introduces the issue of climate change and its impacts. The matters discussed therein are related to global air pollution and international community commitments; Section 2 presents climate funds as a source of financing of climate protection actions; Section 3 outlines research methodology; Section 4 analyzes empirical research results; Section 5 presents the interpretation of results and conclusions emerging from the study.

[1] The following works constitute exceptions: Swianiewicz, Lackowska, 2017, 55-80; Gradziuk, Gradziuk, 2017, 95-105; Wajda, 2022, 51-65; Gręda, Kania, Skomorowska, Wiśniewski, 2020, 51-61.

2. Literature review

2.1. From financing climate protection to climate funds

Significant financial resources are required to deliver climate protection actions. According to the Adaptation Gap Report "The Gathering Storm", fiscal stimuli amounting to USD 16.7 trillion have been made available worldwide (UNEP, 2021). However, merely a small part of the money has been allocated to adaptation to climate change. The report points out that the delivery of adaptation-related activities has been growing slowly. Moreover, further initiatives towards funding and implementation are required (Adaptation and mitigation…, 2021). It is therefore necessary to ensure financial support for climate-oriented actions, both from public and private sources. For this purpose, funds dedicated to environmental protection must be established, whose task is to finance programmes and projects aimed at combating climate change.

In-depth research in the field of climate protection allows to distinguish several main dimensions related to climate funds, namely the legal and institutional dimension of climate funds (Kalinowski, 2020; Caldwell, Larsen, 2021; Bowman, Minas, 2018), their effectiveness (Omukuti et al., 2022; Bhandary et al., 2021; Cianbiao et al., 2019) and their social perception (Hugel, Davies, 2020; Bhandary, 2021a; Begum, Mahanta, 2017).

In the literature of the subject, one can find articles on the establishment and operation of international climate funds (Caldwell, Larsen, 2021; Bowman, Minas, 2018), as well as their structure and portfolio strategy (Amighini et al., 2022; Fonta et al., 2018). Such an approach to viewing the funds can be described as legal and institutional. The same applies to national climate funds where the analysis indicates their attributes, including the legal form, the scope of their activities and sources of financing (Bhandary, 2022). As far as the analysis of legal and institutional solutions of climate funds is concerned, studies discussing the role of intermediaries in shaping the financing of climate change actions are also available. Chaudhury (2020) notes a certain dominance of international intermediaries in the development and implementation of projects under climate funds. National intermediaries, on the other hand, have a poor capacity to create and scale projects.

The second area of research concerns the effectiveness of climate funds. Bhandary et al. (2021) point out that in addition to minimizing public costs, while taking fairness aspects into consideration, it is important to achieve climate-related goals, i.e. in addition to economic efficiency, achieving environmental efficiency as well. The basis for studying the effectiveness of climate funds is reporting and monitoring the effects of project implementation. However, as indicated by Weikmans and Roberts (2019), the lack of internationally agreed methods of tracking climate protection activities may cause discrepancies in statements and reports. Such a situation may lead to the inability to conduct a fair comparison of the effects of project implementation and outcomes of activities financed under climate funds.

Climate funds are also examined in the context of their social perception. As Hügel and Davies (2020) point out, it is important to engage society in problems pertaining to climate-related financing. At the same time, it is vital to ensure appropriate access to information as well as the possibility of public participation in decision-making processes. While examining the issue of mainstreaming climate change, Bhandary (2021a) noted that climate funds can engage local communities and be a kind of relay of expertise in climate programming.

The analysis of literature concerning climate-related financing conducted by Jayaram and Singh (2021) indicated an insufficient level of research in certain aspects such as the weakness of local funding institutions and issues connected with the allocation model. These may serve as future research areas concerning climate-related financing. Therefore, a research gap exists in this domain which requires further examination.

2.2. Climate protection funds in Poland

In Poland, institutions that drive activities related to financial support for environmental protection are, inter alia, the National Fund for Environmental Protection and Water Management and 16 voivodship funds for environmental protection and water management. These institutions, based on the Environmental Protection Act, implement the environmental policy of the state and the policies of individual voivodships in terms of environmental protection specified in regional strategies and programmes. Additionally, once every four years they establish a common strategy of action which indicates the critical substantive objectives and priorities of cooperation (Common Strategy, 2020). Voivodeship funds for environmental protection and water management are public institutions offering subsidies, loans and other forms of funding for environmental protection programmes. Beneficiaries of the support offered by the funds encompass local governments, public entities, enterprises, social organizations and natural persons. In the past five years, the voivodship funds commenced a large-scale implementation of joint priority programmes for environmental protection, including air protection. Jointly implemented programmes provide the financing of projects from both the National Fund and the individual voivodship funds. Regarding air protection, joint activities of the institutions are aimed not only at improving air quality and transitioning towards a low-carbon economy, but also at achieving the objectives of the climate and energy package for Poland (Common Strategy, 2020).

In 2018, cooperation in the implementation of joint environmental protection programmes between the National Fund and the individual voivodship funds began to gradually increase, mainly concerning financial redistribution. In the aspect of air protection, these institutions began to implement the largest to date Clean Air Priority Programme, whose main objective is to enhance energy efficiency and reduce particulate matter and pollutant emissions into the atmosphere. In 2018, the value of funds made available by the National Fund under contracts concluded with the individual voivodship funds for payments to final beneficiaries of the programme amounted to PLN 1,004,000 thousand of which PLN 830,000 thousand was in the

form of grants and PLN 174,000 thousand in the form of loans (Common Strategy, 2020). The most vital tasks related to the implementation of the programme were assigned to the voivodship funds, which deal with the processing of applications, concluding and settling contracts with beneficiaries, monitoring and reporting activities. The implementation of the Clean Air Priority Programme is scheduled for 2018-2029. The budget of the programme is over PLN 103 billion (Clean Air Priority Programme…, 2022). The second joint programme concerning air protection implemented since 2018 by the voivodship funds was the Air Quality Improvement Programme dedicated to reducing energy consumption in the construction sector. As part of the cooperation in 2018-2020, the National Fund concluded 15 contracts providing grant-based funding to final beneficiaries via the voivodship funds for a total amount of over PLN 250 million. As part of the cooperation, the voivodship funds funded 301 grant-based co-financing applications and 52 loan-based ones (Common Strategy…, 2020). It should be noted that in addition to this, the funds also spend their finances on the basis of the Environmental Protection Act in the framework of the so-called "fields". In their annual operational plans, the funds specify environmental protection financing avenues scheduled to be funded during the particular year. For example, regarding air protection, individual funds allocate their own resources to the delivery of various tasks aimed at reducing emissions of air pollutants and tasks associated with thermo-modernization, and develop and implement their own air protection programmes[2]. Actions eligible under air protection programmes delivered by the voivodeship funds include, e.g. replacement of inefficient solid fuel heat sources, insulation of building partitions or replacement of window and door joinery.

Research on the role of the funds in financing the implementation of air protection programmes and projects is carried out to a limited extent by the Supreme Audit Office as part of the auditing operation of the institution (Post-inspection report – Opole…, 2020). Fura (2017) researched the effectiveness of air protection and climate actions in voivodeships in Poland. Mesjasz-Lech (2014) studied regional air protection actions. However, these studies do not directly pertain to the voivodship funds for environmental protection and water management. The change in the role of the funds is reflected in the content of subsequent Common Strategies of the National Fund and the voivodship funds for environmental protection. However, there is a lack of up-to-date[3] research on the operation of the voivodship funds, their role in and increasing responsibility for the implementation of air protection programmes.

[2] The Voivodeship Fund for Environmental Protection and Water Management in Warsaw executed, e.g., OA-1 programme entitled "Reduction of air pollutant emissions, reduction of heating consumption, and exploitation of renewable energy sources" and OA-2 entitled "Modernization of electrical lighting", Report on the activities of the Voivodship Fund for Environmental Protection and Water Management in Warsaw for 2019.

[3] Works on the role of the voivodship funds date back to several years ago, e.g. Górka, Rosiek, 2007, 51-74, i.e. they predate the amendment of the Environmental Protection Act of 2009, which resulted in the funds operating as local government legal entities since 2010. The operation of voivodship funds for environmental protection was also examined by the Supreme Audit Office. However, the audit concerned the 2014-2017 period, https://www.nik.gov.pl/plik/id,16844,vp,19402.pdf, 10 September 2022.

3. Methodology

In order to establish answers to the research questions, the desk research method and statistical methods were employed. The data analysis was made on the basis of information made available by the National Fund for Environmental Protection and Water Management and voivodship funds for environmental protection and water management (NFEP&WM and the VFEP&WM). Data on two programmes implemented jointly by the funds were analyzed, i.e. Clean Air Priority Programme and Air Quality Improvement Programme for the reduction of energy consumption in the construction sector. In addition, data on the delivery of air protection tasks financed from own resources of individual voivodship funds in 2018-2020 were also analyzed. The present study employed statistical methods and the desk research method, consisting in analyzing and processing data from existing sources, the so-called legacy data and, based on them, formulating conclusions on the surveyed issue (Encyclopedia…, 2022). As part of the applied method, the analysis of programming documents and the analysis of reporting data were carried out. The Clean Air Programme, as well as the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector, were delivered by the voivodship funds since 2018. Therefore, the research covers the 2018-2020 period, and in relation to the Clean Air Programme, the 2018-2021 period. In 2018-2021, the voivodship funds for environmental protection, jointly with the National Fund, also implemented other air quality improvement programmes, which will be disregarded in this article[4]. This is due to the fact that they were not implemented by all voivodship funds, only concerned selected ones or were implemented by few funds as pilot projects (National Fund report…, 2021).

The analyzed data encompassed the number of applications and signed contracts, the value of signed contracts and funding transferred under programmes implemented from own resources and under the Clean Air Priority Programme and Air Quality Improvement Programme for the reduction of energy consumption in the construction sector. In the case of the Clean Air Priority Programme, data on the obtained environmental effects were also collected. The research process is outlined in Figure 1.

[4] Excluding the Air Quality Improvement Programme, which was discussed in the article because it was not implemented exclusively by the Voivodship Fund for Environmental Protection and Water Management in Zielona Góra.

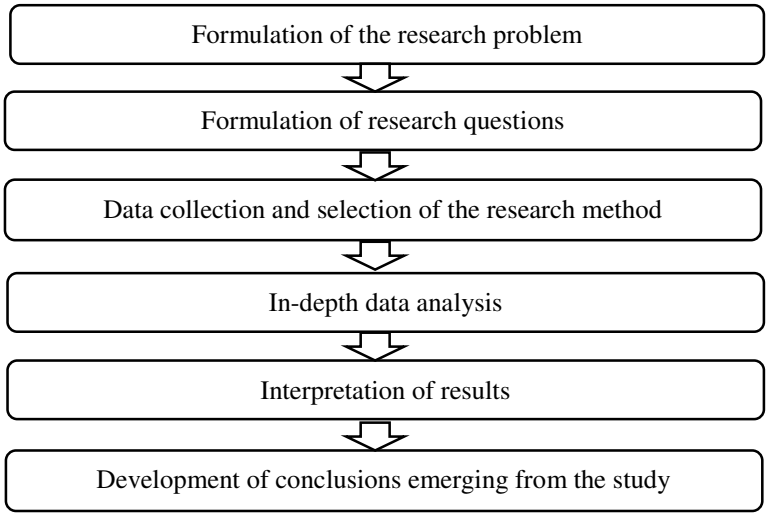

Figure 1. Research process.

Source: own elaboration.

4. Research results

4.1. Analysis of the Clean Air Priority Programme

Table 1 presents the number of applications submitted to the individual voivodship funds for environmental protection and the value of the requested co-financing under the Clean Air Priority Programme.

Table 1.
Applications submitted under the Clean Air Priority Programme in 2018-2021

No.	VFEP&WM	Number of project applications (pcs.)				Value of the requested co-financing (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	1182	3731	2904	4989	29 465	89 339	54 567	89 200
2.	Gdańsk	1908	5635	4160	8504	36 453	109 659	63 107	129 253
3.	Katowice	3722	10040	12413	37990	79 022	168 837	155 775	491 179
4.	Kielce	1640	5122	4634	9228	34 248	117 296	86 721	169 364
5.	Kraków	2364	8925	10056	19973	62 825	223 857	171 931	344 910
6.	Lublin	2042	5791	4203	9265	51 233	137 585	78 829	153 028
7.	Łódź	1094	6116	6103	12469	25 243	121 149	88 182	180 890
8.	Olsztyn	697	3183	3238	5949	16 005	70 259	59 102	96 874
9.	Opole	864	1904	2234	5843	16 434	33 705	29 154	83 121
10.	Poznań	1999	6696	6805	15682	46 782	131 246	101 481	224 330
11.	Rzeszów	1318	4999	4798	10128	32 084	109 806	91 435	177 744
12.	Szczecin	816	2416	1984	4134	18 687	47 672	29 293	60 992
13.	Toruń	1479	5580	5982	10746	22 808	98 049	86 226	162 339
14.	Warszawa	2699	9546	8755	18642	48 084	184 027	135 563	278 231
15.	Wrocław	1131	4069	3586	9107	20 088	74 067	49 638	124 273
16.	Zielona Góra	564	1788	1946	3624	9 576	30 074	27 259	52 795
17.	**Total**	**25519**	**85541**	**83801**	**186273**	**549 037**	**1 746 627**	**1 308 263**	**2 818 523**

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The study indicated that in 2019 and 2020, the number of applications submitted under all voivodship funds was at a similar level. In 2018, the number of applications was lower due to the fact that the programme was launched in Q3. The programme noticeably accelerated only in 2021. The largest number of applications was submitted to the Fund in Katowice – 64,165, and the lowest in Zielona Góra – 7,922. The requested value of co-financing in 2018-2021 for all applications submitted to the funds amounted to over PLN 6.4 billion.

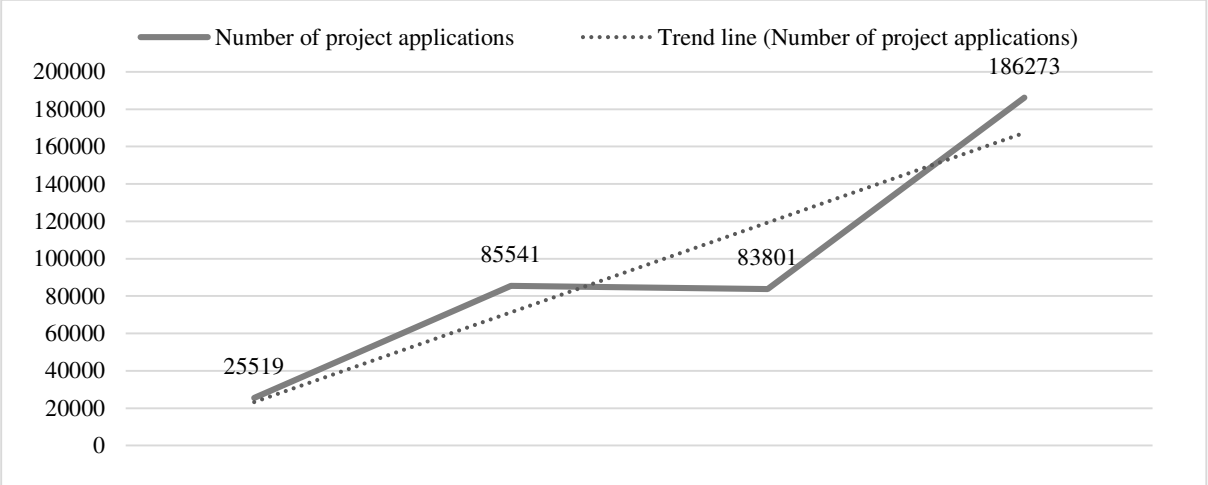

Figure 2. Number of applications submitted under the Clean Air Priority Programme plotted with the trend line.

Source: own elaboration.

Similar results were obtained in relation to the number and value of co-financing contracts concluded in 2018-2021 under the Clean Air Programme (Table 2).

Table 2.
Co-financing contracts concluded under the Clean Air Priority Programme with final beneficiaries in 2018-2021

No.	VFEP&WM	Number of concluded co-financing contracts in individual years (pcs.)				Value of contracts (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	0	2969	3362	4151	0	66 674	67 238	75 375
2.	Gdańsk	16	4965	5115	6434	165	16 445	151 812	97 463
3.	Katowice	0	5536	15675	26333	0	87 902	217 999	338 536
4.	Kielce	0	3480	5662	8364	0	69 197	113 769	149 725
5.	Kraków	0	5402	11463	16743	0	123 920	221 996	286 952
6.	Lublin	0	2990	7111	7651	0	62 557	143 955	127 877
7.	Łódź	0	2937	7639	8838	0	56 664	121 561	129 091
8.	Olsztyn	9	3321	3097	4888	104	65 329	56 431	81 820
9.	Opole	0	1182	2820	4383	0	18 279	37 809	61 958
10.	Poznań	0	3112	9117	11784	0	57 517	150 765	170 403
11.	Rzeszów	0	3227	5218	8294	0	71 564	102 218	145 857
12.	Szczecin	0	2665	2004	2390	0	44 866	30 720	35 855
13.	Toruń	0	4966	5839	8281	0	80 442	86 585	123 966
14.	Warszawa	29	7039	11088	14211	318	123 616	186 157	213 191
15.	Wrocław	0	2513	3761	6129	0	40 434	53 569	77 099
16.	Zielona Góra	5	1671	2075	3254	49	24 805	29 839	46 468
17.	**Total**	**59**	**57975**	**101046**	**142128**	**636**	**1 010 211**	**1 772 423**	**2 161 636**

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The study indicated that despite the launch of the programme on 19 September 2018, only 59 contracts were signed by the end of that year. In the following years, the situation regarding the number of signed contracts began to change gradually. Therefore, certain acceleration in the implementation of the Clean Air Programme can be observed. At the same time, there are differences in the number of submitted applications and signed co-financing contracts between individual voivodship funds. The largest number of co-financing contracts was concluded by the Fund in Katowice – 47,544, and the lowest in Zielona Góra – 7,005. The value of signed co-financing contracts in 2018-2021 for all applications submitted to the funds amounted to approx. PLN 5 billion.

One of the factors affecting this situation is certainly the number of inhabitants in individual voivodships, which translates into the number of applications submitted and contracts signed under the programme (Figure 3). In view of the foregoing, the largest number of applications for co-financing under the Clean Air Programme was submitted in śląskie, małopolskie and mazowieckie voivodships, respectively 64,165, 41,318 and 39,642. Similarly, in the case of co-financing contracts, the largest number of contracts was signed in the same voivodships, respectively in the śląskie voivodship – 47,544, małopolskie voivodship – 33,608 and mazowieckie voivodship – 32,367.

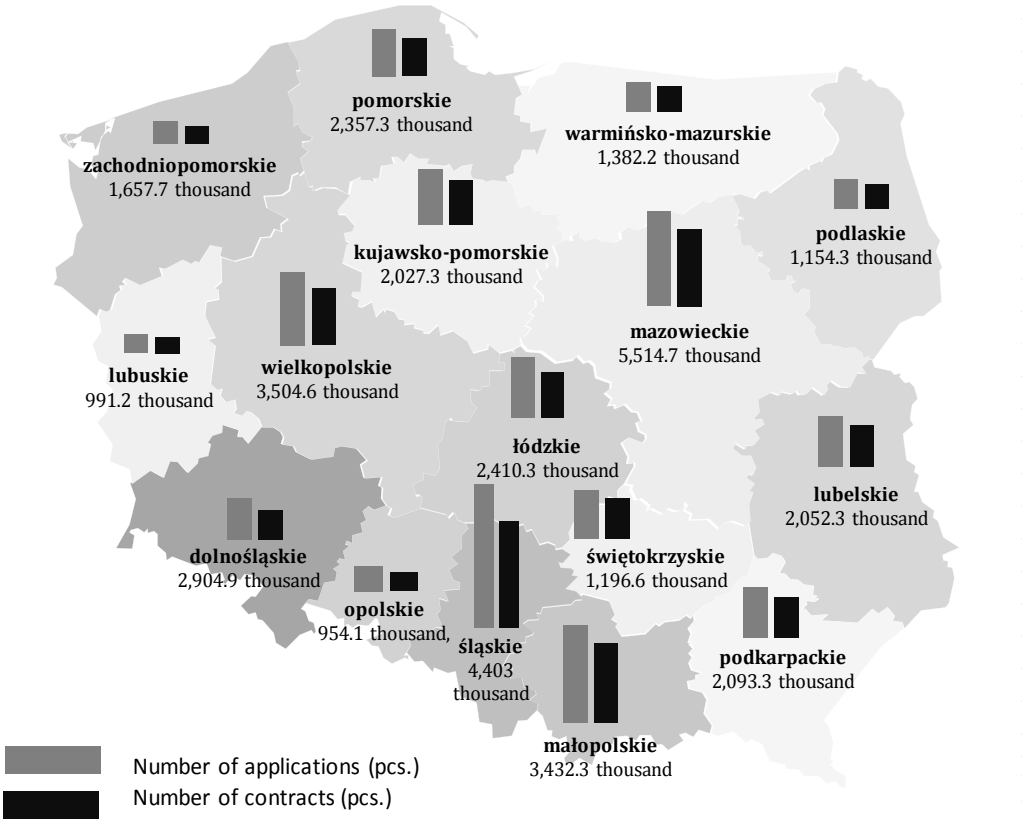

Figure 3. Number of applications (pcs.) and signed co-financing contracts (pcs.) under the Clean Air Programme in 2018-2021 in relation to the number of inhabitants in the individual voivodships.

Source: own study based on https://excelraport.pl, CSO (National Census, 2021) data and reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

Taking into account the per capita subsidization of projects, the most funding in 2018-2021 went to a resident of the świętokrzyskie voivodeship 278 PLN, and the least to a resident of the dolnośląskie voivodeship: 59 PLN (Table 3).

Table 3.
Per capita subsidy in 2018-2021 by voivodeship

No.	Voivodship	Value of contracts 2018-2021 (PLN thousand)	Population of voivodships (pcs. thousand)	Subsidies per capita (PLN)
1.	podlaskie	209287	1154	181
2.	pomorskie	265885	2357	113
3.	śląskie	644437	4403	146
4.	świętokrzyskie	332691	1197	278
5.	małopolskie	632868	3432	184
6.	lubelskie	334389	2052	163
7.	łódzkie	307316	2410	128
8.	warmińsko-mazurskie	203684	1382	147
9.	opolskie	118046	954	124
10.	wielkopolskie	378685	3505	108
11.	podkarpackie	319639	2093	153
12.	zachodniopomorskie	111441	1658	67
13.	kujawsko-pomorskie	290993	2027	144
14.	mazowieckie	523282	5515	95
15.	dolnośląskie	171102	2905	59
16.	lubuskie	101161	991	102

Source: own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

In the analysis of the implemented programme, the speed and amount of co-financing made available by the institutions are also crucial.

Table 4.
Disbursements under the Clean Air Priority Programme

No.	VFEP&WM	Disbursement of funds from the NFEP&WM to the VFEP&WM - transfer of funding (PLN thousand)				Disbursements to final beneficiaries (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	0	39 676	43 936	35 742	0	9 927	49 925	52 841
2.	Gdańsk	0	62 000	27 500	53 852	0	2 988	76 364	59 191
3.	Katowice	0	20 208	70 385	153 195	0	13 746	86 718	121 519
4.	Kielce	0	30 000	76 800	74 893	0	21 717	72 570	79 212
5.	Kraków	0	41 533	44 375	95 998	0	6 806	57 771	113 596
6.	Lublin	0	66 599	64 700	108 305	0	16 066	79 677	94 337
7.	Łódź	0	12 900	56 275	96 200	0	8 324	52 444	87 096
8.	Olsztyn	0	15 000	66 400	60 857	0	20 679	53 671	45 554
9.	Opole	0	14 000	17 500	56 500	0	7 300	23 199	37 386
10.	Poznań	0	86 000	0	104 153	0	19 828	60 195	86 622
11.	Rzeszów	0	50 000	64 000	75 000	0	21 343	70 562	77 190
12.	Szczecin	0	13 409	22 071	24 794	0	15 735	28 179	23 413
13.	Toruń	0	50 000	49 800	67 234	0	29 564	62 271	63 550
14.	Warszawa	0	100 000	51 000	130 190	0	25 161	122 996	99 478
15.	Wrocław	0	62 000	0	65 420	0	17 293	35 057	40 629
16.	Zielona Góra	0	12 066	26 000	21 000	0	8 018	22 052	25 402
17.	**Total**	**0**	**675 391**	**680 742**	**1 223 333**	**0**	**244 495**	**953 651**	**1 107 016**

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The budget of PLN 103 billion was set for the implementation of the Clean Air Programme. The first allocation of finances to the funds to be disbursed among final beneficiaries was made in the second year of the programme. Despite the transfer of over PLN 675 million by the National Fund, by the end of 2019 the voivodship funds disbursed merely just over PLN 244 million among final beneficiaries. The situation improved in two following years when the funds made disbursements to final beneficiaries at a level exceeding PLN 2 billion (Figure 4).

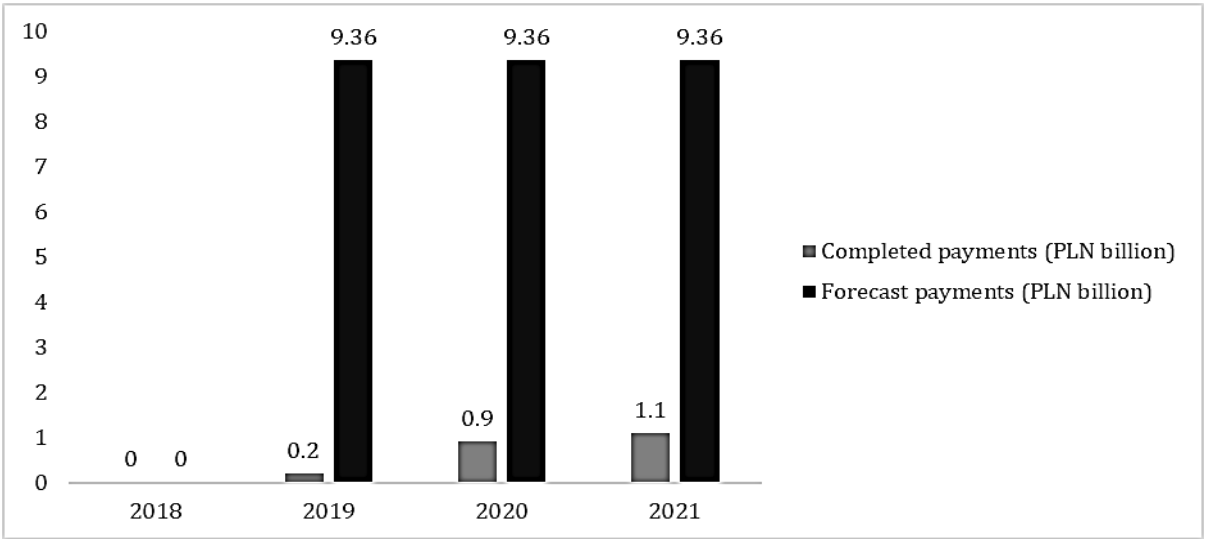

Figure 4. Payments made to the beneficiaries of the Clean Air Priority Programme in 2018-2021 in relation to forecast payments.

Source: own elaboration based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021[5].

Taking into account the disbursement of funding to beneficiaries, the study showed that despite the acceleration of the implementation of the Clean Air Programme in 2021, it may turn out that by the end of September 2029 the budget of the programme will not be expended[6]. The level of payments made to beneficiaries by the end of 2021 is merely over PLN 2 billion, which is slightly over 2% of the total budget of the programme. This may result in a lack of effective use of available funding and affect the achievement of the environmental and material effects assumed under the programme. Taking into account that environmental effects are determined by the number of delivered projects, it is necessary to monitor the speed and effectiveness of the implementation of the programme so that the achievement of the effects is not threatened. This is also confirmed by the report (Stefańczyk et al., 2022) according to which it is necessary to maintain certain dynamics of introducing changes in the programme, as well as to draw attention to key issues such as reducing energy demand. In this report, the Clean Air

[5] As part of the disbursement forecast, it was taken into account that the Clean Air Programme has been implemented since 19 September 2018, and in accordance with the provisions of the programme, disbursements may be made by the voivodship funds until 30 September 2029. Due to the fact that the Clean Air Programme has been implemented since Q2 2018 and no disbursements were made in the first year, no disbursements were forecast in 2018.

[6] According to the provisions of the programme, this is the deadline for the disbursement of funding by the voivodship funds for environmental protection.

Programme is referred to as a two-speed programme due to the fact that more than half of the projects funded under it have not scheduled energy efficiency (Stefańczyk et al., 2022) improvement measures. Conclusions emerging from the present study indicate that if the programme does not implement comprehensive thermo-modernization activities to a greater extent, the achievement of air quality improvement in the short-term will not be possible, especially in connection with the rise of gas and electricity prices in Poland (Stefańczyk et al., 2022).

The disbursement of funding to the beneficiaries aims to aid the achievement of the Clean Air Programme objective, which is to "improve air quality and reduce greenhouse gas emissions by exchanging heat sources and improving the energy efficiency of single-family housing" (Clean Air Priority Programme…, 2022). The framework of the programme assumed the funding of a number of activities aimed at delivering the programme's assumptions, such as dismantling inefficient solid fuel heat sources, insulation of building partitions or replacement of window and door joinery. The achievement of the objective is to be confirmed by the achievement of the following material and environmental effects (Clean Air Priority Programme…, 2022):

- number of buildings/residential premises with improved energy efficiency – 3,030,000 pcs.;
- number of inefficient heat sources replaced by low-carbon ones in buildings/residential premises – 3,000,000 pcs.;
- additional electricity generation capacity from installed photovoltaic micro-installations – 50 MW/year;
- reduction of final energy consumption – 37,500,000 MWh/year;
- reduction of particulate matter emissions with a diameter of less than 10 micrometers (PM10) – 210,000 Mg/year;
- reduction of benzo-alpha-pyrene emissions – 140 Mg/year;
- reduction of CO_2 emissions – 14,000,000 Mg/year.

Table 5 illustrates the selected environmental and material effects after four years of the implementation of the Clean Air Priority Programme.

Table 5.
Environmental and material effects resulting from concluded and completed contracts under the Clean Air Priority Programme between 2018-2021 (for the entire programme)

No.	Environmental and material effect	2019		2020		2021	
		from signed contracts[7]	from completed projects	from signed contracts	from completed projects	from signed contracts	from completed projects
Environmental effects							
1.	Reduction of electric energy and heating demand (thousand MWh/year)	1 123,6	269,5	1 292,7	597,8	2 535,7	1 141,9
2.	Volume of limited or prevented CO_2 emission (Mg/year)	362 829	87 420	542 262	303 472	1 110 400	518 500
3.	Reduction of PM2.5 particulate matter emission (Mg/year)	678	191	1 401	745	2 860	1 342
4.	Reduction of PM10 particulate matter emission (Mg/year)	826	240	1 571	834	3 202	1 503
5.	Reduction of SO_2 emission (Mg/year)	3 296	947	6 164	3 655	12 526	5 889
Material effects							
6.	Number of inefficient heat sources replaced by low-carbon ones in existing buildings (pcs.)	35 442	10 708	62 993	33 704	135 366	62 432
7.	Number of thermo-modernized buildings (pcs.)	42 051	11 569	70 922	38 202	143 558	67 428
8.	Number of low-carbon energy sources installed in newly erected buildings (pcs.)	16 750	5 379	6 498	3 864	1 772	3 133

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The actual effects of the programme are spread over time. As a result of the delivery of the Clean Air Programme, 106,844 inefficient heat sources were replaced by low-carbon ones in existing buildings over the period of four years. This represents 3.6% of the number assumed in the programme. In the case of other effects, i.e. volume of limited or prevented carbon dioxide emissions and reduction of PM10 emissions, they were achieved in 6.5% and 1.2% of the assumed effects of the entire programme, respectively.

[7] The discrepancy between the number of signed contracts and completed projects primarily resulted from the fact that projects were being delivered in certain timeframes determined by regulations pertaining to the delivery of projects under the priority programme. Data concerning the number of signed contracts were based upon a schedule. On the other hand, data on the number of completed projects pertained to the actual number of projects executed in a specific year.

4.2. Analysis of the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector

The delivery of the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector was different. Much like the Clean Air Programme, the voivodship funds commenced the delivery of this programme in 2018. The call for applications was opened and operated by the National Fund for Environmental Protection and Water Management in Warsaw (Call for applications…, 2017). Subsequently, based upon joint agreements, the applications were evaluated by the voivodship funds and projects were delivered in their respective areas of responsibility. The delivery of the programme was scheduled for 2016-2022. The budget of the programme was set at PLN 1,129,567 thousand (Air Quality Improvement Priority Programme…, 2017). The objective of the Air Quality Improvement Programme is "to improve the quality of air by limiting or preventing CO_2 emission as a result of increasing renewable energy production and decreasing energy consumption in buildings" (Air Quality Improvement Priority Programme…, 2017). The beneficiaries of the programme encompass entities operating medical in-patient 24/7 services, entities operating museums, dormitories, owners of national heritage buildings, as well as churches, church legal entities, and religious associations (Air Quality Improvement Priority Programme…, 2017). The achievement of the programme's objectives is to be confirmed by the achievement of the following effects (Air Quality Improvement Priority Programme…, 2017):

- energy production from renewable sources at least 100 thousand MWh/year;
- reduction of primary energy consumption by at least 157.16 thousand MWh/year
- reduction of CO_2 emission by at least 47.6 thousand Mg/year.

The programme scheduled funding of thermo-modernization of buildings, inter alia, museums, hospitals, dormitories, religious buildings, monuments, and other buildings for the purpose of culture, science and education (Air Quality Improvement Priority Programme…, 2017). The data pertaining to the delivery of the programme by individual voivodship funds in 2018-2022 is outlined in Table 6.

Table 6.
Delivery of the Air Quality Improvement Programme. Part 2) Reduction of energy consumption in the construction sector in 2018-2020[8]

No.	VFEP& WM	Number of evaluated applications in 2018-2020	Number of signed contracts (pcs.)			Value of signed contracts (PLN)			Value of disbursements to beneficiaries (PLN)		
			2018	2019	2020	2018	2019	2020	2018	2019	2020
1.	Białystok	3	0	0	1	0	0	961 367	0	0	961 367
2.	Gdańsk	6	0	4	0	0	10 258 289	0	0	689 816	7 001 099
3.	Katowice	43	0	27	3	0	24 379 682	2 801 199	0	15 296 914	12 963 010
4.	Kraków	37	0	5	9	0	5 147 522	4 946 206	0	0	8 161 512
5.	Lublin	53	14	16	7	13 420 182	18 388 697	10 533 391	830 131	7 060 678	16 389 433
6.	Łódź	13	1	7	0	516 500	9 852 515	0	0	1 077 519	2 202 608
7.	Olsztyn	10	2	8	0	1 378 599	3 925 137	0	0	3 332 540	1 971 196
8.	Poznań	16	5	1	0	5 073 039	318 585	0	225 412	1 199 633	645 746
9.	Rzeszów	41	0	26	6	0	16 314 832	2 472 613	0	4 057 305	10 162 107
10.	Toruń	8	0	5	2	0	5 206 000	2 888 000	0	6 247 000	1 883 000
11.	Warszawa	24	0	9	12	0	19 932 053	18 322 086	0	3 934 173	11 862 660
12.	Wrocław	8	0	3	3	0	1 161 569	16 740 278	0	679 011	1 308 245
13.	**Total**	**262**	**22**	**111**	**43**	**20 388 320**	**114 884 881**	**59 665 140**	**1 055 543**	**43 574 589**	**75 511 982**

Source: Own elaboration based upon data made available by the voivodship funds and data included in the reports of these institutions.

The study indicates that between 2018 and 2019 the largest number of applications was evaluated by the Fund in Lublin, and the lowest by that in Białystok. The case was similar as far as the number of signed contracts for funding is concerned. The Fund in Lublin concluded 37 contracts and that in Białystok merely one. Therefore, a difference between the funds emerged as regards the number of evaluated applications and delivered projects. The discrepancy stems from a different number of applications transferred to the voivodship funds by the National Fund[9]. In the first year of the programme's delivery, the voivodship funds completed two payments to the beneficiaries totaling over PLN 1 million. In the following years, the payments to the beneficiaries totaled over PLN 120 million.

The study also showed that the requirements for preparing institutions for the implementation of the programmes may result from the specificities of the programmes themselves. The Air Quality Improvement Programme required a slightly different preparation of the implementing institutions than the Clean Air Programme. The number of evaluated applications and signed contracts in 2018-2020 was much lower in this programme than in the Clean Air Programme. Assuming that the National Fund, as part of cooperation in 2018-2020, transferred 353 applications for implementation to the voivodship funds, on average 23.5 applications (Common Strategy, 2020) per institution were evaluated and settled[10].

[8] The table does not include data from the Funds in Kielce, Opole and Szczecin due to the information not being made available. The fund in Zielona Góra did not deliver the programme.

[9] For example, as part of the contract concluded on 29 May 2018 the Voivodship Fund for Environmental Protection and Water Management in Lublin received 53 applications for evaluation (data from the fund's operational report in 2019, Available online: https://www.wfos.lublin.pl/materialy/_upload/sprawozdanie /Sprawozdanie2019r.pdf) whereas the Voivodship Fund for Environmental Protection and Water Management in Toruń received eight applications (data from the fund's operational report in 2019, Available online: http://bip.wfosigw.torun.pl/uploads/files/Sprawozdania/ SPRAWOZDANIE%202019.pdf).

[10] Assuming that the Voivodship Fund for Environmental Protection and Water Management in Zielona Góra did not participate in the programme.

The study revealed that the implementation of projects submitted to the voivodship funds for evaluation and delivery proceeded quite slowly. In 2018, merely 22 funding contracts with beneficiaries[11] were signed, which translated into just two of the examined funds disbursing funding.

4.3. Programmes and projects delivered by the voivodship funds in the framework of own resources

Pursuant to the Environmental Protection Act, by each 30th November, voivodship funds for environmental protection and water management must adopt plans for their operation for the consecutive year (Environmental Protection Act…, 2022). Individual funds schedule the execution of own programmes and projects concerning environmental protection within the scope of own funds at their disposal.

As far as air protection is concerned, individual funds allocate own resources for the delivery of initiatives aiming to reduce air pollution and for thermo-modernization purposes. The funds also deliver own programmes. For example, in 2019, the Fund in Warsaw, delivered the OA-1 programme entitled "Reduction of air pollutants emission, reduction of heating consumption, and exploitation of renewable energy sources", as well as OA-2 programme entitled "Modernization of electrical lighting" (Voivodeship Fund report, 2019). In 2017, the Fund in Lublin executed the "EKODOM" programme (Regulations for the call…, 2017). Data pertaining to the delivery of programmes and initiatives regarding air protection by the voivodship funds is outlined in Table 7.

[11] Considering the data from the studied voivodship funds.

Table 7.

Data pertaining to the delivery of programmes and initiatives regarding air protection excluding those executed jointly with the National Fund for Environmental Protection and Water Management (own programmes)[12]

No.	VFEP&WM	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)
		2018				2019				2020			
1.	Białystok	0	14	5 317 198	5 994 070	6	3	143 000	143 000	19	16	1 400 842	1 400 842
2.	Gdańsk	197	69	28 224 604	15 672 711	16	18	45 517 214	4 963 496	26	12	8 362 139	8 393 778
3.	Katowice	518	366	40 695 583	199 913 825	243	338	214 048 149	172 184 527	229	242	221 657 401	223 265 426
4.	Kraków	173	117	28 867 272	26 756 262	82	75	38 733 888	38 713 362	39	38	13 932 512	13 909 596
5.	Lublin	153	114	80 084 508	20 445 830	65	40	95 932 789	19 374 433	46	29	16 098 623	10 101 614
6.	Łódz	172	131	70 840 941	63 706 714	195	125	49 946 494	60 091 751	356	153	65 667 663	38 439 397
7.	Olsztyn	48	21	12 255 115	15 873 196	52	22	577 934	1 132 561	50	35	3 919 572	2 858 539
8.	Poznań	121	38	33 879 568	63 723 702	63	28	34 909 965	21 517 519	133	84	17 253 282	33 517 384
9.	Rzeszów	228	194	30 554 273	28 500 369	51	45	6 583 705	10 543 105	97	41	8 583 252	7 190 558
10.	Szczecin	247	179	5 861 212	8 095 697	45	27	458 760	9 487 053	91	37	1 438 407	479 076
11.	Toruń	272	170	18 158 000	26 747 000	47	44	15 437 000	11 442 000	53	33	1 904 000	3 488 000
12.	Warszawa	66	23	8 701 898	14 343 955	51	22	13 309 793	14 411 277	196	139	19 761 326	30 414 692
13.	Wrocław	115	93	44 131 000	39 758 000	54	57	98 721 000	71 510 000	52	41	116 387 000	113 200 000
14.	**Total**	**2 310**	**1 529**	**407 571 172**	**529 531 332**	**970**	**844**	**614 319 690**	**435 514 084**	**1 387**	**900**	**496 366 021**	**486 658 902**

Source: Own elaboration based upon data made available by the voivodship funds for environmental protection.

[12] The table does not include data from the funds in Kielce, Opole and Szczecin due to their not being made available.

The study revealed that in 2018-2020, the largest number of applications pertaining to air protection were submitted to the Fund in Katowice - 990, and the fewest to the Fund in Białystok - 25. A similar observation was made concerning signed funding contracts. Between 2018 and 2019, the voivodship funds disbursed over PLN 1.4 billion of their own financial resources to the beneficiaries. Interestingly, in certain cases, the number of signed contracts exceeds the number of applications submitted to the funds in a specific year. This is due to the fact that the evaluation procedure may not be have been completed by the end of the specific year. Occasionally, applications go under evaluation in the following year, thus the number of signed contracts may exceed the number of applications, which was the case in e.g. the Fund in Katowice in 2018-2019 (Voivodeship Fund report, 2018).

4.4. Factors determining environmental effectiveness of the Clean Air Programme

In order to verify the relationship between the environmental effect and economic and social variables, an r-Pearson correlation analysis was carried out. Based on the literature on the subject (Pello et al., 2021; Begum & Mahanta, 2017), for the Clean Air Programme, the author selected such variables as the reduction of CO_2 emissions in 2021, the level of urbanization, the amount of financing disbursed under the programme, as well as disposable income per capita. Significance level $p < 0,05$.

Table 8.
Correlation between the environmental effect and economic and social variables for the Clean Air Priority Programme

Voivodship	Reduction of CO_2 emission	Disposable income	Urbanization level	Disbursed funding
podlaskie	19 272,9	415,6	2,808849	52 841
pomorskie	29 409,7	876,2	2,748661	59 191
śląskie	57 475,7	1 847,3	2,686767	121 519
świętokrzyskie	62 610,6	431,7	3,050998	79 212
małopolskie	25 098,0	1 229,7	3,104854	113 596
lubelskie	36 752,1	771,1	3,150392	94 337
łódzkie	42 765,0	972,6	3,443650	87 096
warmińsko-mazurskie	19 639,6	546,1	2,686594	45 554
opolskie	16 019,7	339,4	2,711650	37 386
wielkopolskie	46 828,7	1 273,5	2,399934	86 622
podkarpackie	29 358,3	676,6	3,498706	77 190
zachodniopomorskie	11 766,5	661,6	2,663452	23 413
kujawsko-pomorskie	53 425,6	769,5	3,137206	63 550
mazowieckie	48 268,1	2 222,9	2,849209	99 478
dolnośląskie	23 187,6	1 157,8	2,901037	40 629
lubuskie	13 419,0	385,3	2,427276	25 402
Reduction of CO_2 emission				
Disposable income	0,483836024	1		
Urbanization level	0,265877616	-0,033847719	1	
Disbursed funding	0,701048721	0,672998961	0,372914616	1

Source: Own study based on data made available by the voivodship funds and statistical data – Eurostat.

The results indicate that the strongest correlation occurs between the reduction of CO_2 emissions and disbursed financing. It can be concluded that the increase in the disbursed funding reduces CO_2 emissions. There is also a strong correlation between the disbursed funding and disposable income, r = 0.67. Therefore, it can be argued that in more affluent regions, more funding was disbursed under the Clean Air Programme.

However, no correlation was found between the amount of funding and the level of urbanization. These variables are therefore not related to each other.

5. Conclusions

The objective of the study was to determine the role of voivodeship funds in disbursing funding for air protection in Poland. The study revealed that the voivodship funds, jointly with the National Fund, have started to implement air protection programmes since 2018. Initially, the pace of implementation was slow. In the case of the Clean Air Programme, implementation accelerated significantly only in 2021 when the number of submitted funding applications more than doubled compared to applications submitted in the two previous years. Similar conclusions can be drawn as regards the number of contracts concluded under the programme. The study revealed that there are differences between the individual voivodship funds in the number of submitted applications and signed funding contracts. One of the factors influencing this situation is certainly the population in each voivodeship, which translates into the number of applications submitted and contracts signed under the program and indirectly into the value of per capita funding. Initial problems related to the implementation of the programme were also due to the lack of experience and proper organizational structure of the institutions. In order to implement the Clean Air Programme, the funds had to prepare for dealing with a much larger number of applications and projects to be settled than before. These institutions faced new challenges and needs. Until 2018, the institutions did not implement such an extensive programme designed for natural persons. This is confirmed by the results of the audit by the Supreme Audit Office which indicates that in the period from 19 September 2018 to 19 July 2019, the implementation of the programme in the Fund in Opole was assessed negatively (Post-inspection report – Opole…, 2020). The fund did not establish an appropriate organizational structure that would allow for efficient processing of incoming applications and did not train the staff who were to become responsible for this area of the programme's implementation. At the same time, in the institution that faced the largest number of applications and signed co-financing contracts, i.e. in the Fund in Katowice, the audit showed that the organizational structure was being adapted on an ongoing basis in order to manage tasks emerging from the implementation of the programme (Post-inspection report – Katowice…, 2020).

The results pertaining to an overly slow submission rate concerning project applications at the onset of the Clean Air Programme delivery are reflected in another report (Adamkiewicz et al., 2021). The report argues that between 19 September 2018 and 14 May 2020, the daily submission rate[13] merely amounted to 18% of the expectations (822 applications daily). As a result, the initial version of the programme, valid until 14 May 2020, required reforms in, among others, the improvement of the service for beneficiaries at the level of the voivodship funds for environmental protection. The introduced changes resulted in a 30% increase of the daily submission rate, compared to expectations, in the period from 15 May 2020 to 31 March 2021(Adamkiewicz et al., 2021). However, despite the observable significant acceleration of the submission rate, the results were still unsatisfactory. Should the trend continue for a longer period, a risk may arise that the budget of the programme may not be fully disbursed. The lack of effective disbursement may affect the delivery of environmental and material outcomes scheduled in the project.

The study indicated that challenges the implementing institutions face may stem from the specific character of programmes themselves. The Air Quality Improvement Programme required a slightly different preparation of the institutions than the Clean Air Programme. The number of evaluated applications and signed contracts in 2018-2020 was much lower in this programme than in the Clean Air Programme. However, as studies show, the delivery of the programme was still relatively slow.

Since 2018, in connection with air protection, the voivodship funds have been performing and increasingly redistributive function, i.e. they disbursed funding to specific entities. Such a conclusion can be drawn when we analyze the data on the implementation of air quality improvement programmes and projects financed exclusively from own resources. In 2018-2020, the voivodship funds implementing their own initiatives and projects on air protection faced fewer challenges than while implementing joint priority programmes with the National Fund, including such an extensive programme as the Clean Air Programme. The number of submitted applications and signed contracts for financing from own funds in 2018-2020 accounted for only over 2% of applications and contracts handled by these institutions under the Clean Air programme during this period[14].

The study confirmed the significant role of the voivodship funds in financing air quality projects. The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds for environmental protection, their role in and responsibility for the implementation of air protection programmes. A limitation of the study is the inclusion of data on the programmes implemented only by 12 voivodship funds. The desk research method applied in the study covered the period between 2018 and 2020, and in the case of the

[13] The results of the study did not refer to all submitted applications, but only to applications for the replacement of a heat source without applications related exclusively to thermal modernization activities.

[14] The calculation pertains to 13 voivodship funds that enabled access to data on implemented programmes and initiatives funded from own resources in 2018-2020. Therefore, it does not include the funds in Kielce, Opole and Zielona Góra.

Clean Air Programme also 2021. Therefore, future studies should be extended to include data from all funds and cover further periods of implementation of air quality programmes by these institutions. However, with regard to the evaluation of factors influencing environmental efficiency, future studies may take into account other variables in the analysis of correlations, both in terms of environmental effects and socio-economic variables. This would allow for the development of a more complete picture of factors determining the environmental efficiency of the Clean Air Programme.

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OUTSOURCING IN THE MANAGEMENT OF MANUFACTURING COMPANIES IN POLAND

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Purpose: The aim of this article is to explain how manufacturing companies approach the outsourcing of processes/functions to external entities and to identify the benefits they gain from using outsourcing arrangements. An effort was also undertaken to diagnose the factors for not using outsourcing services**.**

Design/methodology/approach: The formulated objectives of the study influenced the hypotheses and structure of the survey. The survey was conducted in 2020 in the pre-pandemic period, with a sample size of N = 120, including owners/managers of manufacturing companies. Non-random sampling was used. Questionnaires were sent to 200 companies, and only 126 were completed, of which 6 were not completed in full, and were therefore rejected. Hypothesis verification was carried out in turn using a chi-square test.

Findings: When considering the premises for the use of outsourcing by business entities, one should first of all take into account the fact that in each enterprise there are many different internal factors, the existence of which affects, to a greater or lesser extent, outsourcing decisions.

Research limitations/implications: The study carried out for this thesis does not fully explore the issues involved. It is recommended that studies of this type be conducted again in the future.

Practical implications: Outsourcing is undoubtedly a concept consistent with the current trends in the management of economic entities which result primarily from changes occurring in their turbulent environment. Therefore, outsourcing should be seen as a complex business management tool that has a solid theoretical basis, with its impact covering many various aspects of the functioning of modern economic entities.

Social implications: Outsourcing as a management concept is one of the easiest ways for companies to achieve greater efficiency. The vast majority of respondents using outsourcing assessed it positively from the perspective of expected benefits.

Originality/value: The research carried out in the article potentially extends the literature on the subject by presenting the importance of outsourcing for Polish manufacturing companies.

Keywords: management, outsourcing, manufacturing companies, benefits.
Category of the paper: Research paper.

1. Introduction

Modern economic actors operate in a variety of cooperative arrangements that are primarily aimed at creating competitive advantage and strengthening themselves to meet the requirements of competitors (Hoff, Stiglitz, 2000, p. 33). The strategic nature of the competitive advantage has been determined by the content of the project, and its importance, essence, competences and values have been brought to the alliance (Vivas López, 2005, pp. 662-663). In the latter half of the 1980s, cooperation between enterprises has taken on a completely different meaning than before (Dunning, Lundan, 2008, p. 35, 46). There has been a rapid development of cooperation on a partnership basis (Figure 1)

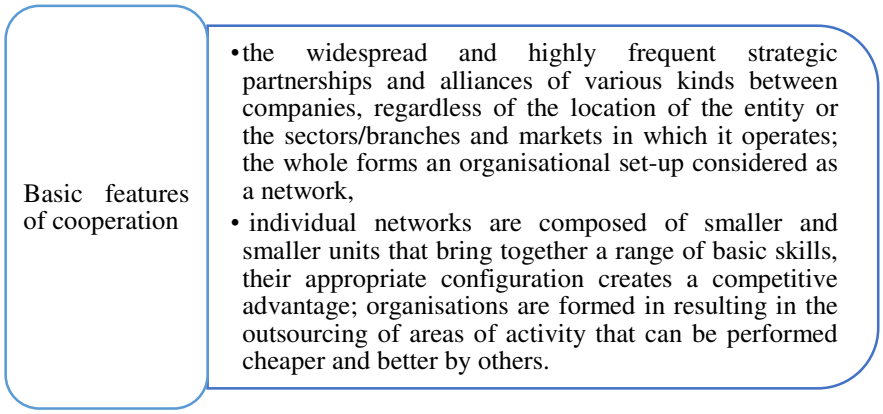

Figure 1. Characteristic features of the cooperation between modern business entities.

Source: Obłój, K. (2007). *Organisation strategy. In the search for sustainable competitive advantage.* Warszawa: PWE, pp. 22-23.

The acceleration and development of business processes in modern companies are also greatly influenced by the appropriate integration and organisation of the value chain (Rajendra et al., 1999, pp. 168-169; Swink, 1999, pp. 694-695; Kopishynska et al., 2016, pp. 105-107). This causes companies to focus their attention in particular on innovations that concern management and organisation (Laursen, Salter, 2006, pp. 132-133). As a consequence, tendencies to increase the fluidity and flexibility of organisational structures are becoming increasingly noticeable and widespread (Whitley, 2006, pp. 82-83). This is achieved mainly by reducing and flattening them – decreasing hierarchical levels along with outsourcing areas that are less important from the perspective of the functioning of the company (Sandhu et al., 2018, pp. 2201-2202).

This has been caused by the dynamic development of new concepts, methods and systems of business management. Modern solutions accentuate the tendency to treat the management system as a whole, granting it a characteristic orientation and a certain identity (Thierauf, 1999, p. 45; Brickson, 2007, pp. 865-866).

The ongoing globalisation, together with the increase in competition on the global market, means that companies are now looking for effective organisational and management methods to increase their efficiency and competitiveness (Shah, 2014, Su, Levina, 2011, pp. 717-719; Grossman, Helpman, 2005, pp. 143-144). This is most often carried out by increasing the value of economic entities and maximising their profits while reducing the costs of their activities (Gospel, Sako, 2010, pp. 1369-1370; McLaren, 2000, pp. 1240-1241). One of the possible ways to reduce costs may be outsourcing (Garcia-Castro, Francoeur, 2014, pp. 415-417). It consists in outsourcing a part or the entirety of certain tasks, processes and functions of an enterprise which are necessary for the proper functioning of a specific entity, however they do not represent its core business (Kabus et al., pp. 2-3; Holcomb,;Hitt, 2007, pp. 467-469, Churkina, 2016, pp. 72-73). Using this solution helps to reduce operating costs while improving the quality of individual processes and controlling them more effectively, and enables the company to focus on its core business.

A review of current literature highlights the growing role of outsourcing in business management. Outsourcing is studied by scientists in terms of multidimensional aspects, e.g. benefits, threats, application of IT tools. This topic is also relevant from the perspective of human resources, cost measurement and the impact of knowledge management on outsourcing success. Few literature items discuss/focus on detailed analysis of outsourcing applications in manufacturing enterprises, therefore the primary objective of this article is to analyse the use of outsourcing by Polish manufacturing companies. The issues presented in the paper are focused around a multifaceted characteristics of outsourcing, with particular emphasis on operational areas of the company that are most frequently outsourced and a diagnosis of the greatest benefits of outsourcing.

Therefore, the authors have attempted to demonstrate how manufacturing companies view the outsourcing of processes/functions. The diversity of aspects of the research subject, oscillating around the main objective, influenced the necessity to distinguish theoretical and empirical levels which in turn contributed to the formulation of specific objectives of the dissertation:

- systematisation of the theoretical background covering issues covering issues related to outsourcing and its role,
- defining the determinants shaping the functioning of outsourcing in contemporary enterprises,
- defining the benefits gained by Polish companies when using outsourcing solutions,
- diagnosis of reasons for not using outsourcing services.

2. Literature research

When considering contemporary theories of entrepreneurship, it can be noticed that outsourcing has taken many elements from the previous scientific work. It mainly concerns agency, transaction cost, resource or contractual theories (Carter, Yan, 2007, pp. 215-216, Chongvilaivan et al., 2009, pp. 20-22). New approaches to the management of economic entities include the relationships between the various entities operating within the company, and the generation of financial surplus (profit) is no longer the sole and most important objective of the company (Damanpour et al., 2020, pp. 770-772).

Outsourcing is undoubtedly a concept consistent with the current trends in the management of economic entities which result primarily from changes occurring in their turbulent environment (Bilan et al., 2017, p. 178). Therefore, outsourcing should be seen as a complex business management tool that has a solid theoretical basis, with its impact covering many various aspects of the functioning of modern economic entities (Greenemeier, 2002, pp. 49-50; Warner, Hefetz, 2012, pp. 313-314; Kirillova, 2015, p. 329).

Ford is considered to be one of the precursors of the outsourcing idea. He formulated an extremely revolutionary and controversial, as for his time, hypothesis, according to which a company that is not able to produce something better, cheaper or more efficiently than its competitors, should not do it, but hire someone else (an entity, person) to do this work, assuming that this person (entity) will do it better. 1980s are considered to be the beginning of the outsourcing era since in this period the establishment of long-term cooperation between companies in terms of outsourcing projects began to become common (Cheshmberaha et al., 2019, pp. 233-234).

The functioning of companies using outsourcing in their activities shows the existence of differentiation of such undertakings, which may result from the criteria presented in the figure number 2.

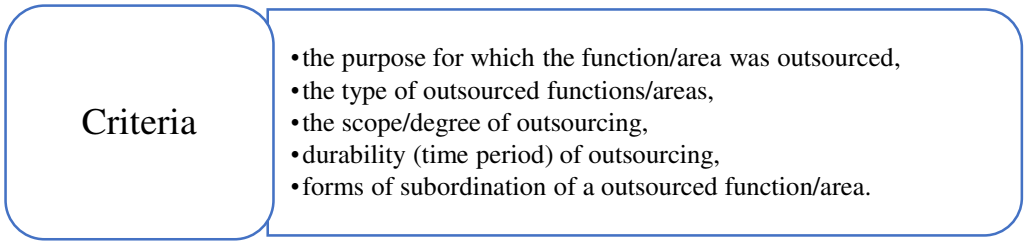

Figure 2. Criteria influencing the differentiation of outsourcing in enterprises.

Source: Cheshmberaha, M., Rahbinb, R., Eftekharia, M. (2019). An integrated framework (CTSR-BWG) for outsourcing decisions in a marine manufacturing firm. *Uncertain Supply Chain Management, 7,* p. 233.

Outsourcing, considered as a restructuring project, is undertaken in order to rectify the existing situation, to adapt to the requirements, conditions and changes occurring in the environment, as well as to provide conditions for future development (Linder, 2004, p. 37).

This results in the following types of outsourcing (Klochko et al., 2019, p. 2; Foltys, 2012, pp. 40-43):

- recovery – used by economic entities threatened with liquidation or in crisis,
- adaptive – used by economic entities that want to develop, be competitive and become market leaders,
- developmental – includes strategic decisions and activities of a developmental or innovative nature; in its essence, it promotes seizing the opportunities and market chances of the company while limiting any threats.

Outsourcing, having a significant impact on the strategic and organisational situation of an economic entity, at the same time influences the economic aspect of operation of the company (Li, Wei, Liu, 2010, pp. 1457-1458). It is commonly equated with the reduction of costs incurred by the entity. This approach should be seen as natural, bearing in mind that the cost reduction criterion is one of the most important factors that are considered when deciding to outsource. On the other hand, most outsourcing decisions are not purely financial, and if costs are the only criterion for making them, most often the decision turns out to be wrong.

In conclusion, it should be noted that outsourcing has specific reasons which are the objectives of outsourcing projects, and to a significant extent determines the behaviour of an economic entity which manifests itself by generating specific events that are important from the perspective of the functioning of every enterprise (Morales-Gualdron, Roig, 2005, pp. 479-480). In practice, many different divisions of outsourcing can be distinguished. They can be found by analysing the rich literature on the subject. According to the author of the paper, the essence of the outsourcing process is most accurately captured by types based on the model of mutual relations considered as a whole (Shi, 2007, p. 29). These include the nature and relationship of these processes (indirect and direct) and their thoroughness which can be manifested in the mutual benefits of the project for the various partners involved (Lacity, Willcocks, 2013, p. 63).

The literature review conducted by the authors revealed a research gap in the state of knowledge on the topic in question. According to what was found, there are no studies referring to and reporting on the importance of oustourcing in Polish manufacturing companies in terms of the benefits achieved and the reasons why some companies do not use external services. The issue raised is important and potentially fills a research gap.

3. Methods

The subject of the study conducted for the purpose of this thesis is the use of outsourcing by Polish manufacturing companies. Outsourcing is understood in this case as commissioning tasks in the execution of particular areas of the company to external entities (e.g. production,

logistics, human resources management, cleaning, security, etc.). The aim of the study in turn is to diagnose how manufacturing companies view the outsourcing of processes/functions. The authors set themselves the task of answering two research questions:

- What are the greatest benefits of outsourcing?
- Why do enterprises not use outsourcing services?

Hypotheses were also put forward:

H01: Majority of Polish manufacturing companies use outsourcing services, and the greatest benefit of outsourcing is the ability to focus on the core business of the company.

H02: The main factor why companies do not use outsourcing is the lack of sufficient financial resources,

For the purposes of this study, the diagnostic survey method, which involves collecting data using techniques such as a questionnaire or an interview, was applied. The survey method was used. The research tool used for this study was a survey questionnaire that included four sections:

- an introduction which contained a request to participate in the study and outlined: the purpose of the study along with an assurance of its confidentiality,
- a main part for companies using outsourcing services which consisted of 6 closed questions,
- a main part for companies not using outsourcing services which consisted of 3 closed questions,
- a questionnaire with 4 closed questions.

The survey was conducted in 2020 during the pre-pandemic period, with a sample size of N = 120, incl. owners/managers of manufacturing companies. Non-randomised sampling was applied. Questionnaires had been sent to 200 companies, only 126 were completed, of which 6 were not filled entirely and were therefore rejected.

MS Excel was used to process the obtained results, which enabled their graphical and statistical presentation. Hypothesis verification was in turn conducted with the use of the chi-squared test.

4. Results

Based on the survey, data was obtained proving that 65% enterprises participating in the survey (78 entities) use outsourcing in their activities. The remaining part – 35% (42 entities) do not use this type of services. The data presented in Table 1 indicate that all medium and large enterprises use outsourcing services, among small enterprises this percentage is 81.1% (30 out of 37 entities), and for micro enterprises it is 36.4% (20 out of 55 entities) (Table 1).

Table 1.
Characteristics of the research sample by company size and use of outsourcing

Company size	Outsourcing Used		Total
	Yes	No	
Micro-sized	20	35	55
Small-sized	30	7	37
Medium-sized	21	-	21
Large-sized	7	-	7
Total	**78**	**42**	**120**

Source: Own elaboration.

Considering the scope of company activities, it can be observed that all participating entities with international operations outsource certain functions, and that no entity operating locally uses this type of service. In the case of companies with a regional scope, the percentage of outsourcing is 25% (3 entities out of 12) and 50.9% (3 entities out of 12), and 50.9% for those operating regionally (28 entities out of 55). Detailed data on this issue are presented in Table 2.

Table 2.
Characteristics of the research sample in terms of the scope of company activities and the use of outsourcing

The scope of company activities	Outsourcing Used		Total
	Yes	No	
Local	-	6	6
Regional	3	9	12
Domestic	28	27	55
International	47	-	47
Total	**78**	**42**	**120**

Source: Own elaboration.

Exploring the cross tabulation showing the research sample from the perspective of the market operation duration and the use of outsourcing, it can be noted that companies operating in the market for less than 1 year do not use this type of service. The percentage of companies that operate on the market for 1 to 5 years and use outsourcing is 46.7% (7 out of 15 entities), from 6 to 10 years – 66.7% (18 out of 27 entities), from 11 to 15 years – 60.9% (14 out of 23 entities), and over 15 years – 84.8% (39 out of 46 entities). Detailed data on this issue are presented in Table 3.

Table 3.
Characteristics of the research sample by market operation duration and use of outsourcing

Market operation duration	Outsourcing Used		Total
	Yes	No	
Less than 1 year	-	9	9
1-5 years	7	8	15
6-10 years	18	9	27
11-15 years	14	9	23
More than 15 years	39	7	46
Total	**78**	**42**	**120**

Source: Own elaboration.

The last area that needs to be analysed is the use of outsourcing from the perspective of the place of business (headquarters) of the company (Table 4).

Table 4.
Characteristics of the research sample by market operation duration and use of outsourcing

Place of business	Outsourcing Used		Total
	Yes	No	
City	58	30	89
Village	20	11	31
Total	**78**	**42**	**120**

Source: Own elaboration.

As it can be concluded from the data presented above, the percentage of companies using outsourcing by location of their business is similar. In the case of enterprises located in urban areas, 65.2% of them use outsourcing (58 out of 89 entities). Among enterprises located in the countryside this percentage is 64.5% (20 entities out of 31).

The use of outsourcing by companies is also associated with certain benefits that are expected by contractors. Figure 3 shows the answers of respondents on how the benefits identified influenced their decision to use outsourcing.

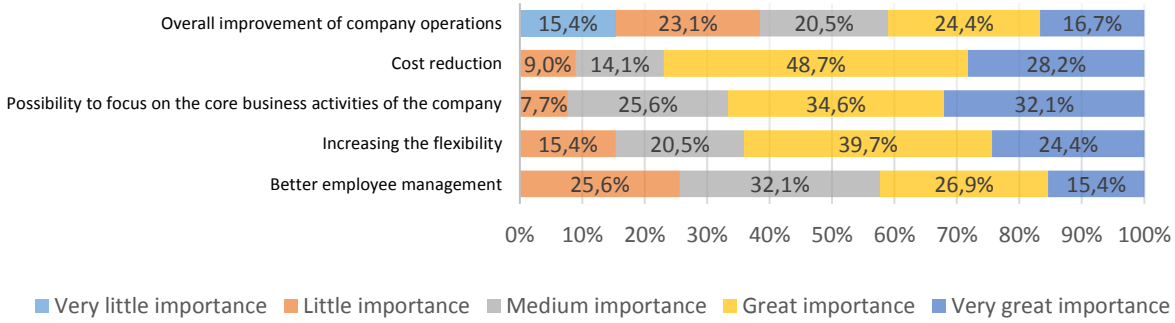

Figure 3. Evaluation of the impact of selected benefits on the use of outsourcing (N = 78).
Source: Own elaboration.

In the opinion of 42.3% of respondents (33 entities), the overall improvement of company operations was a benefit that had a high and very high impact on the use of outsourcing. Its medium impact was indicated by 32.9% (25 entities) and low impact by 25.6% (25 entities).

Cost reduction was perceived by 64.1% of respondents (50 entities) as a benefit with a high and very high impact on the decision to use outsourcing in their enterprises. 20.5% (16 entities) stated that it had a medium impact on the phenomenon discussed. In turn, 15.4% (12 entities) believed that it influenced the issue to a small extent.

According to 66.7% of respondents (52 entities), the possibility to focus on the core business activities of the company when outsourcing certain functions to external entities was a factor that had a high and very high impact on the decision to use outsourcing. 25.6% (20 entities) stated that this factor influenced them to a medium extent, and 7.7 percent (6 entities) described its influence as low.

Increased flexibility was, according to 76.9% of respondents (60 entities), a factor with a high and very high impact on the use of outsourcing. 14.1% (20 entities) described the contribution of this element as medium, and 9% (7 entities) identified it as low.

The last factor evaluated – better employee management – was rated as a high and very high impact by 41% of respondents (32 entities). 20.5 % of respondents (16 entities) were of the opinion that the impact of this factor was medium, and 38.5% (30 entities) described its contribution as small.

Table 5 provides a synthetic assessment of the impact of selected benefits on the use of outsourcing by the companies under the survey. The average of the individual benefits was calculated in the same manner as in the previous cases.

Table 5.
Average rating of the impact of selected benefits on the use of outsourcing (N = 78)

Benefits of using outsourcing	N	Marginal response values		Average	Mode
		Minimum	Maximum		
Overall improvement in the functioning of the enterprise	78	2	5	3.32	3
Cost reduction	78	2	5	3.73	4
The ability to focus on the core business of the enterprise	78	2	5	3.91	3
Increasing the flexibility	78	2	5	3.96	3
Better employee management	78	1	5	3.04	4

Source: Own elaboration.

The analysis of the data presented in the table above clearly shows that the benefits that determine to the greatest extent the decision to use outsourcing are: increased flexibility (average answer – 3.96, mode – 3) and the possibility to focus on the core activities of the enterprise (average answer – 3.91, mode – 3). The benefits that have the least impact on the above-mentioned phenomenon include: better employee management (average response – 3.04, mode – 4) and a general improvement in the functioning of the company (average response – 3.32, mode – 3).

To conclude this part of the discussion, it is necessary to refer to the last question answered by the respondents from the companies using outsourcing. This concerned whether the use of outsourcing brought the expected benefits (Figure 4).

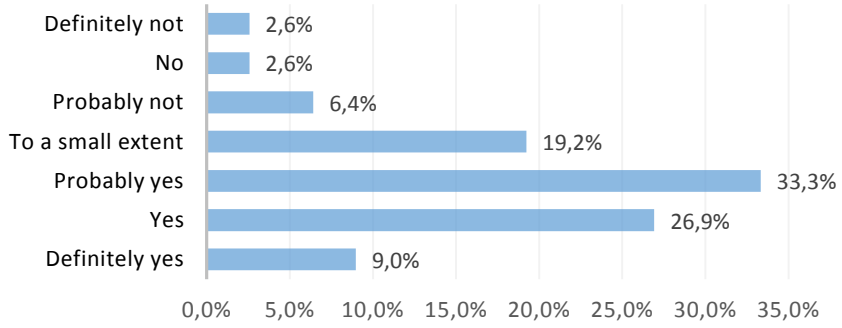

Figure 4. Assessment of the use of outsourcing from the perspective of the expected benefits (N = 78).
Source: Own elaboration.

As it can be seen from the above summary, 88.5% of respondents (69 entities) expressed greater or lesser satisfaction with the benefits of outsourcing in their companies. Dissatisfaction, on the other hand, is 11.5% of those participating in the survey (9 entities). The average of the answers given by the respondents was 0.95 (answer: "definitely yes" – weight of 3, answer "to a small extent" – weight of 0, answer "definitely not" – weight of -3) with a mode value of 1. Therefore, it can be concluded that the companies participating in the study are rather satisfied with the benefits brought by using outsourcing.

Subsequently, it was necessary to diagnose the reasons why 42 participating companies did not use outsourcing. The responses to this issue are presented in figure 4.

The figure 5 shows 92.9% of respondents (39 entities) believe that the lack of sufficient financial resources causes, to a large and very large extent, that they do not use outsourcing. For 7.1% (3 entities), this factor has an average impact on the discussed phenomenon.

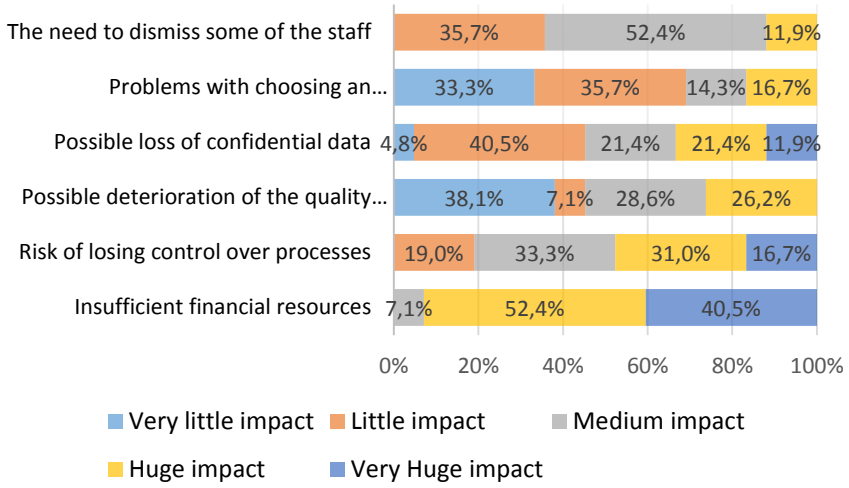

Figure 5. Assessment of situations determining the non-use of outsourcing by enterprises (N = 42). Source: Own elaboration.

The risk of losing control over processes is a factor that discourages 47.6% of respondents (20 entities) to a large and very large extent to outsource the implementation of specific services to external companies. 33.3% (14 entities) described the share of this factor as average, and 19% (8 entities) as small.

In the opinion of 45.2% of respondents (19 entities), the risk of service quality deterioration is not important in terms of their company not using outsourcing. The medium influence of this factor on the phenomenon in question was indicated by 28.6% (12 entities), and large and very large - 26.2% (11 entities).

The risk of losing confidential data has a low and very low impact on the fact that 45.2% of respondents (19 entities) do not use outsourcing. The risk of confidential data leakage is a problem of average importance for 21.4% of respondents (9 entities), and for 33.3% (14 entities), it is a great and very great threat. Problems with choosing an outsourcing operator, according to 69% participating in the survey (29 entities), have little impact on their non-use of

outsourcing. 14.3% (6 entities) indicated that the problem has a medium impact on the mentioned phenomenon. In turn, 14.3% (6 entities) indicated that this problem has a medium impact on it, and 16.7% (7 entities) described it as large or very large.

According to 52.4% of respondents (22 entities), the necessity to make some employees redundant at the time of outsourcing has a medium influence on not using this type of service. 35.7% (15 entities) thought that the risk of such a situation occurring had little influence on the phenomenon in question, while 11.9% (5 entities) thought that the risk had little influence on the situation.

In order to deepen the discussed issue a synthetic assessment of the significance of selected situations that determine the fact that the surveyed companies do not use outsourcing. The average was calculated in the same manner as in the previous cases.

Table 6.
Average rating of importance of situations determining the non-use of outsourcing by enterprises (N = 42)

Situations determining the non-use of outsourcing	N	Marginal response values		Average	Mode
		Minimum	Maximum		
Insufficient financial resources	42	3	5	4.33	4
Risk of losing control over processes	42	2	5	3.45	4
Possible deterioration of the quality of services	42	1	4	2.43	1
Possible loss of confidential data	42	1	5	2.95	2
Problems with choosing an outsourcing operator	42	1	4	2.14	2
The need to release some of the staff	42	2	4	2.76	3

Source: Own elaboration.

The table 6 shows, the situations that to the greatest extent determine the non-use of outsourcing services by the surveyed enterprises are: insufficient financial resources for this type of activities (average response – 4.33, dominant 4) and the risk of losing control over processes (average response – 3.45, mode – 4). On the other hand, the situations which have the least influence on the phenomenon in question are: difficulties in selecting an outsourcing provider (average response – 2.14, mode – 2) and the risk of deterioration in the quality of services (average response – 2.43, mode – 2). Therefore, it can be concluded that the respondents have no major issues with choosing an outsourcing operator and are little concerned about the possible deterioration of the quality of services. This is mainly due to a lack of sufficient resources and, to a lesser extent, the fear of losing control over the outsourced processes.

Hypothesis 01 - The greatest benefit of using outsourcing is the ability to focus on the core activities of the business, was verified by analysing the responses to assess the impact of selected benefits on the use of outsourcing. When exploring the answers it can be seen that the benefits that are most relevant from the perspective.

Conducting the chi-squared test allowed the examination of the relationship between the number of the highest answers given by the respondents (high and very high impact) in terms of the ability to focus on the company core activities, and the highest answers given in terms of

other benefits. The relationship between the indicated variables was not statistically significant – the statistic value of χ 2 was 3.233, the p-value – 0.072167 and was higher than the adopted significance level of 0.05. Therefore, it should be concluded that the greatest benefit of outsourcing is not the ability to focus on the company core activities. The auxiliary hypothesis was rejected.

Hypothesis 02 - The main reason why enterprises do not use outsourcing is the lack of sufficient financial resources, it was verified by analysing the responses in terms of assessing the significance of the situations determining the non-use of outsourcing by enterprises. When exploring the answers, it can be noticed that the basic reasons indicated by enterprises in this regard are: insufficient financial resources and the risk of losing control over processes. Conducting the chi-squared test enabled the possibility to examine the relationship between the number of the highest answers given by respondents (high and very high impact) in relation to the lack of sufficient financial resources, and the given highest answers in relation to other situations that determine not using outsourcing. The relationship between the indicated variables was statistically significant - the statistic value of $\chi 2$ was 4.7423, the p-value – 0.029429 and was higher than the adopted significance level of 0.05. Therefore, there are no grounds to reject the hypothesis. It should thus be considered that the main reason why companies do not use outsourcing is the lack of sufficient financial resources. The H02 hypothesis was also confirmed.

5. Discussion

Outsourcing directly influences both the strategy and the organisational structure of an enterprise, resulting in its significant impact on economic and social conditions within the business entity. The outsourcing impact power depends in particular on the outsourced areas and functions of the company and their greater or lesser strategic significance (Kłos, 2017, p. 42). Figure 6 depicts the outsourcing impact power of activities on corporate strategy.

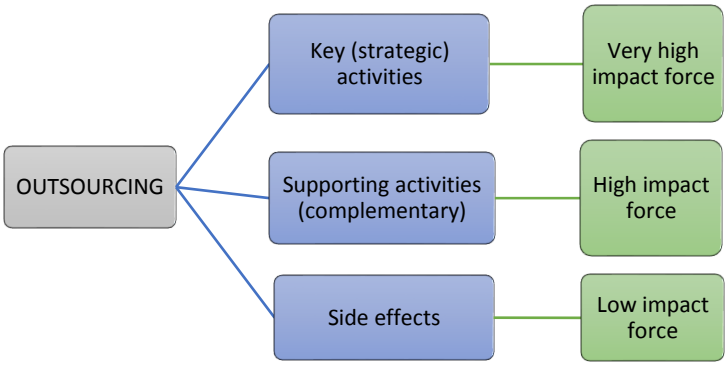

Figure 6. Impact power of activities conducted within outsourcing on corporate strategy.

Source: Kłos, M. (2017). *Outsourcing in Polish enterprises*. CeDeWu Publishing House. Warsaw, p. 42.

As it can be observed in the above diagram, side activities usually have a marginal impact on achieving strategic objectives. Outsourcing of auxiliary (supplementary) functions is more significant for the company, while the core (strategic) activities, which both create value and contribute to achieving superior objectives, are the most important (Rothaermel et al., 2006, pp.1034-1035; Fisher et al., 2008, p. 173). When outsourced, it can weaken the position of the outsourcer, which is most often due to poor identification of areas/functions that may be the subject of outsourcing. There are also cases in which a company has several strategic areas of activity and outsourcing some of them can be an effective solution if an analysis is carried out in advance (Sdiri, Ayadi, 2016, pp. 3-4).

It should be noted that the benefits for an enterprise that result from outsourcing cooperation are in most cases dependent on such factors as: the size of the business entity, the industry/sector, the scale of operations or the type of outsourced function/activity. In practice, however, there are certain positive aspects that usually occur in a business entity after the implementation of outsourcing, regardless of the factors indicated above. They include mainly (Holcomb, Hitt, 2007):

- a significant increase in the flexibility of a particular economic entity,
- the ability to focus and develop those activities that are strategically important for the company,
- the opportunity to save time, and the opportunity to use their experience and knowledge due to cooperation with external entities,
- the possibility of reducing costs related to areas/functions excluded from the economic entity,
- an increased liability of external entities – transactions made as part of outsourcing result in sharing risks incurred,
- the possibility of reducing financial obligations and employment.

The individual benefits of outsourcing can be considered in the terms of strategic, organisational, technological and financial gains, as presented in Figure 7.

Effective cooperation with external entities may also greatly improve customer service. It could be manifested by, e.g. much faster decision-making (e.g. handling complaints) or order processing. This fact can improve the manner in which the company is perceived by customers, as much as it can increase its credibility (Bhide, 2005, pp. 44-45). Another important aspect from the perspective of the functioning of a business entity is the impact of outsourcing on its organisational structure. Along with the constantly changing economic, technological, formal, legal and social conditions, an objectively determined necessity arises for both continuous improvement and adaptation of the organisational structure to the changing and turbulent environment. Stable organisational structures are perceived nowadays as a brake on intensive company development (Wernerheim, 2012, p. 437). The new conditions, together with progressive globalisation, require a flexible organisational structure to facilitate the implementation of increasingly difficult tasks.

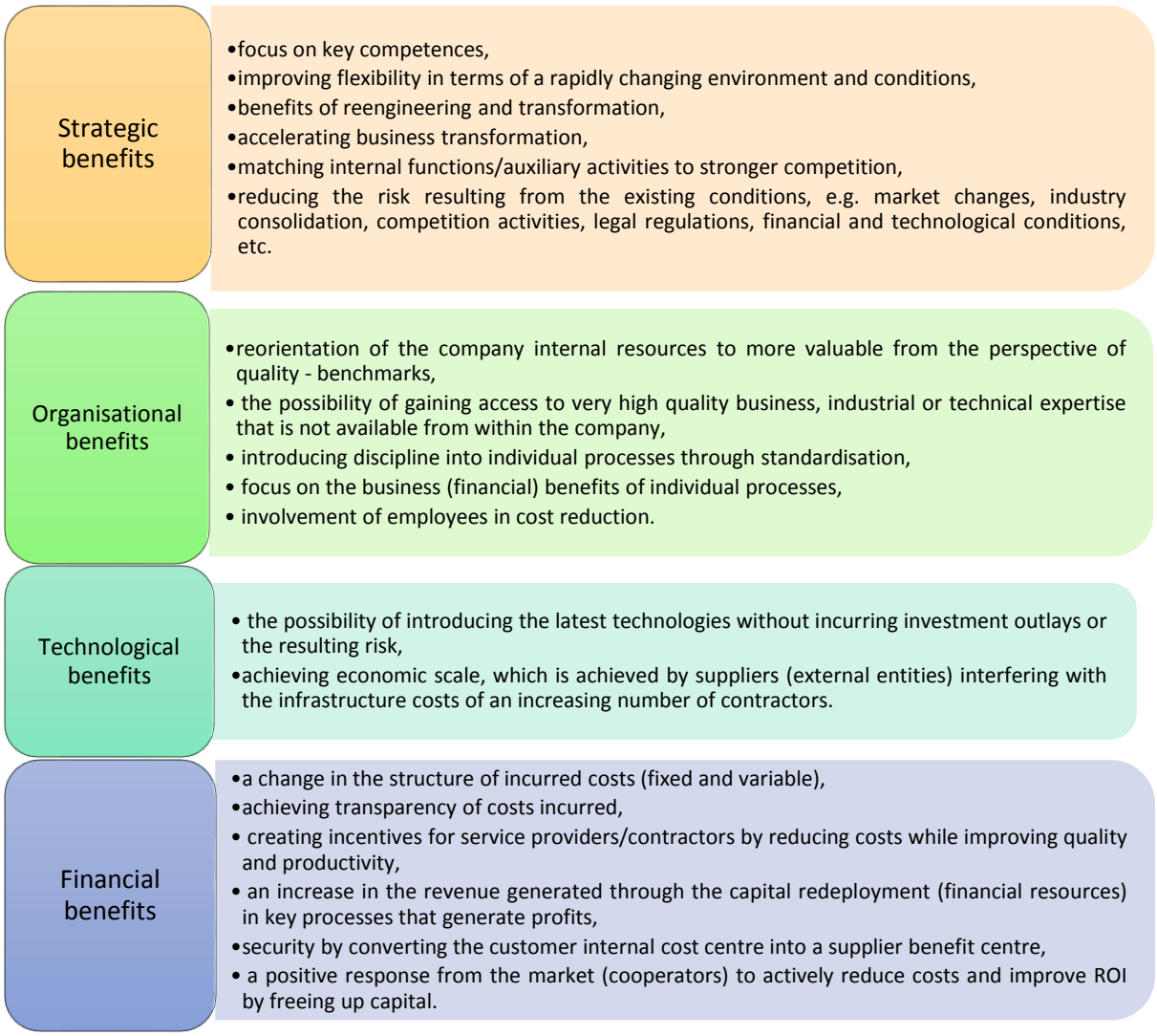

Figure 7. Characteristics of the benefits of outsourcing in the company.

Source: Bhide, B.D. (2005). *Strategic: Decision, Analysis, Best Practices and Emerging Trends*. In: Brudenall (ed.): *Technology and Offshore Outsourcing Strategies*. Palgrave Macmillan, New York, pp. 44-45.

In the age of globalisation, outsourcing is becoming one of the most important tools for bringing order to organisational structure (Piersiala, 2019, p. 169)

However, amongst the typical disadvantages/threats and issues arising from the use of outsourcing by companies, the following can be distinguished (Bhagwati et al., 2004, pp. 94-95):

- wrong managerial practices related to outsourcing functions/areas from the company activity (the reasons may be numerous, e.g. badly conducted/prepared preliminary analysis, choosing the wrong external entity, improperly (badly) formulated outsourcing agreement),
- higher start-up costs for outsourcing than initially assumed; the risk of additional hidden costs (in the case of cooperation with a dishonest outsourcer),

- the risk of losing control over the method used to conduct the unbundled business,
- increased dependence on external parties (suppliers),
- the risk of losing confidential information,
- the risk of having to make some employees redundant, which causes problems between employer and employee,
- the risk of deterioration in the quality of the products provided, which may be the result of inadequate workmanship by an external entity,
- the risk of losing certain competitive advantage sources in the market.

Depending on the nature of a specific threat/problem/disadvantage, they can be divided in a similar manner as advantages into: strategic, organisational, technological and financial, as presented in Figure 8.

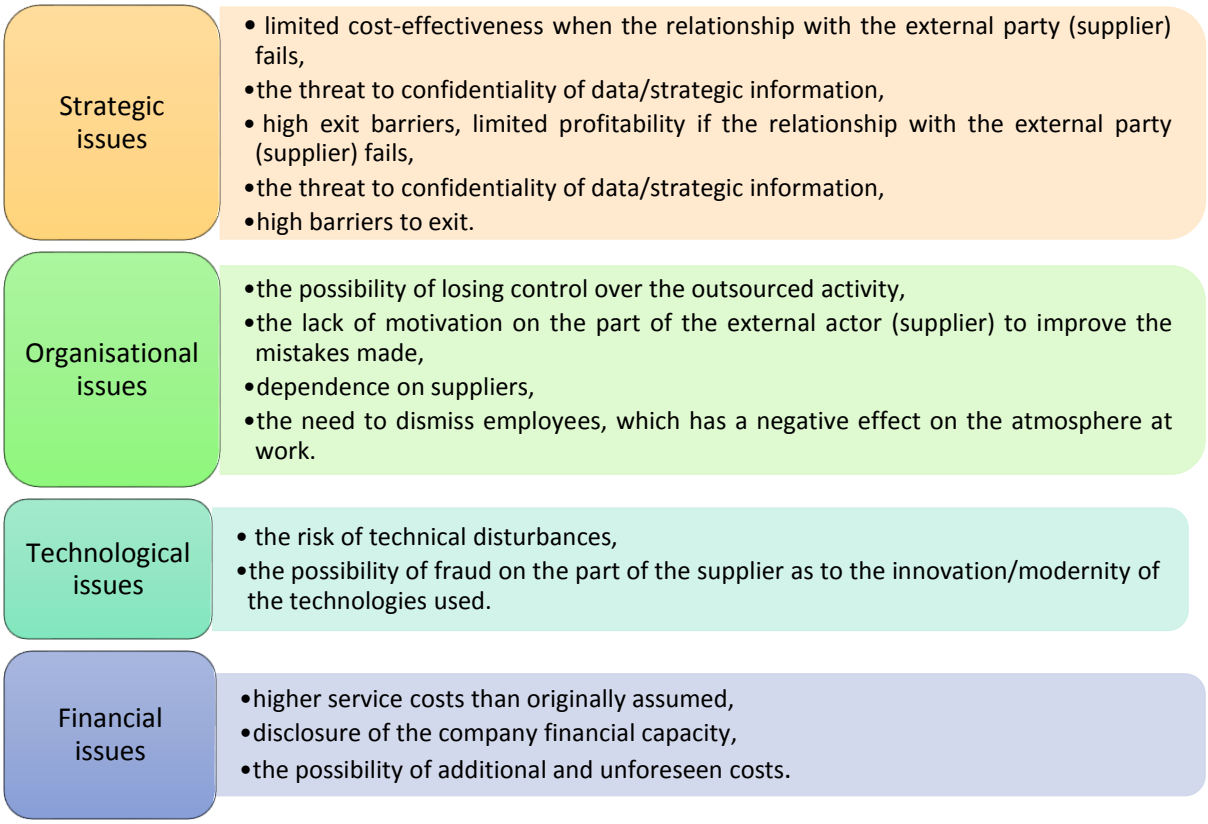

Figure 8. Characteristics of potential disadvantages/problems resulting from the use of outsourcing in the enterprise.

Source: Bhide, B.D. (2005). *Strategic: Decision, Analysis, Best Practices and Emerging Trends*. In: Brudenall (ed.), *Technology and Offshore Outsourcing Strategies*. Palgrave Macmillan, New York, pp. 45-46.

Summarising the above considerations, it can be concluded that outsourcing is a management concept that implies significant changes in the organisation of company activities (van Jaarsveld,Yanadori, 2011, p. 3, 10). This applies not only to changes in the economic and organisational area, but also to shifts in the social area. What is important here is that the human factor plays an extremely important role in outsourcing. People can be both the creators of any innovation and the primary source of resistance to it. They are also the essence

of economic entities (Brecher, Chen, 2010, pp. 990-992). It is reflected in their skills, abilities, motivation, knowledge, creativity and potential (Bhide, 2005). These factors are highly important from the perspective of the economic benefits of outsourcing.

In view of the above, research was conducted to determine which manufacturing companies and what percentage of them use outsourcing services and what benefits they gain from doing so. The study involved a total of 120 business entities with manufacturing operations in Poland. According to the data, micro-enterprises (employing up to 9 workers) were the most numerous group, with 45.8% (55 entities). Small enterprises (employing from 10 to 49 employees) also had a significant share in the total number – 30.8% (37 entities) and medium-sized enterprises (employing 50-249 employees) – 17.5% (21 entities). Large companies (employing 250 and more employees) accounted for only 5.8% (7 entities).

The businesses participating in the survey were operating at different ranges. The largest percentage of them – 45.8% (55 entities) operated on a national scale. Enterprises that operated on the international market accounted for 39.2% (47 entities). The smallest share in the sample was recorded in the case of companies operating locally – 5% (6 entities) and regionally – 10% (12 entities). A detailed summary of the feature concerning the examined enterprises is presented in Figure 9.

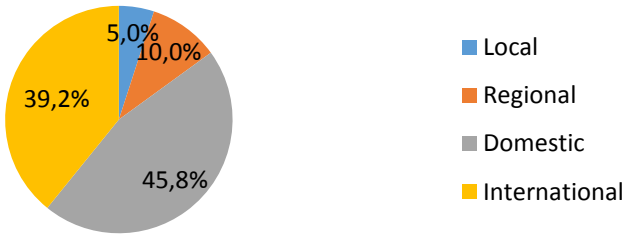

Figure 9. Structure of the research sample by business scope.

Source: Own elaboration.

The survey was dominated by the oldest companies, operating for over 15 years, which accounted for 38.3% in total (46 entities). Enterprises operating on the market for 6 to 10 years accounted for 22.5% (27 entities), and from 11 to 15 years old – 19.2% (23 entities). The total share of enterprises that have been in the market for up to 5 years was 20% (24 entities). Most of the analyzed enterprises are based in urban areas - 74.2% (89 entities). Enterprises located in rural areas account for only 25.8% (31 entities).

6. Summary

When considering the premises for the use of outsourcing by business entities, one should first of all take into account the fact that in each enterprise there are many different internal factors, the existence of which affects, to a greater or lesser extent, outsourcing decisions.

Critical analysis of the literature on the subject, on the basis of which the theoretical issues presented and the survey with the use of the questionnaire, were described, allowed to answer the research questions and verify the hypotheses. The following hypotheses were confirmed:

H01: Majority of Polish manufacturing companies use outsourcing services, and the greatest benefit of outsourcing is the ability to focus on the core business of the company.

H02: The main reason why companies do not use outsourcing is the lack of sufficient financial resources.

Most of the surveyed entities used outsourcing, however to a different extent and scope. Taking into account the size criterion, all medium-sized and large entities, the majority of small entities and almost every third micro-enterprise used outsourcing. From the perspective of the scope of their activities, outsourcing was used by all entities operating on the international market, nearly half of the companies operating on the domestic market and every fourth company operating locally. On the other hand, entities operating locally did not use outsourcing. Considering market operation duration, the percentage of companies using outsourcing increased proportionally to their existence, with companies operating on the market for up to 1 year not using it at all. There were no significant differences in terms of locating the enterprise. In both cases (city, village), the percentage of enterprises using outsourcing was similar and amounted to approx. 65%.

Representatives of enterprises using outsourcing services noticed many benefits of using this type of solution. Among the most important of these, they pointed out: the ability to focus on the core business of the company and increased flexibility of operation. Benefits such as an overall improvement in the functioning of the company and better personnel management were of little importance to them. It should also be noted that the vast majority of respondents using outsourcing assessed it positively from the perspective of expected benefits.

Failure by companies to use outsourcing is primarily due to the lack of sufficient financial resources and the risk of losing control over outsourced processes. Despite not currently using outsourcing, the majority of respondents wish to use this type of service in the future. They would cover areas such as finance (incl. accounting), health and safety, IT and public relations.

In conclusion, it should be noted that outsourcing as a management concept is one of the easiest ways for companies to achieve greater efficiency, and therefore it is necessary to pay great attention to it. This is because it fits in very well with the trends set by globalisation processes and the development of information technologies, which enable companies to cross national borders and sectors. It is thus necessary to monitor the use of outsourcing by economic entities. It is also important to mention that the study carried out for this thesis does not fully explore the issues involved. It is recommended that studies of this type be conducted again in the future. Particular attention should also be paid to enterprises from the SME sector as they constitute the backbone of the Polish economy and their use of outsourcing may have a positive impact on increasing the efficiency of their operations and increasing their competitiveness, especially in the current post-pandemic economic situation.

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STATISTICAL ANALYSIS OF ACCIDENTS AT WORK IN THE SELECTED MANUFACTURING ENTERPRISE

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Purpose: The aim of the work is to analyze the accidents at work in the selected manufacturing enterprise from automotive industry.
Methodology: The research includes three workplaces: warehouseman, machine operator and transport worker. The accidents investigation was based on the methodology and work accident model developed by the EU Statistical Office (Eurostat) as a part of the European Statistics on Accidents at Work (ESAW) project. This model includes three phases: pre-accident, accident and post-accident.
Findings: In the years 2019-21 in the selected workstations there were noted 25 accidents at work (12 accidents in 2019, 8 accidents in 2020 and 5 accidents in 2021). The accidents at work were analyzed taking into consideration: the type of injury and the part of body injured, the physical activity at the time of the accident, an event that is a deviation from normal practice, and causes of the accident.
Practical implications: The results of the analysis allow to introduce suitable corrective actions, e.g. 5S method, 'shoptalks' about occupational health and safety, suggestion submission program, etc., what influenced the reduction of accidents at work in 2020 and 2021.
Originality/value: The use of statistics for accident at work allows to evaluate the safety state in an enterprise. The statistics also allows to formulate various factors that can be used to evaluate accident rates, workstations with a special risk of accident, realization of various comparative analyzes in the area of investigation of accident situations, and corrective actions towards hazards reduction.

Keywords: accidents at work, ESAW methodology, causes of the accidents, preventive actions.

Category of the paper: Research paper.

1. Introduction

Occupational health and safety in enterprises is a subject of discussion and research conducted by organizations around the world (Alali et al., 2016). Maintaining the proper safety level in a workplace is an important element of the whole company operation (Niciejewska, 2018). Furthermore, conditions created by an employer in the working environment have a large impact on occupational safety (Rahimi Pordanjani, 2015).

The causes of accidents are usually associated with inadequate human behavior and poor work organization (Lu, 2022; Jafari et al., 2019; Dembe et al., 2005). In the work (Vasconcelos et al., 2015), there was shown that accidents at work were caused by organizational factors in the workplace, including irregularities and/or errors in the management. It also was found, that 6.9% of serious and fatal accidents in the construction industry could have been avoided if measures had been taken in the design of equipment. The level of accident rate, apart from the situation on the labor market and the financial condition of companies, is significantly affected by a level of work safety culture and technical culture in enterprises. Mohammed Abubakar et al. conducted an analytic predictive analysis using artificial neural network and survey data from 306 metal casting industry to study the relationship among workplace injuries, safety climate, and safety-related behaviors. Authors reported that an organizational safety climate mitigates workplace injuries. Moreover, safety behaviors amplify the strength of the negative impact of a safety climate on workplace injuries.

Despite the fact that in recent years there has been a downward trend in the number of accidents at work, the prevention of accidents is one of the most important tasks of both employers and employees. To make strategic decisions in the field of occupational safety, deep analyzes of data on accidents at work are used (Szóstak, 2019; Betsis et al., 2019). The article (Szóstak, 2019) presents the results of a statistical analysis covering 630 accidents at work that took place in Poland in 2008-2017 in selected voivodeships. For this action to be effective, it is necessary to know those areas, where there are the most accidents and where they are associated with the most serious consequences, to know the mechanisms of these accidents and their real consequences. The author stated that staff training should be conducted taking into account the needs of each group of employees. Moreover, particular attention should be paid to the group of employees with no or little work experience (up to 1 year). All activities carried out by the employer to ensure health and safety of working conditions are related to accident prevention (Dyreborg, 2022).

First, the concept of an accident at work needs to be identified. The accident at work is considered to be a sudden event which occurred in connection with work caused by an external causes, causing injury or death. Lack of person injury (i.e. no damage to human body tissues or organs due to an external factor) indicates, that an event qualifies as a potentially accidental event (Journal of Laws, 2002). There is lack of obligation to record and analyze information on

potentially accidental events in accordance with applicable law. However, many enterprises that have implemented an occupational health and safety management systems consistently maintain such a register. Nevertheless, it is important, that the analysis of accidents at work was realized in a detailed and reliable manner to implement appropriate corrective actions (Szóstak, 2019; Vasconcelos et al., 2015).

In case of an accident at work, the employer is obliged, among others, to (Polish Labor Code, 1974; Rączkowski, 2009):

- taking actions to eliminate or reduce the hazards,
- providing first aid to victims,
- determining the circumstances and causes of the accident (appointment of an accident team),
- measures to prevent similar accidents at work in the future,
- prepare and archive of an accident documentation (accident report or accident card, statistical card),
- keeping a register of accidents at work.

The established accident team determines the circumstances and causes of an accident, inspects the place of an accident, technical condition of machinery and other technical devices, and protective devices, as well as evaluates the conditions of work and other circumstances that could have had a significant impact on the occurrence of the event.

Analyzing the circumstances of an accident, the accident team should take into consideration (Polish Labor Code, 1974):

- activities which the injured performed or activities belonged to his duties,
- what machines (devices) he operated, which substances or agents he worked with,
- whether he used the required personal protective equipment and other protections,
- whether the protections were functional and properly selected for the duties performed,
- whether the injured respect the health and safety regulations and rules, had appropriate qualifications to perform the work,
- whether the injured had up-to-date training, medical examination and whether he was familiar with the occupational risk at the workplace as well as occupational health and safety instructions, operation of the machine.

After determining the circumstances and causes of the accident, no later than within 14 days from the date of obtaining a notice of the accident, the team draws up the protocol establishing the circumstances and causes of an accident at work. In this report the team performs legal classification of the accident, specifies preventive measures, and verifies the occupational risk assessment at the workstation in which the accident occurred.

Accident report relating to fatal, serious and collective accidents shall be forwarded without delay by the employer to the competent Labor Inspector (Kaźmierczak, 2017).

Based on the approved accident report, the employer is obliged to prepare a statistical card of accident at work. The statistical card for accident at work was introduced by the regulation of the Minister of Economy and Labor of 8 December 2004 concerning the statistical card for accident at work. This regulation has been in force since January 2005. The supplemented accident card at work includes the data of: employer, at which the accident at work occurred, injured person, the consequences of the accident, its course and circumstances, as well as the causes of the accident. The causes of accidents in the statistical accident card are defined as any deficiencies and irregularities that directly or indirectly contributed to the accident. They are closely related to the employee' activities, material (technical) agents, general organization of work and the workstation equipment.

The statistical accident card classifies the accident causes as follows (Węgrzyn, 2017):

1. incorrect condition of the material agent (19 subcategories),
2. incorrect general organization of work (15 subcategories),
3. incorrect organization of the workplace (7 subcategories),
4. lack of material agent or incorrect its use by employee (9 subcategories),
5. not using protective equipment by employees (4 subcategories),
6. incorrect arbitrary behavior of an employee (8 subcategories),
7. psychophysical state of the employee does not ensure safety performance of the work (6 subcategories),
8. improper employee behavior (9 subcategories),
9. other reason.

It should be noted, that most of these 9 categories relate to various types of incorrectly performed actions by the employee, which affect the recording of the causes of accident and the results of statistical analysis.

Currently in Poland, due to the pandemic and the planned adoption of remote work on a permanent basis, additional information will be introduced in the Labor Code and for the purposes of national statistics. It will concern the injured person's work in a remote form. This is to obtain data on possible accidents that have occurred in connection with the performance of work organized in a remote form.

The current statistical card is based on the methodology and model of an accident at work developed by the EU Statistical Office (Eurostat) in the framework of the European Statistics on Accidents at Work (ESAW) project. The ESAW project was launched in 1990, and the ESAW methodology was published by Eurostat in 2001. Member states of the European Union provide data on accidents at work to Eurostat. In connection with the Eurostat system application, a new classification has been made in the statistical cards, including occupations, citizenship, employment status, causes and sources of the accident. Unification of the system allows for comparative analysis of data from Poland and other EU countries (Obolewicz, 2011).

The statistical accident model based on ESAW methodology distinguishes three phases: pre-accident, accident and post-accident (Bojanowski, 2005; Pietrzak, 2007; Eurostat, 2013).

In a pre-accident phase, the employee is taken into account in his broadly understood work environment. The working environment should be understood not only as the place where the victim was at the time of the accident, but also as elements related to the organization of the injured person's work. It should also be noted that all elements of the pre-accident phase are not related to the accident and should be considered as such (Eurostat, 2013).

Accident phase – means the last event that led to the accident. The accident situation is a deviation, non-compliance with the accepted standard. The element associated with deviation is the material agent that caused or was associated with the work process. In the accident phase, it is also important to identify the event that led to the injury.

Post-accident is the last stage in which information is collected regarding: the type of body injured, the number of days unable to work, material losses.

Figure 1 presents the diagram of the statistical accident model based on the ESAW methodology.

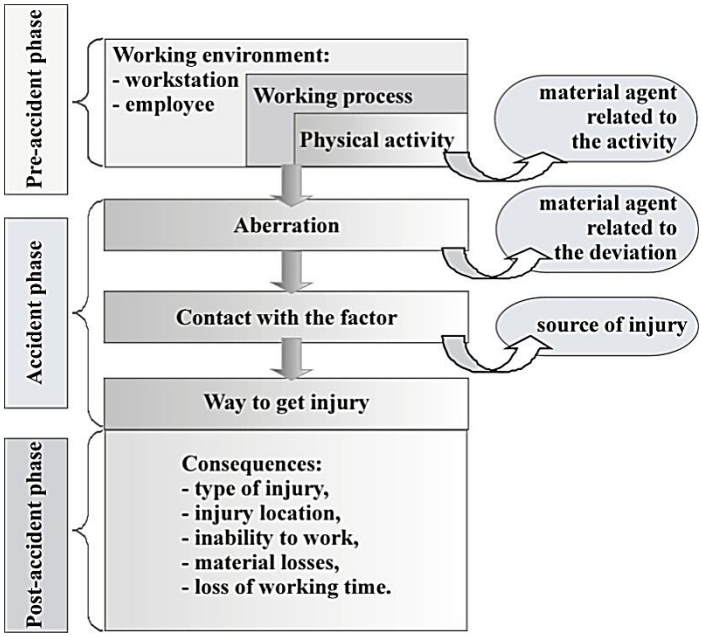

Figure 1. Statistical model of an accident at work based on the ESAW methodology.

Source: Rączkowski B. (2009). OHS in practice. XII edition. Gdansk: Human Resources Consulting and Improvement Center.

As a part of the ESAW project, Eurostat records: fatal accidents at work and accidents at work that result in more than 3 days of absence from work. Moreover, the following variables are taken into account in the ESAW methodology (Eurostat, 2013):

- information about the accident and injured (the economic activity of the employer; occupation of the victim, employment status of the victim; age, sex, and nationality of the victim; geographical location of the accident, the date and time of the accident, size of the enterprise; the working environment, the workstation and the working process),

- information on how the accident occurred, in what circumstances, and how the injuries arose (the specific physical activity at the time of the accident, deviation from normal practice, way in which the injury was incurred, details about associated material agents – there are three variables on material agents: material agent associated to the specific physical activity, material agent associated to the deviation, material agent associated to the contact – mode of injury),
- information on the nature and seriousness of the injuries, the consequences of the accident (the part of body injured, the type of injury, the number of days lost).

The use of statistics for accident at work allows to evaluate the safety state in an enterprise. The statistics also allows to formulate various factors that can be used to evaluate accident rates, workstations with a special risk of accident, realization of various comparative analyzes in the area of investigation of accident situations, and corrective actions towards hazards reduction.

The work describes the principles and practical application of ESAW in a manufacturing company on the example of three workplaces: warehouseman, machine operator and transport worker. The analysis of the work accidents and the victims covers the years 2019 to 2021.

2. Methodology

Based on the model presented in Figure 1, statistical analysis of accidents at work in the selected manufacturing enterprise from automotive industry was presented. Steel car parts are manufactured in the company. The plant consists of: a warehouse, a press shop, a paint shop, a welding shop, assembly and an office part. The enterprise attaches a great importance to the occupational health and safety and keeps a high level of safety culture among employees. It is important for them to be aware of the hazards at the workstations. Due to the nature of the industry, the production in this plant lasts for twenty-four hours a day, seven days a week. Stopping and restarting a production come with enormous costs that no company can afford. Every employee has the required qualifications necessary to work at the workstations. The employee is trained in occupational health and safety before being allowed to work and undergoes periodic training in this area. All new employees undergo general training before being allowed to work. On the other hand, before the work at a given workstation, toolbox talks carried out. Each of the machines/devices in the plant has a technical documentation. The devices meet the requirements of the occupational health and safety, and ergonomics. Their arrangement ensures convenient passageways, free access to them and access to emergency exits. Each device is marked accordingly. Near the machine there is also a manual and a description of personal protective equipment that should be used before starting the work.

The analysis of accident at work includes three workplaces: warehouseman, machine operator, transport worker. In the ESAW methodology, the term workstation is precisely defined. This is the place/workplace occupied by the victim at the time of the accident. Therefore, the work can be permanent or occasional. The term 'usual workstations' should be understood in a restrictive way, always inside the premises of a normal local work unit. It can be a permanent workplace in a workshop, shop, office, etc. (Eurostat, 2013). Another aspect that needs to be defined is the working process. By definition, the working process is actually the main type of work or possibly the tasks that the victim was performing at the time of the accident. Therefore, it must contain a proper description of the type of work and its broadly understood task that the victim was performing at the time of the accident. It should be noted that the work process does not have to be related to the physical activity performed by the injured employee (Eurostat, 2013). According to the ESAW methodology, the working process should be coded according to a two-digit classification (Table 1).

Table 1.
Examples of codes in classification of working process by ESAW methodology

Working process	
Code	**Description**
00	Lack of information
10	All types of manufacturing, production, processing
11	Production, manufacturing process
12	All types of storing
19	Others
20	All types of excavation, construction, repair, demolition
21	Excavation
22	Building of new construction
23	Civil engineering, infrastructures, roads, bridges, etc.
24	Repairing, extending, remodeling of all types of buildings
25	Demolition of all types of constructions
29	Others

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

In order to identify the activity during which the accident occurred, it is important to analyze the ordinary working day of the victim. In the analyzed case, at the warehouseman workstation the following activities are carried out:

- unloading and loading material,
- issuing and receiving materials,
- supply control,
- warehouse operation, computer operation, record keeping,
- handling of transport devices,
- manual transport,
- use of chemical substances,
- cleaning the warehouse.

Warehouseman performs a work 8 hours a day. It is, above all, work in a standing position that requires considerable physical exertion.

The activities performed at machine operator workstation include:

- service of machines, tools, including hand tools,
- handling of transport equipment and transport of parts,
- set of process parameters,
- production of components,
- process control,
- cleaning job,
- keeping records and computer skills,
- use of chemical substances,
- personnel management.

The work at the machine operator lasts for 8 hours a day. It is primarily work in a standing position, which requires considerable physical effort.

Activities carried out at the transport workstation are following:

- repair of machines, devices and production stands,
- connection of machines, equipment modifications, retooling and setting machines and production stations,
- operating machines, devices and hand tools, power tools,
- welding works, works at heights,
- manual transport,
- servicing of in-house transport equipment with a mechanical drive,
- use of chemical substances,
- record-keeping and maintenance of computer,
- clearing job,
- personnel management.

The transport worker works 8 hours a day, usually in a standing position. These works require considerable physical exertion.

According to the ESAW methodology, the so-called specific physical activity at the time of the accident are specified. In other words, how the incident differed from normal practice, the exact manner in which the injury occurred, and details of any material factors involved (Eurostat, 2013).

The scope of the research, based on the statistical ESAW model, was narrowed to the following categories of analysis of the statistical accident card:

- the type of injury and the part of body injured,
- the physical activity at the time of the accident,
- an event that is a deviation from normal practice (state),
- causes of the accident.

The results of the analysis should provide the basis for the enterprise to implement additional corrective actions. The analyzed enterprise performs the 5 Why analysis after each accident. Such an analysis allows to notice additional causes of an accident that were not taken into consideration during the post-accident procedure.

The next phase according to the ESAW methodology is the accident phase (Figure 1). In this section, materials agent related to the deviation are specified. There are three variables that provide information about the material factors involved in an accident (Eurostat, 2013):

- the 'material agent' associated to the 'specific physical activity',
- the 'material agent' associated to the 'deviation',
- the 'material agent' associated to the 'contact – mode of injury'.

In practice, usually all three types of agents can be differ significantly. There are also cases identical or significantly related to each other. In some cases there is no 'material agent' to be recorded or encoded. According to the ESAW methodology, if several 'material agents' are revealed with a (last) 'deviation', the last 'material agent' involved, i.e. effective at the time of contact causing the damage, should be recorded (Eurostat, 2013). The last group – material agent associated to the contact with the tool, object or instrument with which the victim of the incident came into contact. It can be both physical and psychological. This is the main 'material agent' associated with the injury. If there are several 'significant agents' associated with the injury, the 'significant agent' with the most severe injury should be recorded (Eurostat, 2013).

The last phase of the ESAW statistical model is the post-accident phase. It covers the scope and type of consequences of the analyzed accident at work.

3. Results and Discussion

3.1. Analysis of accidents at work at the selected workplaces

The first analyzed group of the accidents at work, from the statistical card, is the type of injury with its location. For the analyzed case (analyzed workplaces) the injury codes are summarized in Table 1. Analyzing the Table 2, it can be concluded that the most repeated are the following types of injuries:

- wounds and superficial injuries (code 010),
- bone fractures (code 020),
- dislocations, sprains and strains (code 030).

However, it should be noted that there is a significant difference in the number of these types of injuries. Most accidents, which resulted in wounds or superficial injuries were reported. The reason for this type of injury may result from the employees' contact with devices or tools

that may cause this type of injury or wound, e.g. contact with knife used to open the box with parts. In addition, some machine have sharp components. If the employee does not keep enough concentration, this can cause injury.

Table 2.
Injury codes according to the statistical card

Code	Type of injury	A year of accidents			TOTAL
		2019	2020	2021	
000	Unknown or unspecified	1	0	0	1
010	Wounds and superficial injuries	8	3	2	13
020	Bone fractures	1	2	1	4
030	Dislocations, sprains and strains	1	2	1	4
040	Traumatic amputations (loss of body parts)	1	1	0	2
070	Poisonings, and infections	0	0	1	1
	TOTAL	12	8	5	25

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

The next step of the ESAW analysis was to determine the location of the type of injury (the part of body injured). In the analyzed enterprise collected data are presented in Table 3. The codes for the location of injuries by individual body parts, developed according to the statistical accident card were presented in Table 4.

The analyzed data presented in Tables 3 and 4, and in Figure 2 show that the injuries are often located in the area of upper extremities – hand (code 53), especially of fingers (code 54).

Table 3.
The results in the placement of trauma in the 2019-2021

Location of the injury	Year of accidents		
	2019	2020	2021
Head/face	2		1
Lower extremities	1		1
Upper extremities	9	8	3

Table 4.
Injury location codes for individual body parts

Code	Location of the injury	Code	Location of the injury
12	Facial area	54	Finger(s)
19	Head	58	Upper extremities, multiple sites affected
30	Back, including the spine	59	Upper extremities, other parts not mentioned above
52	Arm, including elbow	63	Ankle joint
53	Hand	64	Foot

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

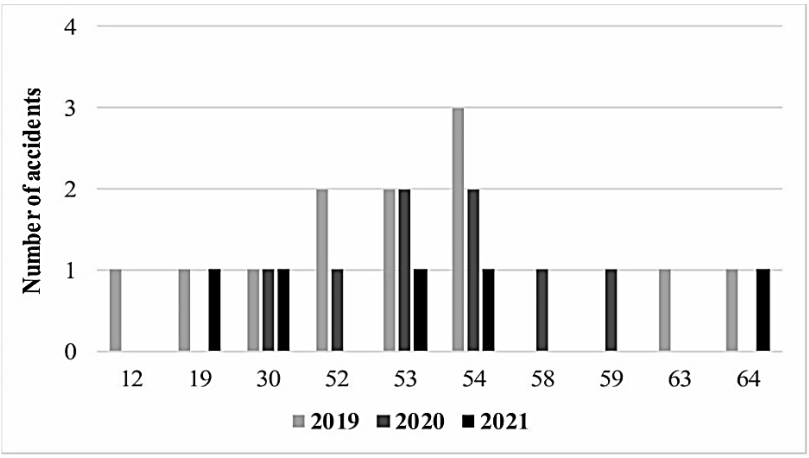

Figure 2. Location of the injuries for individual body parts in the years 2019-2021.

Finger injuries are a result of the production process, which mainly consists of manual work using machines, tools or manual means of transport. Injuries of arm, including elbow (code 52) usually occur at warehouse position like back injuries, including the spine (code 30). Work at the warehouse workstation mainly consists of loading, unloading materials or manual transport actions. The job specifications at this position increase a probability of such injuries. But this is not the only position with those identified hazards. Machine operators also have similar accidents, but with a reduced frequency.

Analyzing the collected data, it can be concluded that foot injuries usually occur during manual transport works. Transport of parties from one position to another is an example of such injuries. Traumatic amputation is connected with a machine operator and this accident was classified as a serious accident.

3.1.1. The activities performed by the victims at the time of the accident

For a better understanding of the course of the accident, according to ESAW model, the focus on the activities performed by the injured at the time of the accident was made. Explanations of the codes from the statistical card for these activities are presented in Table 5.

Table 5.
Type of physical activities performed by the injured at the time of the accident

Code	Type of activities	Code	Type of activities
12	Feeding the machine, unloading the machine: supplying/ receiving materials, semi-finished products, products, etc.	**51**	Carrying vertically – lifting, raising, lowering an object
13	Monitoring the machine, operating or driving the machine	**52**	Carrying horizontally – pulling, pushing, rolling (an object)
31	Driving a means of transport or operating machines and other self-propelled mobile devices	**53**	Transporting a load – carried by a person
41	Manually taking hold of, grasping, seizing, holding, placing – on a horizontal level	**61**	Walking, running, going up, going down, etc.
42	Tying, binding, tearing off, undoing, squeezing, unscrewing, screwing, turning	**65**	Getting up, pitting down
45	Opening or closing the box, package, etc.		

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

The activities performed by the workers (numerically presented) in the years 2019-2021 are presented in Figure 3. It can be stated that the workers at the time of the accident generally supplied or received material or component used in the production process from each other (code 12). These workers were usually machine operators. They constitute 80% of the injured belonging to the group of 12. The reason for the fall of the production part may be the lack of sufficient knowledge about the transport of such parts. This is confirmed by the fact that 4 injured workers have a small seniority in the company (up to half a year). They do not yet have sufficient skills and experience. The company should focus more on training new machine operators or, if possible, limit the work at the workstations where many activities are related to the transport of the parts.

The next, most often repeated actions that occurred at the time of the accident were those related to a vertical or horizontal transport (codes 51 and 52). The warehousemen and machine operators are injured from these groups. But more accidents were noted at the warehouse workstation. In the both positions, the workers are involved in transport. The main causes of the accidents are rush and insufficient focus on the action being performed. Moreover, the company imposes increasingly higher production standards, which means that workers do not comply with the proper transport requirements. They do not transport the one part, as is in the instruction, but they transport two parts at the same time, which speeds up the task, but it is the cause of the accident.

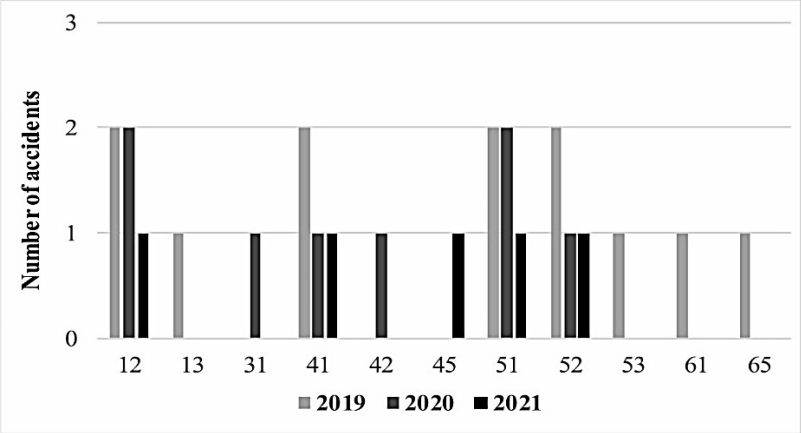

Figure 3. The activities performed by the victim at the time of the accident in the years 2019-2021.

The activities performed during the accident, classified with code of 41 (manually taking hold of, grasping, seizing, holding, placing – on a horizontal level), are related to the injured who worked as the machine operators.

The workers employed at transport workstation represent a smaller part of the analyzed research group. During the analysis, it was found out, that they performed the activities of 13 – monitoring the machine, operating or driving the machine, and 42 – tying, binding, tearing off, undoing, squeezing, unscrewing, screwing, turning, etc. Based on the above data, it was stated that the activities performed at the time of the accidents coincide with the job specifications in the analyzed manufacturing enterprise.

3.1.2. An incident that is a deviation from normal practice

Deviation should be interpreted, according to ESAW model, as an incident that causes the disturbance of the normal course of the work process, which results in an accident. In many cases, such an incident is not connected with the activity which was performed by the injured at the time of the accident. The reason for choosing this group for analysis was to check where in the system there is a nonconformity that causes the accidents. Removal of such 'deviations' from the normal practice may in the future reduce the number of accidents or at least decrease the severity of the accidents.

The selected codes with their explanation concerning incidents that are deviation from the normal practice are presented in Table 6.

The analysis of incidents with deviation from the normal state can be constricted (Figure 4). For many accident events, lack of information about these events (00) or the incident is not specified in the accident statistical card (49).

In addition, a major proportion of incidents is associated with:

- the loss of control of object (44),
- the loss of control of machine (41),
- the loss of control of means of transport (42).

Table 6.
Incident codes that are deviation from normal practice according to the statistical card

Code	Code explanation	Code	Code explanation
00	No information	**49**	Other, unspecified deviations in the group (loss of control of machine)
33	Slip, fall, collapse of material agent – from above (falling on the victim)	**61**	Walking on a sharp object
35	Slip, fall, collapse of material agent – on the same level	**64**	Uncoordinated movements, spurious or untimely actions
41	Loss of control (total or partial) – of machine (including unwanted start-up) or of the material being worked by the machine	**69**	Other, unspecified deviations in the group of body movement without any physical stress
42	Loss of control (total or partial) – of means of transport or handling equipment (motorised or not)	**71**	Lifting
44	Loss of control (total or partial) – of object (being carried, moved, handled, etc.)	**72**	Pushing, pulling

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

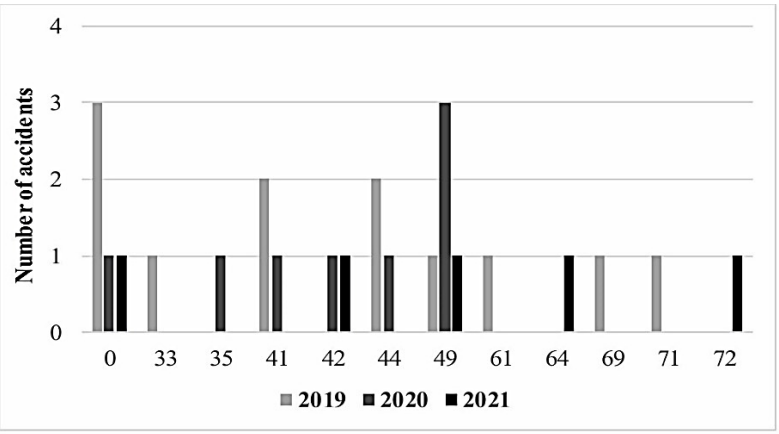

Figure 4. The incident that is a deviation from normal practice in the years 2019-2021.

The monotype of the work decreases the concentration on the actions performed, what can increase the probability of losing control of object, machine. Therefore, it is important that employees rotate to another operations or a machine from time to time. This allows to overcome the routine and also engages employees to work. Thanks to rotation, employees are trained to perform many operations, which make them more flexible. Change of position also allows to meet other employees, and it is easier to work as a team.

As a result of the analysis, it was observed that the loss of control of machine (code 41) is associated with the workers employed in the company over 5 years. Their mistakes could be due to the long working time at one workstation which caused they were too confident in their skills.

3.1.3. Event causing injury

An injury event describes the way in which the injured worker has suffered an injury. The results of these investigations may be the basis for implementation of a new, additional corrective actions in the enterprise that were not previously considered. Table 7 summarizes the selected codes classifying events that are deviations from the state with their explanation.

Table 7.
Codes for the events caused an injury according to the statistical card

Code	Event causing injury	Code	Event causing injury
31	Vertical motion, crash on or against (resulting from a fall)	**51**	Contact with sharp material agent (knife, blade, etc.)
32	Horizontal motion, crash on or against	**61**	Trapped, crushed- in
39	Other, unspecified contact in the group of horizontal or vertical impact with or against a stationary object (the victim is in motion)	**62**	Trapped, crushed- under
42	Struck – by falling object	**63**	Trapped, crushed-between
44	Struck – by rotating, moving, transported object, including vehicles	**64**	Limb, hand or finger torn or cut off
45	Collision with an object, including vehicles – collision with a person (the victim is moving)	**71**	Physical stress – on the musculoskeletal system
49	Other, unspecified contact in the group of struck by object in motion, collision with		

Source: European Statistics on Accidents at Work (ESAW). Summary methodology. Eurostat European Commission, 2013.

According to data presented in Figure 5, in the analyzed enterprise in 2019, 33% of all accidents were caused by a contact with sharp material agent, e.g. knife (code 51).

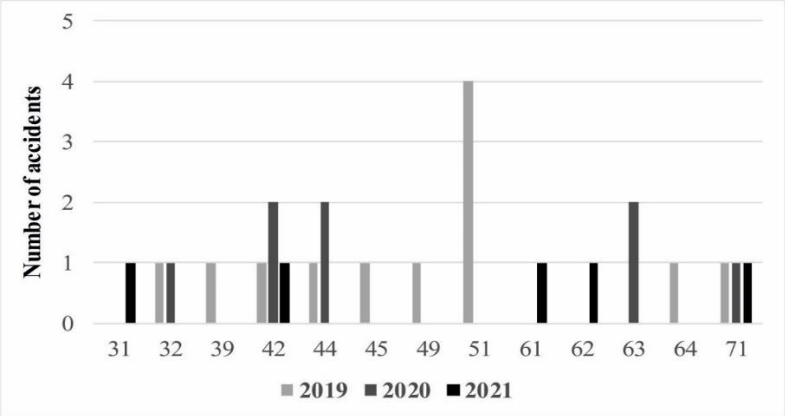

Figure 5. Codes for the events causing injuries according to the statistical card in the years 2019-2021.

This group of injured workers have been working in the company for over 5 years. The workers, probably, did not keep their concentration. They performed this activity routinely, ignoring the hazard. After the implementation of 'safety knives' and training of employees, similar events did not occur in other years.

At the turn of 2019/2021, there was often accidents in which workers were injured as a result of being struck – by falling object (code 42) or by rotating, moving, transported object, including vehicles (code 44). In both cases, the events concerned the transport of production parts. The high number of similar accidents means that employees have limited awareness about the hazard or they do not respect the health and safety rules. Another reason may be the lack or unclear instructions for transport works. If an employee does not have sufficient knowledge and skills, he is more exposed to an accident.

In 2020, two accidents indicated as being trapped or crushed between a given factor (code 63), resulting in a finger injury were observed. In the both cases, the employees did not work in the company for one year. This may suggest that they did not have sufficient skills to operate the machine. The musculoskeletal load (code 71) causing the injury is repeated at least once each year.

3.1.4. Causes of the accidents

Definition of the causes of accidents at work can be present as all deficiencies or irregularities that directly or indirectly contributed to the occurrence of an accident at work, taking into account material agents, work organization and workspace (Eurostat, 2013). The analysis of this category of the statistical card is one of the most important part of the investigations. The analysis results will allow to introduce corrective actions that can eliminate the repeated causes of accidents at work. It also creates a chance that a similar situation will not occur in the future. In the statistical accident card can be selected more than one cause of an accident.

Selected codes of the causes of accidents at work with their explanation at the turn of 2019/2021 were collected in Table 8.

Table 8.
Codes of the causes of accidents at work according to the statistical accident card

Code	Code explanation	2019	2020	2021	Total
059	Other, unspecified material defects	1			**1**
061	Overexploitation of material agent		1		**1**
101	Inappropriate division of work or task layout		1		**1**
119	Other, unspecified irregularities related to the overall organization of work	1			**1**
123	Improper distribution and storage of work instruments (raw materials, intermediate products, products, etc.)	1	1	1	**3**
139	Other, unspecified irregularities of workstations organization	1			**1**
147	Inadequate fit, mounting, hanging		1		**1**
225	Insufficient focus on the realized action	3	1	2	**6**
226	Surprise by an unexpected event	3	2	1	**6**
227	Improper pace of work	2	1	1	**4**

Source: Pietrzak, (2007). *Analysis of accidents for prevention needs*. Warsaw: National Labour Inspectorate.

The results from Table 7 show, that a frequent causes of the accidents at work are:

- insufficient focus on the realized action (code 225),
- surprise by an unexpected event (code 226),
- improper pace of work (code 227).

From the above analysis, it can be concluded that the main cause of the accidents at work is due to the mistakes done by the employee. According to data from the Polish Central Statistical Office (CSO) about the causes of accidents at work in 2020, 60.8% of accidents were caused by an inappropriate employee behavior. This indicates that a similar problem exists in many other companies. The machine is not responsible for an accident but the employee.

The results presented in Table 7 also indicate that the cause of the accidents often was the improper distribution and storage of work instruments (code 123). This information should be a clue for the company that a reorganization of the workstations is necessary.

4. Preventive and corrective actions

In the analyzed enterprise the number of accidents at work in 2020 and 2021 is successively reduced (Table 2). This is because of the preventive and corrective actions undertaken by the management of the enterprise by the end of 2019. In addition to initial and periodic trainings, the health and safety department started organizing ‘shoptalks’ about OHS. Important safety information was given on the bulletin board. Weekly audits carried out by the health and safety department allowed to check all areas in terms of safety and employees’ knowledge on the

hazards occurring at workstations. If in a given area there is low risk awareness, then supervisor is obliged to conduct an additional training for employees. Top management also realized its own audit based on a prepared check-list. Such audits are a good example for employees and show that management is also involved in building a safety culture. The employees are kept informed about new hazards in this way. Moreover 5S principles were implemented at the workstations at the beginning of the year 2020. The 5S program is a collection of methods and techniques that are developed to keep a well-organized, clean and safe workstation (Veres et al., 2018; Costa et al., 2018). The motto of the method is 'a place for everything and everything in its place'. The 5S method owes its name to five successive steps leading to a correctly organized workstation, when each of these five stages start with 'S': sort, set in order, shine, standardize, and sustain. A lack of order at the workstations made the employees work more difficult what led to mistakes. That is why trainings in the scope of the 5S method were introduced for employees and managerial staff. The management also implemented a suggestion submission program. Each employee can submit its suggestion, e.g. on safety. Once a month, the commission which was appointed checks the suggestions and selects the best individual or group change proposal. The awarded person or group of employees receive a cash prize, that contributes to raising awareness and care for the occupational safety state in the company.

5. Conclusions

In this work the statistical analysis of accidents at work according to the ESAW methodology in the selected automotive enterprise was presented. In particular:

- collected data providing reliable information on working conditions at workplaces, like: warehouseman, machine operator and transport worker;
- defined areas which were characterized by the highest number of accidents at work – that was manual transport work, including vertical or horizontal transport. This applied to the positions of warehousemen and machine operators. The accidents often were associated with the improper distribution and storage of work instruments;
- identified areas where accidents at work were associated with the most serious health consequences for employees – it can be concluded that foot injuries usually occurred during manual transport works. The most serious accident was traumatic amputation and it was connected with a machine operator;
- specified, that probable causes and mechanisms of identified accidents at work were the mistakes done by the employee. The monotype of the work decreases the concentration and then workers loss of control of machines. That is mechanism for workers employed in the company over 5 years.

All the actions carried out enabled the selection of effective tools and corrective, and preventive actions adequate to the current working conditions.

Summarizing, statistical data on accidents at work are one of the basic sources of information on working conditions used to develop policies in the field of occupational safety both in Poland and at the European Union level.

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SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2023
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ENTERPRISE MANAGEMENT USING E-COMMERCE. CASE STUDY OF THE HOSPITALITY INDUSTRY

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Purpose: Recently, the importance of the Internet for the functioning of many enterprises, including entire sectors of the national economy, has been growing. The reason for this is primarily the fact that e-commerce is developing at a very fast pace, which is related to the development of technology, knowledge and innovation. What's more, the changes taking place on the market resulted in the emergence of a completely new participant in the market game, a new type of consumer, hereinafter referred to as e-consumer, which is a specific group of entities using the offers available on electronic markets. E-consumer, using electronic commerce, facilitates the consumption process: identifying needs, looking for solutions, purchasing products and services, answering questions and solving problems. In this context, the aim of the study is to attempt to assess the use of e-commerce in the hotel industry by customers of four hotels based in the city Częstochowa.
Design/methodology/approach: In order to achieve the aim of the study, a survey was conducted among 152 hotel customers. In the second place, the relationship between hotel management and e-commerce was examined using the $\chi 2$ statistics, and to assess the strength of the relationship between the examined features, the T-Czuprow convergence was calculated.
Findings: The study showed that the e-commerce enjoys intereset entrepreneurs, but also consumers, for whom it is an attractive and quick form of shopping. What's more, the study showed what factors are important when buying a hotel offer.
Research limitations/implications: The conducted study is a pilot study, therefore it requires a deeper study of the issues. Not only due to the number of entities covered by the study, but also factors in the field of e-commerce management.
Originality/value: The subject discussed in the study is a source of information for hotel managers, which aspects of e-commerce affect the decision to purchase an offer.

Keywords: e-commerce, e-consumer, hotel industry.

Category of the paper: Research paper.

1. Introduction

E-commerce has rapidly expanded around the world, entering some of society's most dynamic sectors. Over the last two decades, e-commerce has grown significantly, and the COVID-19 pandemic has increased the dynamics of the e-commerce environment (Kraenzlin et al., 2020; Satar et al., 2023). It can be said that e-commerce has become an important tool in today's economy, because it allows companies to reach a wide range of customers from around the world, without time and space restrictions. In addition, e-commerce can help companies reduce operational costs and increase business efficiency by automating sales and customer service processes (Yingzi, Zhaoji, 2022). Unlike traditional retail, most e-commerce activities take place virtually in the pre-purchase stages (i.e. information search), purchase and post-purchase (i.e. feedback and after-sales service) (Ayob, 2021). One of the most important challenges for e-commerce companies is ensuring the security of transactions and the protection of customer data. Companies must use appropriate technical safeguards and procedures to ensure the security of online transactions and protect the privacy of their customers (Moiseev et al., 2023).

Due to the fact that e-commerce is developing more and more, a number of companies, holdings, companies, etc., wanting to be successful, try to operate within this commerce. This is because e-commerce allows companies to achieve global reach and increase business efficiency. This, in turn, requires the right strategy and management to deliver positive results for customers and businesses. In view of the above, the purpose of this study is to determine an attempt to assess the use of e-commerce in the hotel industry. The study was of a practical and analytical nature and was carried out in the first half of 2023. The article aims to fill the gap in the use of e- commerce in the industry most affected by the COVID-19 pandemic, i.e. in the hotel industry. With regard to the issues adopted in this way, it was assumed that the use of e- commerce plays an important role in hotel management.

2. An overview of the literature

E-commerce is conceptually nothing new (Lin et al., 2015). As Shi (2021) argues, this trade broke the pattern and boundaries of the traditional exchange of goods, so there is no need for direct transactions between sellers and consumers. For this reason, e-commerce has become one of the most important sales channels for many enterprises, both for those that sell only online and for those that have traditional points of sale (Huang et al., 2007; Krzepicka, 2010).

In the narrow sense, e-commerce refers to the buying and selling of goods, services and information over the Internet. However, e-commerce also includes maintaining business relationships and collaboration, as well as serving customers and enabling various processes throughout the organization. Moreover, the concept has a broader scope and includes not only small e-businesses, but also large corporate entrepreneurship (Satar et al., 2023). Kanan and Glavee-Geo (2021, p. 4) define e-commerce as "the process by which entities and individuals exchange goods online using Internet systems with the support of both data transmission between Internet systems and electronic monetary systems".

In turn, Chaffey (2016, p. 12) e-commerce refers to sales and purchases via the Internet, and in his opinion e-commerce should be considered all electronic transactions between an organization and a third party. Gibbs et al. (2003, p. 4), describe e-commerce as: using the Internet to buy, sell or service products and provide services, while e-commerce should not be limited only to financial transactions (buying and selling), but also to other activities such as information exchange, marketing and pre- and post-sales support. An interesting take on e-commerce is introduced by Kalakota and Whinston (1997), who define it through the prism of four perspectives, i.e.: communication, business process, transaction handling and online perspective.

In management and quality sciences, e- commerce is perceived mainly as: business processes, a global business network, platforms for internal and external cooperation of enterprises, a tool for providing broadly understood services (Turban et al., 2004; Awad, 2004). Liu et al. (2022) is of the opinion that e- commerce changes consumer behavior. In the authors' opinion, the development of e-commerce has enabled companies to contact potential consumers in new ways, while becoming a modern communication medium. According to Skare et al. (2023), e- commerce has gradually become a mechanism replacing many economic activities carried out in enterprises, and its initial function of an effective intermediary and information aggregator has become even more pronounced. For this reason, e-commerce also strongly supports the competitiveness of companies and the economic development of countries. It can be said that e-commerce includes a lot of content that keeps up with the times. Within recent two decades trade electronic evolved into different types: B2B (Business-to-Business), B2C (Business-to-Consumers), B2G (Business-to-Government), C2C (Consumer-to-Consumer), C2B (Consumer-to-Business) (Al-Bakri et al., 2010 Jain et al., 2021; Ho and Chen, 2023). E-commerce is undoubtedly a range of benefits for the entrepreneur and contractor. Compared to traditional trade, it has an advantage in many aspects, such as the chance to communicate remotely with virtually the entire world, as well as unlimited access to the global economy. E-commerce is also a series of savings when confronted with traditional trade. There is no need to employ a person whose task would be to provide direct service to the contractor, and above all, there is no obligation to rent or purchase premises for business activity (Bartczak, 2016; Kawa, Dziura, 2022). It should be mentioned that the dynamically developing electronic economy allows entrepreneurs to run an e- commerce business in a flexible and even

more effective way. E-commerce has gained tremendous importance as a technological medium that enables businesses to serve consumers, expand geographic reach, respond to external pressures and reduce spending (Martin, Matlay, 2003). What is more, the improvement speaks for the superiority of e- commerce management process, building a positive image of the company, improving supply chain management, saving time, efficient financial service, increasing employee productivity, and improving customer service (Makowiec, 2008). Studies by Islam et al. (2021), Zhou et al. (2022) suggest that in the emerging digital economy, the adoption of an e-commerce platform significantly impacts transaction costs, speed of delivery, customer satisfaction and subsequent company performance. According to research by Andonov et al. (2021), enterprises are able to significantly increase their level of productivity due to an increased market, better growth opportunities, lower operating costs, less investment requirements. The literature on the subject also discusses issues regarding the negative impact on the functioning of e-commerce. Among those that are discussed most often, there are issues related to the security of transactions on the Internet, trust in sellers, high costs incurred by entrepreneurs in connection with the need to have extensive computer and Internet tools, applications and programs, as well as the lack of appropriate legal regulations on e-commerce (Flis, 2009; Wieczerzycki, 2013; Rodrigues et al. 2023).

It should be mentioned that the high competitiveness of the e-commerce sector forces managers to search for and implement innovations, personalize activities and communication channels, especially in individual industries. Due to the changing values of modern society, technological development and generational changes, tourism should follow the expectations of modern - sophisticated consumers (Polasik, 2016; Mróz-Gorgoń, Szymański, 2017). For this reason, tourism enterprises wanting to develop their activities more and more often use the Internet as an additional distribution channel (Marek, 2011). The effective use of e-commerce – where transactions and other activities take place entirely via the internet – is widely regarded as a key competency required for growth and an important way to gain a sustainable competitive advantage. That is why many hotels are integrating more and more IT capabilities into their core business, aiming not only to improve customer satisfaction, but also to increase operational efficiency by streamlining processes, creating a communication and transactional channel. Such activities can strengthen online customer engagement, communicate product offerings and provide a platform for customer service (Hua et al., 2019). In this way, through technology, the consumer forced to choose from among similar products/offers available to him, turned into a new consumer, referred to as an e-consumer (Skorupska, 2017). The benefits that companies can obtain thanks to high customer satisfaction are difficult to overestimate and usually impossible to achieve in other ways. A satisfied customer is an informal and thus the most reliable source of information about the organization and its products.

3. Research methods

In order to achieve the main goal of the study, the author conducted a diagnostic survey aimed at examining opinions in terms of attitudes, social norms, aspirations, etc. by means of interviews with specific respondents, most often using a previously prepared questionnaire (Shapiro, 2001) regarding the use of e-commerce in the hospitality industry.

The characteristics of the study environment showed that 152 people participated in the study, and:

- 44% were women, 56% were men,
- the average age of study participants was 41 years old with a range of 25 to 65 years,
- the average monthly gross income per person in the household k is PLN 6,626.95,
- the vast majority of respondents are people with higher education, with 48% of the respondents having full higher education, 29% reported that they have an engineer or bachelor's degree,
- 64% of the respondents came from cities with more than 100,000 inhabitants. inhabitants, 31% from the city of 50-100 thousand. people from small towns and towns, 13 people (25%) from rural areas, and 5 respondents (10%).

The choice of such a research group was not accidental. Namely, efforts were made to ensure that the study yielded the most representative results. It was satisfactory that as a result of the data analysis, the structure of respondents due to these demographic and social factors turned out to be diverse. What's more, the people participating in the study are people who use hotel services using e-commerce channels.

To examine the relationship between hotel management and e-commerce, the $\chi 2$ statistic was used, and T-Czuprow convergence was calculated to evaluate the strength of the relationship between the selected features.

4. Results and discussions

Based on the data obtained through the survey, correlation tables were built for factors evaluating the use of e-commerce in hotel management, thanks to which it was possible to determine: is there a relationship between hotel management (y_i) and individual variables (aspects) characterizing e- commerce (individual x_i variables) (Table 1).

Table 1.
Value of χ^2 statistic and the T-Czuprow coefficient of variables characterizing e-commerce

Variable		Statistic value χ^2	T-Czuprow convergence coefficient
x_1	Page content management	48,78	0,41
x_2	Transaction conditions	120,47	0,7
x_3	Preparation for special offers	34,29	0,37
x_4	Personalized promotions	55,73	0,46
x_5	SMS campaigns	20,9	0,29
x_6	Social media presence	64,10	0,49
x_7	Offer distribution via the welcome page of the hotel	10,77	0,28
x_8	Online purchase process	73,61	0,6
x_9	Photos of the facility and its surroundings on the website	36,88	0,38

Source: Own calculations.

Analyzing the data presented in Table 1, it can be concluded that the value of the chi-square statistic after calculating the values of theoretical numbers n_{ij}, and auxiliary activities takes the form: for x_1-$\chi^2 = 48{,}78$, x_2-$\chi^2 = 120{,}47$, x_3-$\chi^2 = 34{,}27$, x_4-$\chi^2 = 55{,}73$, x_5-$\chi^2 = 20{,}9$, x_6-$\chi^2 = 64{,}10$, x_7-$\chi^2 = 10{,}77$, x_8-$\chi^2 = 73{,}61$, x_9-$\chi^2 = 36{,}88$.

Since the χ^2 value for individual variables characterizing e-commerce in hotel management is different from zero ($\chi^2 \neq 0$) it can be concluded that there is a relationship between the examined x_i and y_i values. Analyzing the value of the T-Czuprow coefficient, it can be seen that it ranges from 0.7 to 0.28. This means that the selected factors, in the opinion of hotel customers, have a diverse impact on the e- commerce of the facility. Hotel managers should certainly pay attention to two key variables for which there was a strong relationship. This concerns variable x_2 (transaction conditions) and the online purchase process, where the convergence coefficient was at a level of $T = 0{,}7$ and $T = 0{,}6$ respectively. An average relationship was noted for three features, i.e.: x_1 (page content management), x_4 (personalized promotions) and the x_6 variable (social media presence) the T-Czuprow convergence coefficient reached a level of x_1 $T = 0{,}41$, x_4-$T = 0{,}46$, x_6 $T = 0{,}49$. The remaining variables identified in the course of the research achieved a weak dependence on the level from $T = 0{,}28$ to $T = 0{,}38$. The study confirmed (Abebe, 2014; Gao et al., 2023) that the adoption of electronic commerce facilitates the functioning of enterprises from the SME sector, including the hotel, improving its functioning, and thus its management.

5. Conclusions

The COVID-19 pandemic has posed many challenges for entrepreneurs, as well as for consumers. The physical limitations associated with the COVID-19 pandemic meant limited mobility. This resulted in a change in many shopping habits, shifting them from traditional channels to online channels. In view of the above, the e-commerce industry has become the

most modern and popular industry around the world. The increased use of the internet by people during this period has encouraged them to shop online more often, where they can avoid wasting time and energy (Nanda, Patnaik, 2023). This is also reflected in the hotel industry. Constantly increasing requirements and expectations of guests as well as growing competition force hoteliers to look for the most effective methods of maintaining and strengthening on the market. Research shows unequivocally that the level of services is, apart from the price, the basic criterion determining the choice of a hotel by a guest, and a wealthy guest will usually choose a more expensive but reputable hotel. Therefore, the quality of services is increasingly perceived as a key factor for the success of a hotel on the modern tourist market. In the conditions of increasing competition, the fight for guests, the level of services and the richness (attractiveness) of the service and commercial offer will be the main priority for hotel enterprises. In order to stay on the market in the long term, hotels must expand and make their offer more attractive. Accommodation and meals plus connectivity is not enough and guests are not satisfied. The analysis of the collected material leads to the following conclusions:

- the area of e-commerce in the hotel industry is becoming more and more popular, not only from entrepreneurs, but also from consumers, for whom it is an attractive and quick form of shopping,
- modern hotels try to provide their guests with the widest possible range of services related to recreation, while looking for an attraction that would distinguish it from other hotel establishments of this type and attract customers.

It should be remembered that no enterprise will survive on the market only because the quality of services and customer service by competitors will be even worse. Customer orientation will become more common as companies finally understand that partnership is the key to success in these difficult economic conditions.

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COMPARISON OF CERTAIN EVOLUTION-INSPIRED ALGORITHMS

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Purpose: This paper aims at making a comparison of three optimization algorithms – standard Genetic Algorithm and its two modifications: Extended Compact Genetic Algorithm and Population-based Incremental Learning.
Design/methodology/approach: To reach the objectives of the paper the solver based on algorithms was developed. Certain test functions were applied to test them and evaluate their performance.
Findings: Modifications of Genetic Algorithm reach optimal values faster and more precisely.
Research limitations/implications: Problem of optimization of certain cost functions frequently occurs in many management problems of organizing the optimal workflow in organizations. It can be used also in engineering problems of designing optimal devices at lowest possible cost.
Practical implications: One can optimize function faster using discussed algorithms than by using standard evolutionary algorithm.
Originality/value: The paper shows results of comparisons of three algorithms, discusses how tuning meta parameters helps to increase their efficiency and accuracy.

Keywords: optimization, genetic algorithms, applied mathematics.

Category of the paper: research paper.

1. Introduction

In the first half of 18th century one of the most notable mathematicians of all times – Leonhard Euler wrote that *nothing at all takes place in the universe in which some rule of maximum or minimum does not appear.* So, from the beginning of development of modern science the importance of the task of optimization of functions was well understood. Many calculus-based methods were developed to deal with this problem. But with the development of applications of mathematics plenty of functions needed to be optimized but they did not satisfy conditions for such methods. That being said new approach had to be developed. Plenty of different numerical methods were developed. They are not perfect, for they do not necessary provide correct answer at first approach, but after certain

considerations enable to find local extreme values of some wild functions. Many of such algorithms are heuristics based on some biological phenomena. The algorithms can be inspired by e.g., Ant Colony, Beehive or Wolf Pack. In this paper we shall discuss three algorithms based on central biological theory - Genetic algorithm and its modifications.

The objective of this work is to compare three heuristic algorithms – Evolutionary Algorithm, Extended Compact Genetic Algorithm and Probability-based Incremental Learning based on their performance in the task of optimizing test functions. A thorough discussion of many variants of Evolutionary Algorithms can be found in (Tamilselvi, 2022) and (Vikhar, 2016). Application of variants of EA to engineering problem of optimal design can be found in (Kieszek et al. 2023) Interesting variant of ECGA using properties of machine-precision arithmetic can be found in (Satman, Akadal, 2020). Applications of PBIL are depicted in (Grisales-Noreña et al., 2016). It is even used to optimize nuclear reload (da Silva et al., 2018) As it was shown, the matter of different variant evolution-based algorithms is still a topic of active research. To the best of author's knowledge, no direct comparison of those three algorithms' performance has been published.

2. Methods

Population-based optimization heuristics have been perceived as efficient and universal methods of determining global extremes for a long time. The Evolutionary Algorithm is now considered a classic population-based heuristic. Despite its indisputable advantages, there are still attempts to modify it, aimed at increasing accuracy and reducing the number of assessments of individuals necessary to obtain a solution. The latter feature is particularly important in the case of optimization of complex problems where the evaluation of a single individual is very time-consuming. If individuals with low fitness appear relatively often in the population, their assessment takes time, but does not lead to a solution. Ensuring that low-value individuals appear infrequently is one way to speed up optimization.

In a large group of population-based algorithms, algorithms using probabilistic models have recently started to play an increasingly important role.

These are usually methods with a structure very similar to the structure of the evolutionary algorithm, with the difference that successive generations of individuals/solutions are generated based on a probabilistic model of the population of promising solutions, and not because of crossing or mutation of individuals from the current population.

The population of promising solutions is created from individuals selected because of classical selection (usually a tournament). In such a population there are individuals with a higher-than-average fitness, and the model built on their basis should promote those features of the solution that lead to the optimized goal.

The next generation of solutions is generated in a pseudo-random manner but taking into account the probabilistic model. This means that in methods of this type, the way the model is built is responsible for both the very convergence to the extreme and its pace.

In order to take full advantage of the features of the discussed methods, care should be taken to build the probabilistic model in such a way that, with effective convergence, the ability to properly search the space is not lost. If the population influences model changes in subsequent iterations too much, it may lead to rapid unification of the population and improper exploration of space. On the other hand, changing the model too slowly will make the optimization method look like a random search.

The way in which the model will be built is crucial from the point of view of this type of methods. Other elements of the algorithm, such as succession, usually have a classic form (known from GA) and are used to conduct an iterative process.

In the presented work, two optimization methods using the probabilistic model PBIL - Population based incremental learning and ECGA - Extended Compact Genetic Algorithm will be presented. Both methods represent population heuristics belonging to the group of methods considered as EA modifications.

2.1. Genetic Algorithm

Genetic Algorithm is based on evolutionary mechanisms such as reproduction, recombination, mutation, and selection. It mimics the development of species that occurs in real life. That development can be simplified to few observations:

1. There is some population of certain species.
2. Members of population that are best equipped to live in given conditions have the highest chance of reproduction.
3. Members of population that are not best equipped also have a chance of reproduction, but on the smaller scale – this fact is important in preserving some genomes that can be useful in different conditions.
4. Reproduction consists of mixing genomes of parents – it is not just the replication, but something new.
5. During reproduction some random changes in genome can occur.

To translate the observations some assumptions are needed. To simulate the environment a function called fitness function will be used. Members of population will be points inside the domain of the function. Then the algorithm can be expressed as follows:

1. Initialize metaparameters – size of population, probability of crossing, probability of mutation.
2. Randomly build starting population P^0.
3. Set $t = 0$.

4. do{
    a. Evaluate population P^t according to fitness function.
    b. Select best members of P^t and make temporary population T^t.
    c. Use genetic operators (crossing and mutation) on T^t to produce O^t.
    d. Evaluate population O^t according to fitness function.
    e. Produce P^{t+1} by applying succession operators to O^t and P^t.
    f. $t++$
    }
    while (stop condition).
5. Return the best fitting element in the last population.

The genetic algorithm was applied to continuous, multidimensional problems, so some genes to evolve had to be identified. In d-dimensional problems the coordinate in each of dimensions was treated like one independent gene. For parent vectors $\overrightarrow{\boldsymbol{x_1}}, \overrightarrow{\boldsymbol{x_2}}$ of $\mathbb{R}^d$ the following formula has been applied:

$$\vec{\boldsymbol{y}} = \overrightarrow{\boldsymbol{x_1}} + \vec{\boldsymbol{\xi}}_{U(0,1)} * (\overrightarrow{\boldsymbol{x_2}} - \overrightarrow{\boldsymbol{x_1}})$$

where:
$\vec{\boldsymbol{y}}$ is child vector,
$\vec{\boldsymbol{\xi}}_{U(0,1)}$ is random variable vector with uniform distribution,
$*$ denotes component-wise multiplication. It is called averaging crossing.

Another important genetic operation is random mutation of vector $\boldsymbol{x}$ which is modelled by equation:

$$\vec{\boldsymbol{y}} = \vec{\boldsymbol{x}} + \vec{\boldsymbol{\xi}}$$

where:
$\vec{\boldsymbol{y}}$ is child vector,
$\vec{\boldsymbol{x}}$ – parent vector,
$\vec{\boldsymbol{\xi}}$ – random vector of certain distribution. In our case it was modelled by Gaussian distribution.

Next operator was the selection operator. In the paper the so-called tournament selection was applied. To do this type of selection certain number of competitors had to be chosen from the population. Then the best fitting competitor was found, and it was assigned to the child population. So by number of tournaments the number of elements in child population could be regulated.

Last operator was the succession operator. To do this elitist succession was applied – current populations O^t and P^t were joined and assigned number of best members was set to child population.

2.2. Population-based Incremental Learning

PBIL is a modified Evolutionary Algorithm using a learning process based on "observation" of the current population. In the method, at each iteration step it builds new population using normal distribution with given mean value. In fact, the role of the probabilistic model is played by a vector $\vec{\mu} = (\mu_1, \mu_2, \ldots, \mu_n)$whose components μ_i define mean value of the i-th component of the generated individual.

It is characteristic of the PBIL algorithm that only the best individual in the current generation is used to update the $\vec{\mu}$ vector, which means that the model is based on only one promising individual, marked $\vec{b}$. The value of the standard deviation in one iteration is the same for each component. The population for the next iterative step is generated on the basis of the model adopted in this way.

At the beginning of the iterative process, the components of the vector $\overrightarrow{\mu_0}$ are usually assumed to be random or determined from data about the constraints of the set of feasible solutions.

In subsequent iterations, the components of the $\vec{\mu}$ vector are updated as follows:

$$\mu_j^{(t+1)} = (1 - \lambda) \cdot \mu_j^{(t)} + \lambda \cdot b_j$$

where:

$\mu_j^{(t)}$ is the j-th component of the vector $\vec{\mu}$ in generation t,

b_j - the component of the promising vector $\vec{b}$,

λ - the so-called learning rate.

Individuals of the $t + 1$ population are always drawn considering the current probability vector. Contrary to the standard genetic algorithm, PBIL does not retain the best individual in the population, but the specificity of the procedure gives a great chance of selecting it, because it is on its basis that the probabilistic model is modified. However, it is also possible to use elite succession, which transfers a certain number of the best individuals from the current population to the next generation. Drawing the entire population, taking into account the model (represented by $\vec{\mu}$), gives a good chance of appearing more "good" individuals (from the point of view of the objective function) of individuals, usually better than in the previous generation.

The value of the learning coefficient λ is a parameter set at the beginning of the iterative process and affects its course. It should be remembered that its small value slows down the modification of the model, and its too high value may result in too fast unification of the population. The λ coefficient should be chosen to balance the ability for targeted exploration with the ability to exploit space.

Generally speaking, it exchanges genetic operators with probabilistic model. At each iteration step it builds new population it builds new population using normal distribution with given mean value.

The PBIL heuristic pseudocode is as follows:

procedure PBIL:

1. Initialize metaparameters – size of population, the starting mean value vector $\vec{\mu}_0 = \left(\mu_1^{(0)}, \mu_2^{(0)}, \ldots, \mu_n^{(0)}\right)$ and standard deviation σ_0.
2. Randomly build starting population P^0 according to the normal distribution $N(\vec{\mu}_0, \sigma_0)$
3. Evaluate population P^0 according to fitness function.
4. Set $t = 0$
5. do {
   a. Select the best member of P^t(denoted as $\vec{b}$).
   b. Modification of the mean value vector coordinates according to the formula
   $$\mu_j^{(t+1)} = (1 - \lambda) \cdot \mu_j^{(t)} + \lambda \cdot b_j$$
   c. Modification of the standard deviation to σ_{t+1}.
   d. Generation of a new individuals according to the model $N(\vec{\mu}_{t+1}, \sigma_{t+1})$ to produce O^t.
   e. Evaluate population O^t according to fitness function.
   f. Produce P^{t+1} by applying succession operators to O^t and P^t.
   g. $t++$
   }
   while(stop condition).
6. Return the best fitting element in the last population.

2.3. Extended Compact Genetic Algorithm

The Extended Compact Genetic Algorithm (ECGA) is another variant of the classic evolutionary algorithm.

In this algorithm, because of selection (e.g., tournament) from the current population P^t, a set G is selected, the so-called set of "promising" solutions. Individual components of individuals belonging to the set G are grouped into independent subsets, the number of which is a heuristic parameter. A typical approach is to divide the range to which a given variable belongs into several disjoint sub-intervals. Then, it is determined how many individuals from set G have the observed variable in each of the subintervals. These values are used to determine the boundary probability of each group, and the next generation is generated according to the obtained distributions. Thanks to this, in the progeny generation, the appearance of individuals from the ranges in which the number of promising solutions is significant is greater.

This construction of the heuristic has one disadvantage: in continuous case it does not find optimal value exactly. It rather brackets the point at which optimum occurs. This can be dealt with by slightly modifying the ECGA. Every dozen or so iterations, we narrow the search only to the sub-interval for which the limit probabilities are the highest. This procedure causes that

ECGA, which in the original version copes well with exploration, also begins to exploit space well. Gradually reducing the set of feasible solutions significantly increases the chances of finding an exact solution. This is like a variable-adjacency local search or one of the versions of the ant algorithm.

The ECGA pseudocode in the version described above is as follows:

procedure ECGA:

1. Initialize metaparameters – size of population and set G, spacing density in each direction.
2. Randomly build starting population P^0.
3. Evaluate population P^0 according to fitness function.
4. Set $t = 0$.
5. do {
   a. Select the members of the promising set G.
   b. Determination of the limiting probabilities for each of the variables of individuals belonging to the set of G.
   c. Generation of a new individuals according to the probabilistic model in order to produce O^t.
   d. Evaluate population O^t according to fitness function.
   e. Produce P^{t+1} by applying succession operators to O^t and P^t.
   f. $t++$.
   g. If necessary, reduce the set of admissible solutions to a subset containing a significant number of individuals from the set of G

   }

   while (stop condition).
6. Return the best fitting element in the last population.

3. Results

All algorithms were tested against four test functions:

1. Spheric function

$$f(x_1, x_2) = x_1^2 + x_2^2$$

2. Rastrigin function

$$f(x_1, x_2) = 20 + \sum_{i=1}^{2} (x_i^2 - 10\,cos(2\pi x_i))$$

3. Himmelblau function

$$f(x_1, x_2) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$$

4. Rosenbrock function

$$f(x_1, x_2) = (1 - x_1)^2 + 100(x_2 - {x_1}^2)^2$$

The first of the test functions was used to assess the correct operation of own programs. The spherical function optimizes well and each method should find its minimum correctly. Subsequent functions were selected to check how well the tested heuristics cope with various difficulties in optimization. The Rastigin function is a typical multimodal function. Its tests are to show how resistant the method is to being left in local extremes. The Rosenbrock function reaches its minimum at one point lying in a very flat valley and is difficult to optimize due to the small differences between the values of the objective function. The Himmelblau function is a function having four equivalent local minima. Testing heuristics on it is to check whether the optimization method is able to "capture" the existence of many equivalent global minima.

The following assumptions were made in the tests performed for the purposes of this work:

- the size of the population and the maximum number of iterations were the same for each method and amounted to $N = 30, max_{Iter} = 500$.
- the halting criterion was no change (by more than 10^{-6}) in 20 consecutive generations.
- tournament selection and succession were used, preserving the best individual from the previous generation.
- each test included 50 independent starts.

Optimisation results with the use of each heuristic for selected test functions are shown in Table 1, Table 2 and Table 3. Vectors $\vec{x}_{opt}$, $\vec{x}_{best}$, $\vec{x}_{mean}$ are respectively the point where the analytical minimum occurs, the best result found in 50 runs, the average result over 50 runs. The tables also contain additional information about the relative error understood as

$$\delta_f = \frac{\left|f(\vec{x}_{opt}) - f(\vec{x}_{best})\right|}{1 + \left|f(\vec{x}_{opt})\right|} \cdot 100\%$$

and standard derivaions σ in 50 runs.

Table 1.
Results of Evolutionary Algorithm

Function	**Analytic minimum**	**EA**			
		$\vec{x}_{best} = (x_1, x_2)$	δ_f	$\vec{x}_{mean} = (\tilde{x}_1, \tilde{x}_2)$	σ
Spheric	$\vec{x}_{opt} = (0,0)$	$x_1 = 0.0008197$ $x_2 = -0.001555$		$\tilde{x}_1 = -0.00185$ $\tilde{x}_2 = -0.00176$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 0.00175$	$\approx 0.175\%$	$\tilde{f} \approx 0.00445$	0.0615
Rastrigin	$\vec{x}_{opt} = (0,0)$	$x_1 = 0.004234$ $x_2 = -0.00268$		$\tilde{x}_1 = 0.072767$ $\tilde{x}_2 = -0.013564$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 0.00498$	$\approx 0.498\%$	$\tilde{f} \approx 1.79551$	1.6114
Rosenbrock	$\vec{x}_{opt} = (1,1)$	$x_1 = 1.03732$ $x_2 = 1.06629$		$\tilde{x}_1 = 0.072767$ $\tilde{x}_2 = -0.013564$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 0.01087$	$\approx 1.087\%$	$\tilde{f} \approx 6.5147$	17.302

Cont. table 1.

Himmelblau	$\vec{x}_{opt} = \begin{cases} (3,2) \\ (-2.805, 3.131) \\ (-3.779, -3.283) \\ (3.584, -1.848) \end{cases}$	$x_1 = -3.77734$ $x_2 = -3.28137$		$\tilde{x}_1 = 0.072767$ $\tilde{x}_2 = -0.013564$	
	$f(\vec{x}_{opt}) = 0$	$f(\vec{x}_{best}) = 0.00027$	$\approx 0.027\%$	$\tilde{f} \approx 0.7248$	1.3547

Table 2.
Results of Extended Compact Genetic Algorithm

Function	**Analytic minimum**	**ECGA**			
		$\vec{x}_{best} = (x_1, x_2)$	δ_f	$\vec{x}_{mean} = (\tilde{x}_1, \tilde{x}_2)$	σ
Spheric	$\vec{x}_{opt} = (0,0)$	$x_1 = -2.68 \cdot 10^{-10}$ $x_2 = 4.26 \cdot 10^{-8}$		$\tilde{x}_1 = -0.00076$ $\tilde{x}_2 = -0.00204$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 4.3 \cdot 10^{-8}$	$\ll 0.001\%$	$\tilde{f} \approx 0.000983$	0.00375
Rastrigin	$\vec{x}_{opt} = (0,0)$	$x_1 = 6.06 \cdot 10^{-6}$ $x_2 = -3.87 \cdot 10^{-6}$		$\tilde{x}_1 = 0.080108$ $\tilde{x}_2 = -0.09905$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 1.03 \cdot 10^{-8}$	$\ll 0.001\%$	$\tilde{f} \approx 0.3138$	0.86817
Rosenbrock	$\vec{x}_{opt} = (1,1)$	$x_1 = 1.0002$ $x_2 = 1.0004$		$\tilde{x}_1 = 0.919493$ $\tilde{x}_2 = 0.884791$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 3.31 \cdot 10^{-7}$	$\ll 0.001\%$	$\tilde{f} \approx 0.4694$	0.0876
Himmelblau	$\vec{x}_{opt} = \begin{cases} (3,2) \\ (-2.805, 3.131) \\ (-3.779, -3.283) \\ (3.584, -1.848) \end{cases}$	$x_1 = -3.77932$ $x_2 = -3.283177$		$\tilde{x}_1 = -1{,}10304$ $\tilde{x}_2 = -1.63932$	
	$f(\vec{x}_{opt}) = 0$	$f(\vec{x}_{best}) = 1.1 \cdot 10^{-8}$	$\ll 0.001\%$	$\tilde{f} \approx 0.12695$	0.2396

Table 3.
Results of Population-based Incremental Learning

Function	**Analytic minimum**	**PBIL**			
		$\vec{x}_{best} = (x_1, x_2)$	δ_f	$\vec{x}_{mean} = (\tilde{x}_1, \tilde{x}_2)$	σ
Spheric	$\vec{x}_{opt} = (0,0)$	$x_1 = 1.14 \cdot 10^{-6}$ $x_2 = -2.26 \cdot 10^{-6}$		$\tilde{x}_1 = -0.000996$ $\tilde{x}_2 = 0.0007844$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 2.5 \cdot 10^{-6}$	$\ll 0.001\%$	$\tilde{f} \approx 0.003585$	0.00517
Rastrigin	$\vec{x}_{opt} = (0,0)$	$x_1 = -0.00308$ $x_2 = -0.00244$		$\tilde{x}_1 = 1.13311$ $\tilde{x}_2 = 1.11427$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 0.00306$	$\approx 0.306\%$	$\tilde{f} \approx 3.451923$	2.1875
Rosenbrock	$\vec{x}_{opt} = (1,1)$	$x_1 = 1.00031$ $x_2 = 1.00063$		$\tilde{x}_1 = 1.2217$ $\tilde{x}_2 = 1.54992$	
	$f(\vec{x}_{opt}) = 0$	$f(x_{best}) = 1.1 \cdot 10^{-7}$	$\ll 0.001\%$	$\tilde{f} \approx 0.10692$	0.1768
Himmelblau	$\vec{x}_{opt} = \begin{cases} (3,2) \\ (-2.805, 3.131) \\ (-3.779, -3.283) \\ (3.584, -1.848) \end{cases}$	$x_1 = 3.00007$ $x_2 = 1.99983$		$\tilde{x}_1 = 2.2454$ $\tilde{x}_2 = 1.7731$	
	$f(\vec{x}_{opt}) = 0$	$f(\vec{x}_{best}) = 4.5 \cdot 10^{-7}$	$\ll 0.001\%$	$\tilde{f} \approx 0.0027$	0.00491

The runs of the best optimizations are presented at Figure 1-Figure **4**.

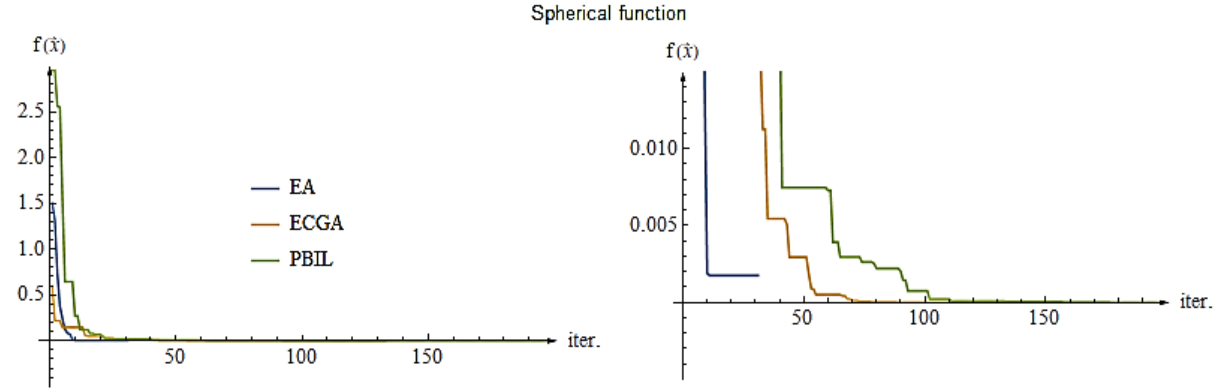

Figure 1. Optimisation runs using the heuristics tested - Spherical function.

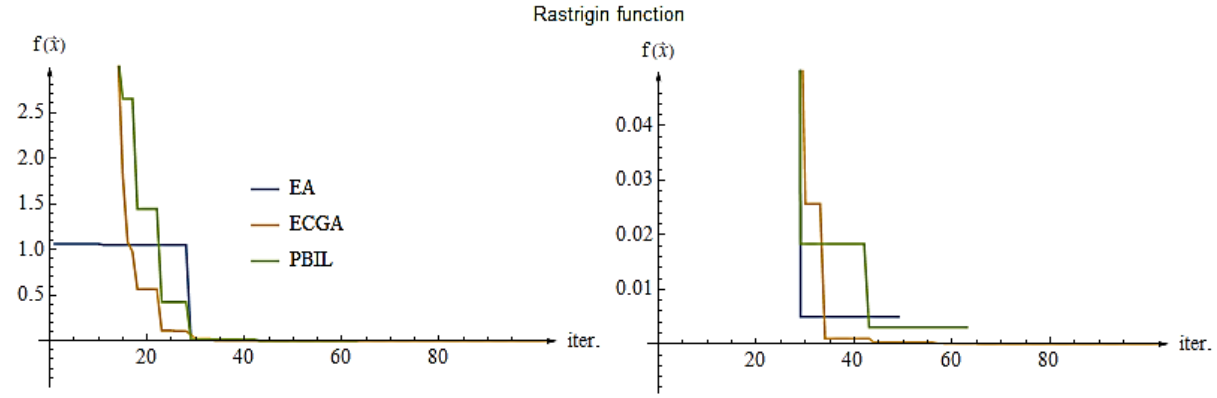

Figure 2. Optimisation runs using the heuristics tested - Ratrigin function.

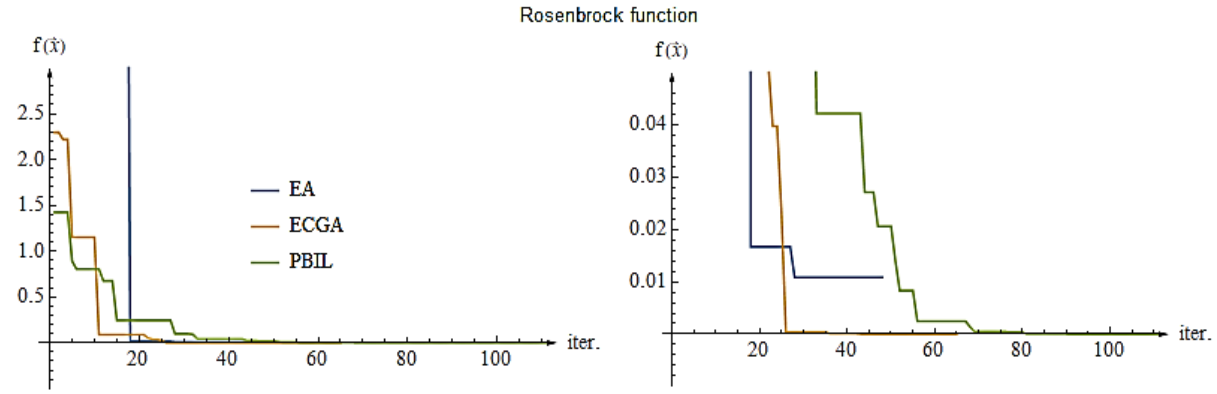

Figure 3. Optimisation runs using the heuristics tested - Rosenbrock function.

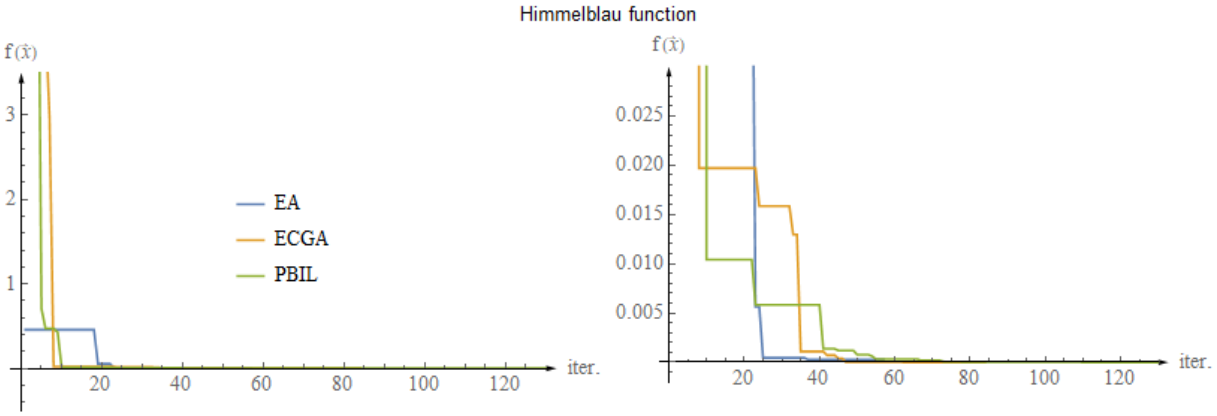

Figure 4. Optimisation runs using the heuristics tested - Himmelblau function.

The graphs show that in the EA, the stop condition intervened the fastest, but at the cost of a loss of accuracy. Both modifications achieve much better results than the original EA. This applies to both the accuracy and the level of standard deviation in 50 runs. Fig. 5 shows that this deviation is the largest for EA, which proves that the best result presented in Tab. 1 is not a typical result. EA is particularly bad at optimizing the Rosenbrock Valley. Although the best result in the test is satisfactory, it should be remembered that it was obtained in 50 runs. A very large standard deviation proves that in many optimizations the result was very inaccurate. We do not observe such an effect in any test of algorithms with probabilistic models.

When it comes to comparing ECGA and PBIL, the results indicate that the second method is worse at dealing with multimodal functions, although still better than the standard EA. PBIL also needs more iterations to get accurate results.

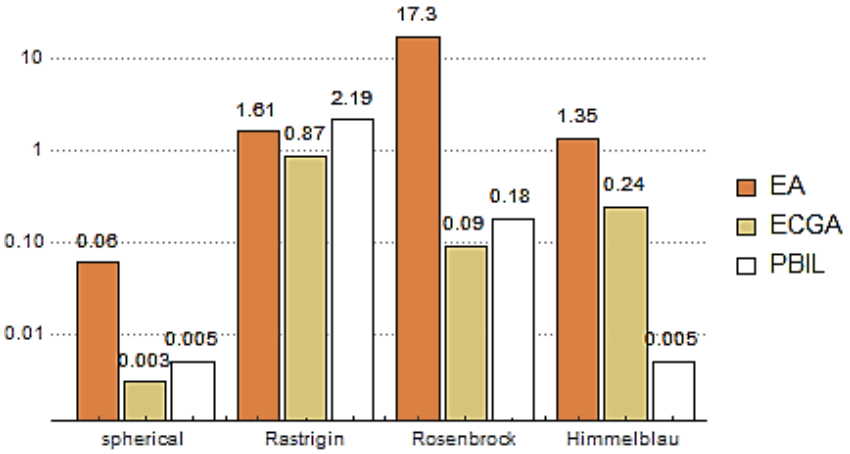

Figure 5. Standard deviation of the objective function values in 50 runs - logarithmic scale.

4. Discussion

The analysis of the obtained results shows that the replacement of genetic operators in the evolutionary algorithm by a probabilistic model built on the basis of promising solutions significantly increases the optimization accuracy. Both PBIL and ECGA determine function minima with much greater accuracy. The slower operation of PBIL and its lower efficiency in the case of multimodal functions result from a very simple procedure of building a probabilistic model. The expectation vector is modified based on one solution, which must affect the rate of optimization. Even such a simple model works better than the standard EA exchange of information based on crossing and mutation.

Of particular importance are the results of optimization of the Himmelblau function. It is a function with four equivalent minima. The population nature of the heuristics in a single run did not capture the existence of several extremes, because in subsequent generations, the population clustered around a single extreme. The existence of several points where the

function reaches the same, minimum value was noticed by analyzing the results of several dozen launches. The random nature of all the analyzed heuristics meant that in different runs, extremes of similar value were found, but located at different points. Since the frequency of the points found was approximately the same, the obtained results had to be interpreted as indicating the existence of several equivalent minima.

5. Summary

An attempt to modify the classic Evolutionary Algotithm by replacing genetic operators with a probabilistic model of promising solutions seems to be a good solution. Such heuristics produce more accurate results and require fewer function evaluations to solve at the level found by EA. The use of a probabilistic model results in fewer low-value individuals in the progeny population. This may give a better chance of finding a solution using smaller populations.

The modifications used in the heuristics discussed in the article are not complicated either from the mathematical or programming side and still remain methods with a simple idea. There are also no requirements for the objective function. As in EA, the value of the evaluation function is sufficient for the correct operation of EA with a probabilistic model.

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STATISTICAL MULTIVARIATE ANALYSIS OF THE DOSING PROCESS RESULTS FOR PREDICTIVE PRODUCTION AND QUALITY MANAGEMENT – A CASE STUDY FROM THE FOOD INDUSTRY

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Purpose: The aim of this article is to perform a multivariate statistical analysis of package filling process results for predictive production and quality management. The article presents a case study from the food industry that demonstrates the feasibility of using an appropriate set of control charts for ongoing and predictive production and quality management.
Design/methodology/approach: The objectives of the article were achieved through the use of Statistical Process Control (SPC) tools, in particular control charts. The control charts used include both traditional numerical chart such as Xbar and S and special charts such as MA, EWMA, CUSUM and GCC.
Findings: SPC tools such as control charts have proven to be extremely useful in monitoring the filling process and predicting future performance. By carefully monitoring the process using traditional and special control charts, it is possible to quickly identify small, gradual or sudden changes that may occur in the production process before the process gets out of control.
Research limitations/implications: The research will continue by identifying additional factors that affect the quality of the product, particularly as regards precision and accuracy of dosing, and by evaluating the process studied in terms of its ability to meet customer requirements. Other statistical techniques will also be used to identify patterns and relationships between the various parameters of the process under study. This approach will provide more comprehensive information about the quality and ability of the dosing process to meet customer requirements..
Practical implications: By implementing the right SPC toolkit and using dedicated software that significantly speeds up data analysis, companies can effectively control the quality of the production process. By monitoring the behaviour of the process over time and detecting small changes and trends, it is possible to respond to potential problems in advance.
Originality/value: This article is intended for production process managers who want to learn how to use the right SPC toolkit to obtain information about the process behaviour and the moments when intervention actions should be taken.

Keywords: production and quality management, SPC, stability analysis, prediction, improvement.

Category of the paper: case study.

1. Introduction

Filling packaging is a key process in industries involving bulk, liquid or semi-liquid products (Fellows, 2009). The process involves placing the correct amount of product into a package, which is then sealed and ready for distribution (Brennan, Grandison, 2011). The quality of the filling process affects the cost of production, the efficiency, effectiveness of the production process and the quality and safety of the products (Herod, 2006). Both too much and too little product in packaging can have negative consequences for the company: technological, legal, cost, image (Mettler, Toledo, 2011). Effective management of the packaging filling process is crucial for efficient production management. Optimising this process can contribute to optimising the use of raw materials, reducing production costs, increasing productivity and reducing the duration of the production process (Kusinska, 2009; Krynke et al., 2022). The quality of the filling process is an important factor affecting the quality and safety of the final product (Fellows, 2009; Brennan, Grandison, 2011).

Organisations are constantly looking for new tools, methods and systems in order to maximise profits and strengthen their competitive advantage (Rosak-Szyrocka, 2018). Controlling, managing and improving the quality of any process, including packaging filling processes, is possible with statistical process control (SPC) tools such as control charts and quality capability indices (Montgomery, 2012; Lim et al., 2014; Knop, 2021a). Statistical analysis of a process using SPC tools makes it possible to assess its behaviour over time, identify trends and changes in the process, and understand the impact of common and special causes affecting the process (Wheeler, 2000; Webber, Wallace, 2007). In this way, process managers can react quickly to abnormal and unfavourable deviations in the process and prevent quality problems, including product nonconformities in an effective manner (Ulewicz et al., 2023). The results of using SPC tools can be the basis for process changes, staff training or machinery upgrades (Madanhire, Mbohwa, 2016). The result can be a reduction in production costs, increased efficiency and effectiveness of the production process (Soriano et al., 2017). SPC tools are a very important tool in the Six Sigma concept (Wojtaszak, White, 2015). Statistical Process Control (SPC) is a subset of Six Sigma and is used to monitor operations to identify any anomalies and suggest possible solutions.

Modern production and quality management and control requires anticipatory actions regarding the production process and quality creation processes based on the prediction of process behaviour (Wolniak, 2021). Predicting future scenarios in a process, especially unfavourable ones, enables appropriate preventive actions to be taken and keeps the process on track (Spree, 2021; Knop, Ziora, 2022). SPC tools can assess the predictability of processes in the future based on current and historical process behaviour (Wheeler, 2000). Control charts can identify unusual large changes in a process, indicate trends in the process, small but progressive changes in the process, thus enabling efficient and effective production and quality

management (Oakland, 2003; Nolan, Provost, 1990). The efficient use of control charts in production and quality management avoids negative scenarios in the process and corrects problems in the process before they have more serious consequences (Lepore et al., 2016). It is important for process managers to use the right SPC tools properly and to be able to read the signals from them that tell them what is happening in the process and how the process can be improved (Deming et al., 2012).

The aim of this study is to statistically analyse multivariate data from the dosing machine for predictive quality and production management. The article is a case study, presenting an approach to the statistical analysis of results from a process using SPC tools to alert process managers to negative situations in the process. Through the use of the SPC tools presented in the article, the author believes that it is possible to alert managers to small and minor changes in the process so that they can take appropriate preventive action. As one of the principles of a flexible and adaptive management approach states, it is better to act and make decisions based on partial knowledge of the future than to rely solely on a full understanding of the past (Fred, 2010). Predicting the behaviour of a process over time can help managers prepare for different scenarios and can be part of risk analysis. The company surveyed had not previously used SPC tools. This article aims to show the benefits of analysing process data using SPC tools in the context of predictive production and quality management.

2. Methods

The research was carried out at a food production facility located in the Silesian Voivodeship in Poland. The process analysed was the filling of a product into packaging of the Twist Off (TO) 190 jar type. The device tested was a dispenser of Dutch manufacture, 1988, designed for filling glass containers with various thick masses, such as ketchup, tomato concentrate, jams, etc. (Technical and operating documentation of the dispenser, 1988). The research concerned the process of filling TO 190 jars with a product of the tomato concentrate type with an extract of 30% with the declared nominal quantity in the jar - 180g. The filling device under study performs the filling function by means of 12 suction and pressing cylinders. The process analysed is therefore a multi-stream process, where 12 jars are filled simultaneously during one machine cycle.

The temporal scope of the filling process analysis covered one year of operation of the tested device, in which the Quality Control Department of the company recorded data on the actual nominal quantity of tomato concentrate filled into TO 190 jars (net weight of the product in the package) on the product manufacturing process chart in the inter-operational test protocol.

In order to comply with the requirements of the Pre-packaged Goods Act of 7 May 2009 regarding the permissible negative value of the error of the quantity (shortage) of the pre-packaged good and the average actual quantity of the product in the package in relation to its nominal quantity (Pre-packaged Goods Act of 7 May 2009), the tested filling machine was set to a dose size value of 183g (i.e. with an allowance in relation to the nominal value of 180g), taking into account the potential variability of the dose size in the individual filling pistons of the machine. While the Act does not specify a positive value for the error in the quantity of the packaged good (over-packaging), dosage sizes above 189g are considered by the company to be problematic in terms of the ability to properly close the jar in the next process step (which is due to the inability to create the correct vacuum to properly close the jar) and expose it to financial loss (every excess gram over the nominal value costs the company money). Too little product in the package, not conforming to the declared weight, and on the other hand, filling too much product - causes losses, and have legal and image consequences for the company.

The statistical analysis of the filling process data carried out was to show whether the dosing process carried out by the filling machine under investigation behaved in a stable and predictable manner over the time period analysed. The analysis was to indicate at which specific time points there were signals of unfavourable changes in the process.

SPC tools from the numerical evaluation control chart group will be used, both classic and special tools to analyse the filling process in terms of changes in stability and to assess the predictability of the results. The analysis will include results from the unit under study and from its individual streams, i.e. the 12 filling pistons. The main objective of the dosing process managers is to keep the net product weight in the jars constant at 183g, regardless of the filling piston used, with a possible minimum variation in results. If there are multiple extremes in a particular piston compared to the others, there is likely to be a problem with that particular filling piston.

As part of the initial statistical analysis of the filling process, an analysis of the distribution of the results using a histogram will be carried out and the conformity of these results to a normal distribution will be assessed (Frost, 2020). In addition, a box-and-whisker plot of the median - quartiles - range type will be made to determine the shape of the data distribution, the type of skewness and the presence of possible outliers in the data set (Frost, 2020; Knop, 2018).

Control charts will be used to assess the stability and predictability of the net mass results for the entire period analysed. The control chart is a widely used Statistical Quality Control (SQC) or Statistical Process Control (SPC) tool to find the assignable cause of variation and detect any changes in the process (Sałaciński, 2015). Generally, Shewart Control Chart for variables, such as Xbar-R and Xbar-S are most commonly used (Kiutras et al., 2007). An Xbar-S control chart will be developed and run pattern tests (also known as configuration tests) (Nelson, 1984; Kiutras et al., 2007) will be performed to detect non-random patterns of points on the control chart and to identify signs of process instability.

Dosing process managers are keen to detect the timing of adverse process changes that cause an increase or decrease in the average net weight of the product in the package in relation to the process objective. There is a need to detect these changes earlier to avoid quality problems and excessive financial losses. Special types of control charts will be used to identify and give early warning of negative trends in the filling process. In some cases the traditional Shewart control charts may not give good results, especially when the data has small average shift. Alternative control charts are needed, such as Moving Average (MA), Exponential Weight Moving Average (EWMA) (Kalgonda et al., 2011; Febrina, Fitriana, 2022; Sukparungsee et al., 2020), Cumulative Sum (CUSUM) (Koshti, 2011; Papić-Blagojević et al., 2016; Riaz et al., 2011) or others.

A MA moving average control chart will be used, with different window sizes, for noticing small changes and trends. In the construction of the MA chart, a window size of 6 will be adopted to notice minor changes in the process average, and a window size of 12 to help notice a global trend in the process. The crossing of control boundaries by points on this control chart will indicate a significant change in the process in terms of the mean performance value to which a response should be made.

The EWMA Xbar-S control chart will be used to detect small variations in the dosing process that may be difficult to spot with traditional control charts such as the mean and standard deviation control chart. This will enable managers to react quickly to potential deviations and identify special causes in the process. The EWMA chart takes historical data and weighs it exponentially using the Lambda parameter, which determines the percentage of influence of the current sample and previous samples on a point on the control chart. Typically, Lambda values between 0.2 and 0.3 are considered to give an appropriately smoothed but still sensitive control. In this case, a Lambda parameter value of 0.25 was adopted, which means that 25 per cent of the weight is left for the current sample and 75 per cent for the historical samples (Kalgonda, et al., 2011; Febrina, Fitriana, 2022; Sukparungsee et al., 2020).

A CUSUM single-value control chart will be used to accurately capture the moment in time when there was an abrupt change in the dosing process compared to the process average (Koshti, 2011; Papić-Blagojević et al, 2016; Riaz et al., 2011).

A graph of the mean ± errors type will be used, where the errors are taken as the 95% confidence interval for the mean value in order to identify the behaviour of the samples due to the mean value of the results (Jobson, 1992), which indicate an abrupt change in the dosing process.

In order to verify which filling machine pistons generated the most extreme results with signs of instability in these net mass results, the use of the XM-R multiple-stream Group Control Chart (GCC) was proposed (Boyd, 1950; Jirasettapong, Rojanarowan, 2011; Liu et al., 2008; Mortel, Runger, 1995).

A box-and-whisker graph was used, which includes information on the mean, standard deviation, minimum and maximum (Johnson, Wichern, 2007). Along with this graph, statistics such as the mean, standard deviation and coefficient of variation were also presented to show the variation in the amount of product in the pack for each filling machine plunger in relation to the average performance value and to indicate the plunger that has the best and worst performance from an accuracy and precision point of view.

A dose size stability analysis will be carried out for each piston separately using the IX-MR control chart to identify pistons with unstable results (Meneces et al., 2008).

3. Results and discussion

The result of the analysis of the statistical distribution of the net product weight over a period of 1 year of operation of the filler is presented by means of a histogram and a box-and-whisker diagram (Figure 1).

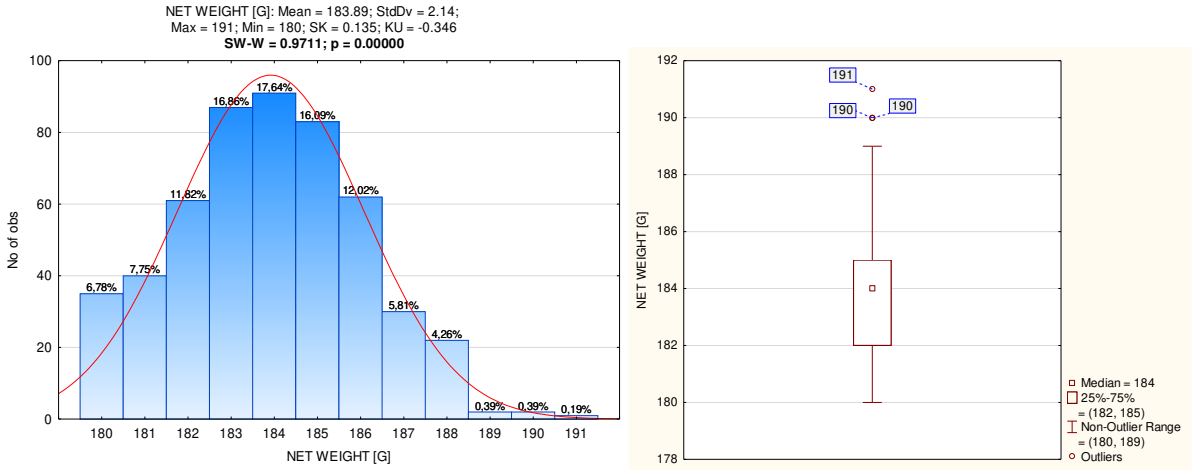


Figure 1. Distribution of the net product weight results using a histogram (a) and a box-and-whisker plot of median - quartiles - range type (b).

Source: own study with the use of Statistica 13.3 TIBCO software.

According to Figure 3a, the range of net weight results was between 180 and 190 g, with a net weight of 184 g being the most common value. The distribution of net weight is not a normal distribution, which was confirmed by tests of the normality of the distribution ($p < \alpha$). The distribution of the function is right-sided asymmetric, as evidenced by the longer right tail of the function. In the box-and-whisker plot, two net mass outliers were identified that are significantly different from the other values.

The result of the X-bar and S chart build is shown in Figure 2.

As can be seen from the X-bar and S control chart, all results on both charts are within control limits, meaning that the process is under statistical control. This indicates the stability and predictability of the process and the presence of only natural (common) variation (so-called

noise) in the process. The process is stable on the R chart, which means that the distributions in the samples are consistent and there is no statistical difference between them. It is possible to predict the net weight variation for 12 samples, where the average spread will be 2.04 g, with a range from 0.72 g to 3.36 g. The process is also stable in terms of mean values, meaning that the variation between sample averages is similar and there is no statistical difference between them. It is possible to predict the average net weight for the 12 pack samples, where the long-term average would be 183.89 g, with a range from 182.08 g to 185.70 g. The configuration tests carried out on the X-bar and S charts also did not show any specific patterns of points that would indicate a deregulation of the process. As a result, the analysed process can be considered fully stable and predictable over the analysed time.

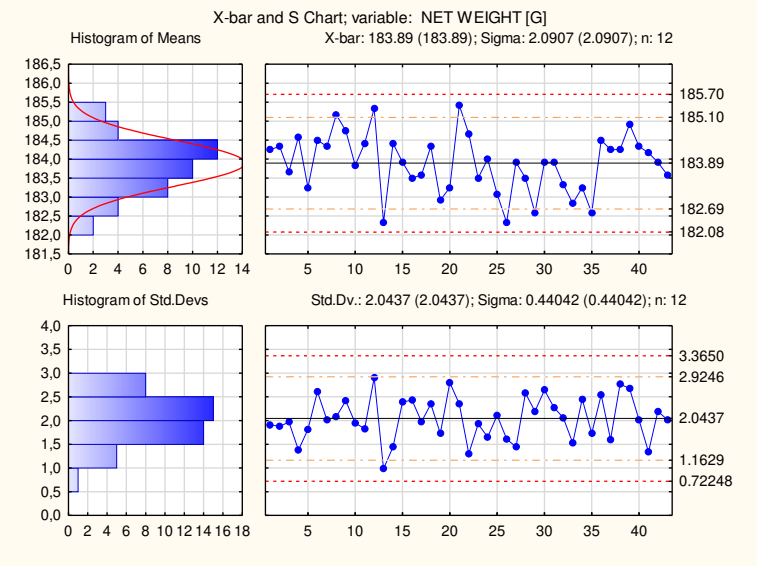


Figure 2. X-bar and S control chart for 1 year of filling machine operation.

Source: own study with the use of Statistica 13.3 TIBCO software.

The result of the MA moving average control chart design for window sizes 6 and 12 is shown in Figure 3a and b.

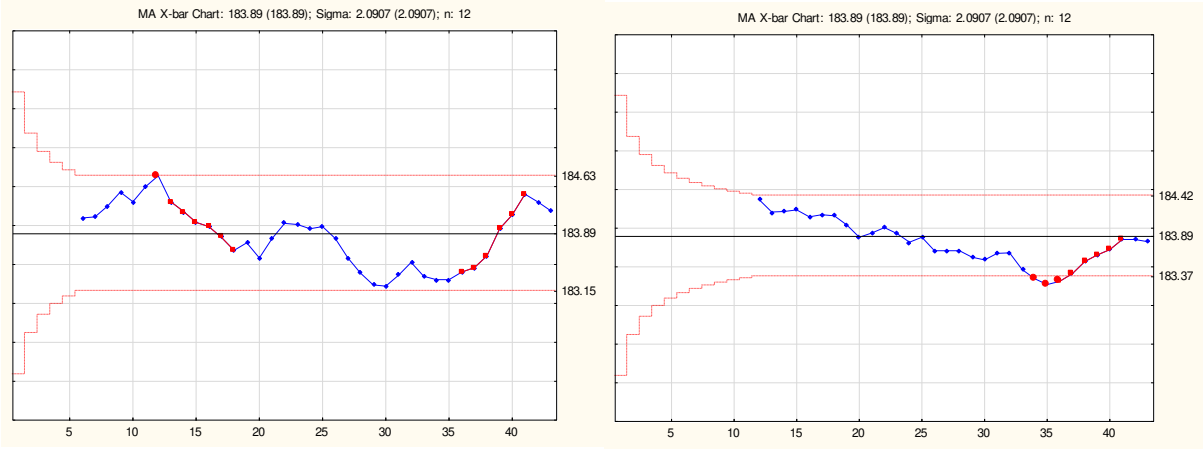


Figure 3. MA chart with a window size of 6 (a - left) and 12 (b - right).

Source: own study with the use of Statistica 13.3 TIBCO software.

When the results are averaged and smoothed on the MA control chart, using different window sizes, various changes and drifts in the moving average values and symptoms of process instability can be observed. On the MA chart with a window size of 6 (Fig. 4a), a worrying symptom of a drift of the process towards higher and higher values is observed, which persists up to sample No. 12. The process then starts to drift downwards, i.e. there is a decreasing trend in the results. A renewed upward trend is noticeable from sample No. 36 to sample No. 41. Adopting a window size of 12 and a greater smoothing of the results (Figure 4b) reveals a clear downward trend in the moving average of the results, which persists until sample No. 35. In sample Nos. 34, 35 and 36, the MA chart signals the instability of the moving average of the results by exceeding the lower control limit. From sample No. 36 onwards, there is again an increasing trend in the net mass results.

The result of using the EWMA X-bar and S chart with an assumed Lambda value of = 0.25 is shown in Figure 4.

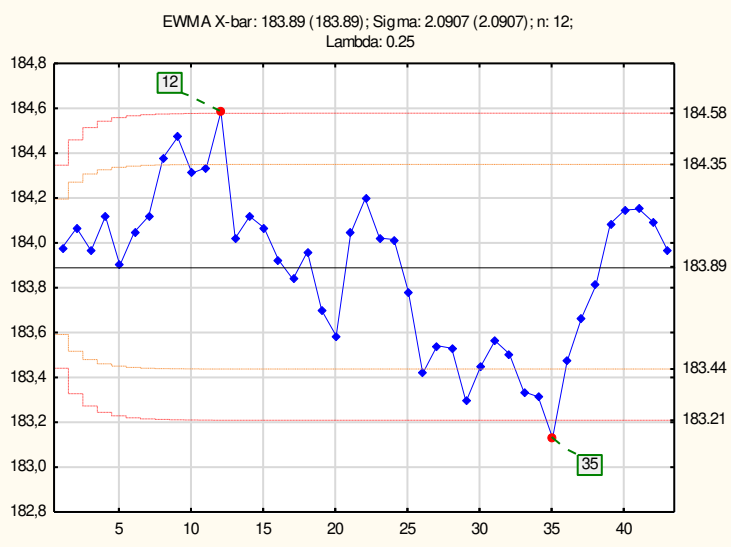


Figure 4. EWMA X-bar and S chart with Lambda = 0.25.

Source: own study with the use of Statistica 13.3 TIBCO software.

Based on the results from the EWMA chart, two significant points in time can be identified where there was a change in the trend of the filling process. The first point of trend change in the process occurred in sample No. 12, when the process started to move towards smaller and smaller values. The second point occurred in sample No. 35, when the process started to move towards larger and larger values.

The result of using the CUSUM single measurement control chart is shown in Figure 5.

As can be seen from Fig. 6, there were three moments in the filling process when there was a significant deviation from the process mean value (183.89 g). This means that there were rapid changes in the size of the dosage, which affected the overdrive of the process. The first moment of deviation occurred in sample no. 12, which contained 12 net mass measurements numbered 132-143. In this range of measurements, there were signals indicating a rapid process change in samples 142-143. The second moment of deviation occurred in the results from

sample No. 21, which contained a further 12 measurements numbered 252-263, with signals of rapid change for samples Nos. 252-262. The third moment of deviation occurred in the results from sample No. 29, which contained measurements numbered 348-359, where sample No. 348 showed a significant signal of process change.

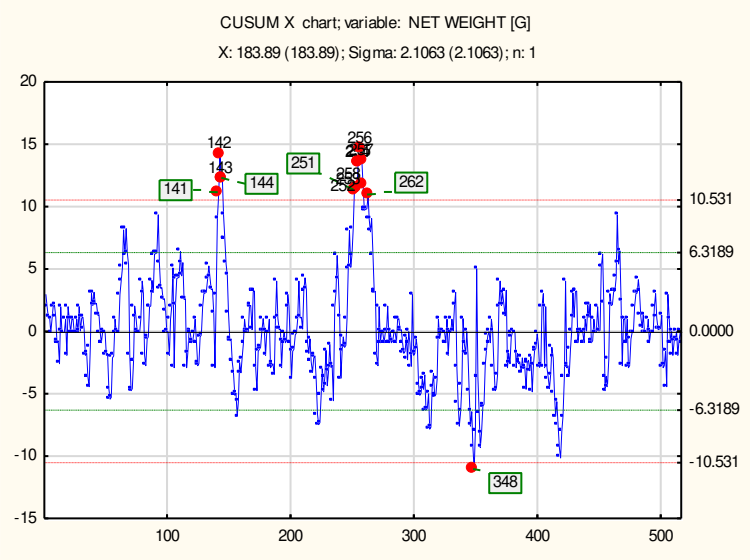


Figure 5. CUSUM chart based on individual observations of the mass of net product weight in jars.
Source: own study with the use of Statistica 13.3 TIBCO software.

A plot of mean ± errors, where the 95% confidence interval for the mean was taken as the error value, is shown in Figure 6.

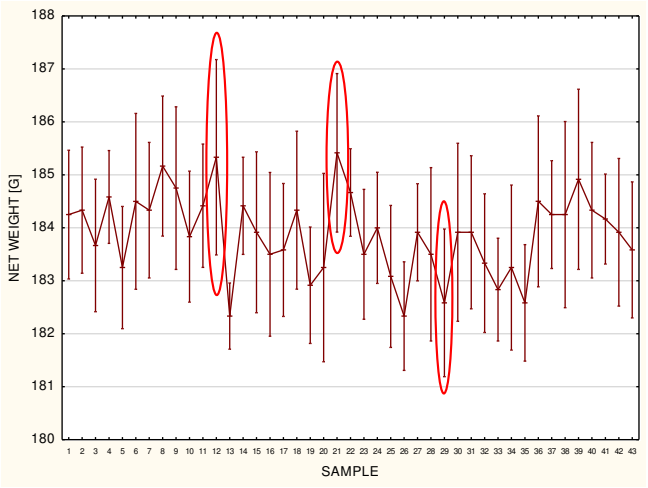


Figure 6. Mean ± errors plot (95% confidence interval).
Source: own study with the use of Statistica 13.3 TIBCO software.

As can be seen from Figure 6, in samples 12, 21 and 29, the 95% confidence interval for the mean value of these samples is either at the top of the graph (for samples 12 and 21) or at the bottom (for sample 29), indicating significant differences in mean values compared to the other samples.

The result of using the multiple stream X and MR chart type GCC is shown in Figure 7.

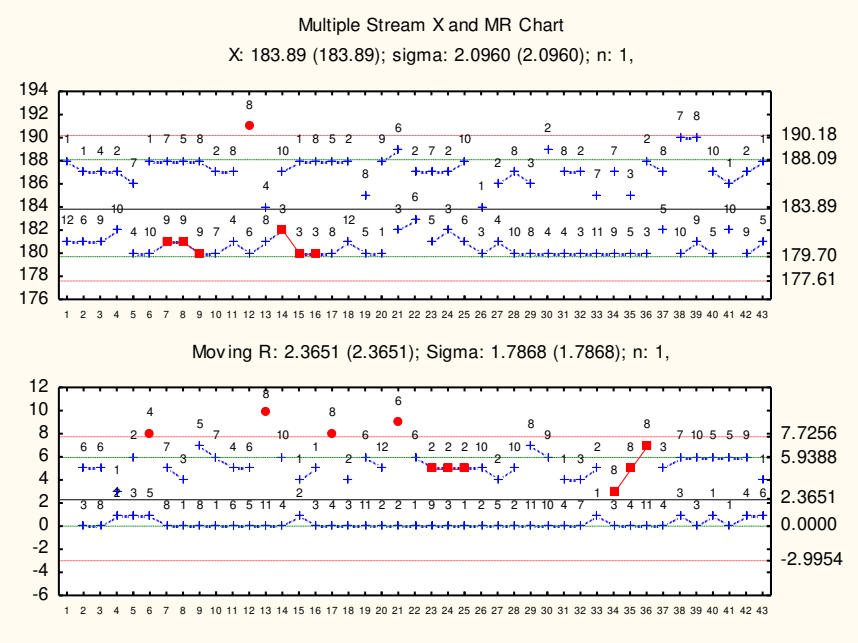


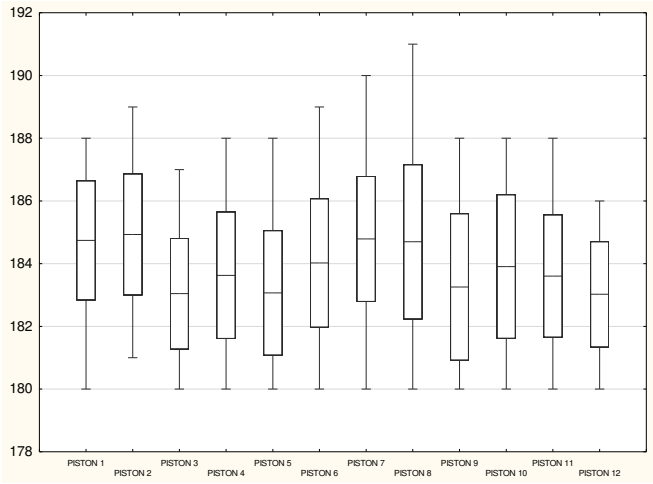
Figure 7. GCC-type Multiple Stream X and MR chart for stability analysis of results from individual filling machine pistons.

Source: own study with the use of Statistica 13.3 TIBCO software.

It can be seen from Figure 7 that the highest value of the dose size in the cross-section of all pistons was recorded for piston No. 8 in sample Nos. 12 and 39, and for piston No. 7 in sample No. 38. Among the pistons dispensing the highest amount of product into the pack in successive samples, piston No. 8 appeared most frequently (8 times), while the piston dispensing the lowest amount of product into the pack among all pistons was most frequently piston No. 9 (7 times).

A box-and-whisker plot of the mean/standard deviation/minimum-maximum type, together with statistics such as mean, standard deviation and coefficient of variation, is shown in Figure 8.

The filling machine piston that was closest to the target for this process (NOM = 183) was piston No. 12, 3 and 5. Piston No. 12 is also the piston that generated the least variation in results against the average value. It was therefore the most precise and accurate filling machine piston. The pistons of the machine that most outweighed the packages were, in turn, pistons No. 2, 7, 1 and 8. The most imprecise (off target) piston of all the machine pistons was piston No. 2, while the most inaccurate (with the greatest variability in results) was piston No. 8.



No of piston	AVG	SD	CV
PISTON 1	184.74	1.90	1.03
PISTON 2	184.93	1.93	1.04
PISTON 3	183.05	1.77	0.97
PISTON 4	183.63	2.02	1.10
PISTON 5	183.07	1.99	1.09
PISTON 6	184.02	2.05	1.12
PISTON 7	184.79	2.01	1.09
PISTON 8	184.70	2.46	1.33
PISTON 9	183.26	2.34	1.28
PISTON 10	183.91	2.30	1.25
PISTON 11	183.60	1.95	1.06
PISTON 12	183.02	1.68	0.92

Figure 8. Box-and-whisker plot of mean/standard deviation/minimum-maximum for pistons 1-12, together with statistics such as mean, standard deviation and coefficient of variation.

Source: own study with the use of Statistica 13.3 TIBCO software.

The use of the Individual and MR charts indicated that pistons numbered 4, 6 and 8 were characterised by instability in terms of variability as measured by the moving range. This instability was due to the significantly different values of the magnitude of the doze between two consecutive results (the current sample, for which the divergence occurred, and the previous sample) for these analysed pistons.

4. Summary

The article presents an analysis of the filling process, with net weight as the outcome measure. Various SPC tools such as control charts (X-bar and S, MA, EWMA, CUSUM, IX-MR multiple-stream charts GCC type, IX-MR chart) and mean ± error plots were used to monitor and identify changes in the filling process.

The results of using the traditional control chart showed that the filling process was under statistical control throughout the entire study period. Using special control charts, signals of process deregulation were indicated. Two significant points in time were identified where there was a change in the process trend. Sudden changes in the size of the dosage were observed, which resulted in an overdrive of the filling process. In addition, there were other points at which the process showed a change in trend. Observation of the results on special control charts provided additional information about the filling process, minor trends and changes in the process that could not be observed with traditional control charts:

- in sample No. 12 from result No. 141, in sample No. 21, from result No. 251, in sample No. 29 for result No. 348 and in sample No. 35, the process should be considered to have gone out of control,

- the highest value of the dose size in the cross-section of all pistons was recorded for piston No. 8 in sample Nos. 12 and 39, and for piston No. 7 in sample No. 38,
- the filling machine pistons that performed closest to the target in the filling process were pistons No. 12, 3, and 5. Among them, piston No. 12 exhibited the least variation from the average value, making it the most precise and accurate,
- pistons No. 2, 7, 1, and 8 were the pistons that caused the greatest deviation in package weights. Among them, piston No. 2 was the least precise (off target), while piston No. 8 showed the highest level of inaccuracy (greatest variability in results).

The overall conclusions of the conducted analyses are as follows:

1. SPC tools such as control charts have proved useful in monitoring the filling process and predicting the future. Careful monitoring of the process using a variety of control charts, both traditional and special, allows for the rapid identification of minor, progressive and sudden changes in the process and makes it possible to respond to these deviations.
2. The use of SPC tools makes it possible to anticipate future changes in the filling process, which allows for a rapid response and correction of the process.
3. The statistical analyses carried out in the area of the process under study provide important information for the food company. They allow for better production control and quality management by identifying unfavourable changes and trends in this process, which provides an opportunity to take appropriate improvement actions.

The conclusions of this article highlight the benefits that the application of SPC tools can bring to the food industry, enabling better production control and quality management of food products.

The conclusion of the analysis is that improvement actions must be taken to improve the precision and accuracy of the dosing process. It is recommended to analyse the technical condition of the parts responsible for the dosage precision in the filling machine and possibly replace these parts with new ones, as well as to continuously monitor the machine percentage of planned production by means of the OEE indicator (Knop, 2021b). In addition, maintenance of the filling machine should be systematic in order to keep it in good working order. In order to further optimise the filling process, it is recommended to continue monitoring and analysing the results and to introduce systematic process improvement using SPC tools and the Kaizen concept tools, such as e.g. 3G analysis, Quick Kaizen (Gajdzik, 2023) and to implement computer system supporting the management of machines operation and maintenance in the analysed company for, among other things, efficient optimisation of maintenance-repair works of the filling machine (White, Freis, 2019).

There is great potential for further research in the area of filling process analysis in the food industry. Research into the optimisation of the filling process will be continued by identifying other factors influencing product quality in terms of dispensing precision and accuracy, and using other statistical techniques and combined quality management tools (Czerwińska,

Piwowarczyk, 2022) to identify patterns and relationships between different process parameters, which can provide more comprehensive information on the quality and ability of the dispensing process to meet customer requirements. This type of research has the potential to bring significant benefits in terms of improving the quality, efficiency and effectiveness of production processes.

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EXOGENOUS STABILITY AND SUSTAINABLE DEVELOPMENT OF ENERGY ENTERPRISES IN THE V4

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Purpose: The paper's main aim is to assess the impact of macroeconomic, social and environmental stability on the sustainable development of energy enterprises in the Visegrad Group (V4: the Czech Republic, Hungary, Poland and Slovakia) from 2008 to 2020.
Design/methodology/approach: To assess a statistically significant relationship, we use the correlation coefficients, the Ordinary Least Squares and the Seemingly Unrelated Regression method.
Findings: The research results indicate that macroeconomic, social and environmental stability have a statistically significant impact on the sustainable development of the energy sector.
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: It is recommended to coordinate macroeconomic, social and environmental policies to achieve positive results in the energy sector. Renewable energy and green energy sources can play a pivotal role here.
Originality/value: This paper fills the research gap regarding assessing the impact of macroeconomic, social and environmental stability on the sustainable development of the energy sector in the V4 countries; this is important for the policies of countries experiencing political transformation. Moreover, the energy sector is important for countries' national security in the current geopolitical conditions related to the raw materials crisis and the war in Ukraine.

Keywords: sustainable development, energy sector, the Visegrad Group.

Category of the paper: Research Paper.

1. Introduction

Sustainable energy enterprises (SD) development incorporates economic, social and environmental goals. It is conditioned by many exogenous and endogenous factors and has a decisive influence on the competitiveness and expansion of business entities (Pieloch-Babiarz et al., 2021). The conditions for the SD are complex and a consequence of globalization processes, the development of modern ICT technologies, social changes and evolutions in the approach to the procedure of economic processes (Misztal et al., 2022; Kuzma, Sehnem, 2022).

Enterprises limit the emission of air pollutants, and the amount of waste contributes to maintaining the continuity of processes related to protecting natural resources and the sustainability of economic processes (Simionescu et al., 2021). The implementation of SD by enterprises is associated with the need to adapt to changing environmental conditions, continuous learning and reorienting the business's goals towards increasing value for stakeholders. SD occurs in specific socio-economic conditions, and its level is influenced by both the external environment and the situation inside the company (Zhou et al., 2022; Wang et al., 2022).

The last research results indicate that socio-economic conditions and regulations regarding protecting the natural environment affect enterprises' decisions to implement SD goals (Nazi, 2022; Barska et al., 2022; Kostakis, Tsagarakis, 2022). Some studies indicate that economic and social progress negatively affects the state of environmental protection, while nature protection regulations contribute to the implementation of innovations and eco-friendly solutions (Udemba et at., 2021). Some researchers show that economic growth has been decoupled from environmental protection (Camporek et al., 2022; Misztal et al., 2021).

SD is significant for macro-social stability, and decisions to produce and supply energy must include renewable energy sources (Cergibozan, 2022; Cader et al., 2021; Islam et al., 2022; Simionescu et al., 2021). Some studies indicate that macroeconomic stability positively impacts the sustainable development of energy companies (Misztal et al., 2022; Camporek et al., 2022; Marti, Puertas, 2022).

The paper's main aim is to assess the impact of macroeconomic, social and environmental stability (exogenous stability) on the sustainable development of energy enterprises in the Vise-grad Group (V4: the Czech Republic, Hungary, Poland and Slovakia) from 2008 to 2020. The research covers the period from the financial crisis to the Covid-19 pandemic. We want to check how transformed economies cope with getting out of the eco-nomic crisis.

The Visegrad Group (V4) is an informal regional form of cooperation between four Central European countries - Poland, the Czech Republic, Slovakia and Hungary, which are connected not only by their proximity and similar geopolitical conditions but, above all, by common history, tradition, culture and values. V4 has been operating since 1991. In addition to European issues, cooperation within the V4 focuses primarily on Central Europe, information exchange,

and cooperation in culture, science, education and youth exchange. The V4 are the sixth economic power and the third consumer market in Europe. One of the key aspects of policy sustainability and stability is macroeconomic stability.

We use the correlation coefficients (Pearson's r, Spearman's rho, gamma, and Kendall), the Ordinary Least Squares (OLS), and the Seemingly Unrelated Regression (SUR).

A novelty in our paper is the creation of models of the impact of macroeconomic (MSP), social (SSP) and environmental stability (EnvSP) on the SD. A contribution to the literature on the subject is developing an original approach to creating social and environmental stability indicators. For this purpose, we create the SSP and EnvSP pentagon. SSP is based on the following pillars: population, health conditions, education, labour and social protection expenditure. EnvSP is based on greenhouse gases emission, the generation of waste, water made available for use, the production and consumption of chemicals, and biodiversity.

Our models have several limitations associated with the selection of analytical indicators and the creation of the pentagons. Nevertheless, the research results are important for operational and strategic decisions by company managers and for macroeconomic policy and environmental protection. They can also support the authorities of the Visegrad Group in making findings regarding the directions of reforms of energy economy factors.

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.

Our paper fills the research gap regarding assessing the impact of macroeconomic, social and environmental stability on the sustainable development of the energy sector in the V4 countries; this is important for the policies of countries experiencing political transformation. Moreover, the energy sector is important for countries' national security in the current geopolitical conditions related to the raw materials crisis and the war in Ukraine.

2. Selected theoretical problems - the overview

2.1. Enterprise sustainable development- definition

Sustainable development is a response to the degradation of the natural environment. Its assignment is to protect the environment and counteract climate change to preserve natural resources for present and future generations (Pieloch-Babiarz et al., 2021; Udemba et al., 2021; George et al., 2022). States, institutions, organizations, households and enterprises must cooperate to protect the natural environment.

SD means implementing its basic economic goal and supplementing it with issues related to taking care of its operation's social and environmental standards. It is de-fined in three key areas, ecological (preserving the environment and its natural re-sources), economic (maximizing the profit and wealth of owners through technological progress and increasing the efficiency of the use of raw materials, materials and hu-man work) and social (improving the living conditions and safety of people) (Table 1) (Pickering et al., 2022; Kaul et al., 2022; Ashraf, 2020).

Table 1.
The sustainable development of enterprises- definition

Author	Sustainable development- definition
J. Elkington (1998)	Focus not only on maximizing profits, but equally on environmental and social issues
G. Hilson, B. Murcka (2000)	It is based on three pillars: economic, social and environmental, and entails implementing innovations and modern technologies
A. Wilkinson (2001)	Sustainability includes the ethical dimension and the trade-off's fairness between current economic pressures and future environmental needs
T. Dyllick, K. Hockerts (2002)	Meeting the needs of a firm's direct and indirect stakeholders (…) without compromising its ability to meet the needs of future stakeholders as well
M.E. Porter, M.R. Kramer (2002)	Take decisions considering the common value
M. Drljača (2012)	A process in which less and fewer resources are being spent to meet the needs of consumers and in which the environment is less polluted
G.F. Dias (2015)	Sustainable development is a way for companies and governments to reverse the negative effects caused by the economic growth model
P. Taticchi, M. Demartini (2021)	Sustainable development of companies is an integral approach to business aimed at strengthening competitive advantage and profitability through the sustainable creation of shared value due to close cooperation with all stakeholders and the integration of ESG factors in the decision-making process
A.J. Costa (2022)	The concept of sustainable development should apply to the external environment of the organization, in other words to a certain region (country, state) in a certain period of time

Source: own elaboration based on the literature on the subject.

The sustainable development of enterprises is a complex issue that requires a holistic approach. In the literature on the subject, there are several definitions of SD. It can be defined as meeting the needs of current and future stakeholders of the company (Dyllick et al., 2002). It also means achieving success today and ensuring its potential in the future (Colbert, Kurucz, 2007). SD is taking decisions considering the common value (Porter, Kramer, 2007). SD is a process aimed at reducing the consumption of resources in order to provide added value for customers and other stakeholders (Drljača, 2012). Sustainable is the company's ability to survive over time, improving its liquidity and profitability, maintaining an appropriate level of debt combined with environmental management and support for employees and local communities (Giovannoni, Fabietti, 2013). SD is a holistic approach to business based on and integrated the social, environmental and economic aspects (Silvestre, Ţîrcă, 2019; Thacker et al., 2019).

2.2. Sustainable development of energy enterprises in the Visegrad Group

Sustainable energy development is a sustainable, safe and effective energy supply process for the countries' economic, social and environmental development. Monitoring the SD should be applicable in assessing the strategy's performance for responsible development (Siksnelyte et al., 2018; Hosseini, 2020).

Energy is the basis for the development of society because the level of its consumption is largely indicative of civilization and technological progress. Energy, on the one hand, increases the quality of life and, on the other, causes the problem of environmental protection to arise and grow. The increasing energy consumption and the wrong structure of its consumption impact the degradation of ecosystems (Hernandez et al., 2019; Siksnelyte et al., 2018).

The socio-economic potential of the region is similar. The main driving factor of the economies is domestic demand and foreign investments, which have been growing in the last two decades. The main differences lie in the economies' size and growth potential. These countries emphasize economic and social issues, while the dynamics of environmental development are lower and recede into the background. These disparities may affect the sustainable development of the energy sector. For example, Slovakia is the only country that has counted on nuclear energy in the past decade (Nyzio, 2017; Kochanek, 2021; Rokicki, Perkowska, 2020).

The energy sector in the Visegrad Group is based mainly on fossil sources, including coal and lignite resources, crude oil and natural gas (Uğurlu, 2022). The share of primary renewable energy is relatively small, but it is expected to have an upward trend (Surwillo et al., 2021). The Czech Republic is accelerating its departure from coal, and its government financially support the development of renewable energy sources. Their approach is changing under the influence of new EU climate targets and rising prices of emission allowances. Slovakia is also accelerating its climate and energy transformation and wants to in-crease the amount of energy obtained from renewable sources and nuclear power. Hungary is also declaring a move away from hard coal. In Poland, on the other hand, discussions are underway on developing energy from renewable sources, although this problem is complex and largely a political decision (Kochanek, 2021; Rokicki, Perkowska, 2020, Kacperska et al., 2021).

A significant problem in the V4 countries is the low level of renewable and green energy sources in developing the energy sector due to the sector's backwardness, systemic transformation, and socio-economic problems (Kacperska et al., 2021; Sulich, Sołoducho-Pelc, 2021). The key barriers to implementing green initiatives are the need for adequate financial resources and the fact that environmental protection is not a priority for the government.

In the V4 countries, one of the critical factors affecting the sustainable development of enterprises is the fact that these countries use European Union funds more effectively and implement green technologies and programs supporting green activities. Economic

development is still necessary because it determines investments and eco-logical development (Wach et al., 2021; Uğurlu, 2022; Gostkowski et al., 2021).

Maintaining macroeconomic, social and environmental stability in the last decade is crucial for developing green initiatives (Su et al., 2018; Kiss-Dobronyi et al., 2021). Therefore, it should be emphasized that this relationship should be positive.

Further development of the energy sector in Czechia, Hungary, Poland, and Slovakia should follow the idea of sustainable development, although it will be required large financial outlays in implementing new technologies and removing damage al-ready formed in nature. In implementing new technologies and removing damage al-ready formed in nature.

2.3. Economic, social and environmental situation and sustainable development of energy companies - review of previous research

Numerous scientific analyses are devoted to the relationship between economic growth, legal environment protection regulations, and social conditions for the sustainable development of energy companies. Researchers conduct empirical research, create models of SD of the energy sector (Szczepankiewicz et al., 2022), emphasize the importance of green solutions (Ruiz, Duarte, Fan, 2022), create models of sustainable development (Pereyra-Mariñez et al., 2022; Szczepankiewicz et al., 2022) and conduct theoretical research devoted to analyzing findings on factors affecting sustainable energy (Schwanitz et al., 2022). It is emphasized that both the internal situation of enterprises and the external environment impact the individual pillars of sustainable development (Rosati et al., 2019; Gnanaweera et al., 2018).

In addition, researchers point to the important role of energy economy instruments, including renewable sources, prices of futures contracts for CO2 emissions, outputs on R&D, and the EU Emissions Trading System (Sikora, 2021; Kolosok et al., 2021). These instruments affect investments in the energy sector, innovativeness, and openness to new technical and technological solutions. At the same time, the direction of the impact of these instruments is diverse and may depend on the internal economic conditions in a given country.

According to some researchers, the impact of the market and environmental legal regulations have a variety of consequences on energy productivity (Wahab et al., 2021; Safarzadeh, Rasti-Barzoki, 2019). Moreover, sectoral regulations can hurt energy efficiency (Wang, Chen, Li, 2022, pp. 48539-48557; Wilkinson et al., 2001, p. 12). In developed countries, there is possible that regulatory reforms have contributed to (Komarnicka, Murawska, 2021; Muñoz-Torres et al., 2021) productivity growth in the steam power generation sector (Nakano, Managi, 2010). It is indicated that regulations and provisions should be adapted to the determinants and situation of the energy sector in a particular country.

Most researchers indicate that economic growth and globalization cause an in-crease in the emission of harmful substances into the atmosphere, degradation of the natural environment and the need to increase energy consumption (Tahir et al., 2021; Acheampong et al., 2019).

In turn, macroeconomic, social and environmental stability positively impacts energy companies' sustainable development (Pieloch-Babiarz et al., 2021; Udemba et al., 2021; Comporek et al., 2022). Macroeconomic stability is a configuration of economic indicators corresponding to economic growth conditions.

Social stability means maintaining appropriate proportions in the development of society concerning indicators such as population, health, education, salaries, and social protection expenditure.

Environmental stability can be understood as reducing greenhouse gas emissions, reducing the consumption of raw materials and access to water, reducing the production and consumption of chemicals and preserving biodiversity.

The countries' economic, social and environmental situation should have an impact on the sustainable development of the energy sector. Moreover, this relationship should be positive because improving the quality and living conditions is conducive to undertaking ecological activities.

3. Research methodology

The main aim of our research is to assess the impact of macroeconomic, social and environmental stability on the sustainable development of energy enterprises in the Visegrad Group (the Czech Republic, Hungary, Poland and Slovakia) from 2008 to 2020. We focus on the period from the economic crisis through economic growth until the Covid-19 pandemic. The Visegrad Group was established in 1991 and is an association of four Central European countries - Poland, the Czech Republic, Slovakia and Hungary, aiming to deepen cooperation between these countries.

Our study supplements the literature on the subject with an assessment of the impact of macroeconomic, social and environmental stability on the sustainable development of the energy sector. In addition to introducing the definitions of these concepts, we present a new approach to determining these indicators. **The central research hypothesis (H)** is as follows:

There is a large variation in the strength and direction of the impact of macroeconomic, social and environmental stabilization in the Visegrad Group between 2008 and 2020.

This research approach results from the fact that these countries that have undergone economic transformation need to catch up compared to the west of the European Union. Hence the fundamental decisions concern strictly economic issues, and social issues and environmental protection recede into the background.

We also formulate the following sub-hypothesis:

- **1 Sub-hypothesis (H1):** In the Visegrad Group, SD increased from 2008-2020;
- **2 Sub-hypothesis (H2):** The macroeconomic stability, social and environmental stability have a positive trend line, but it decreased during the Covid-19 pandemic;
- **3 Sub-hypothesis (H3):** The impact of macroeconomic, social and environmental stability on the pillars of sustainable development, economic (E), social (S) and environmental (Env) varies in the countries.

The research includes the following steps:

1) We create indicators: E, S, Env, SD. We considered numerous research and created these factors based on own, proprietary approach.

Collecting analytical indicators and grouping them into three pillars of SD, including:

- E: stimulants: enterprises (number), turnover or gross premiums written (EUR 1 million), → production value (mil euro), → value added at factor cost (EUR 1 million), gross operating surplus (EUR 1 million), total purchases of goods and services (EUR 1 million), gross investment in tangible goods (EUR 1 million), → investment rate (%); and destimulants: cost level index from total activity (%);
- S: stimulants: wages and salaries (EUR 1 million), social security costs (EUR 1 million), employees: number, apparent labour productivity, gross value added per employee (EUR 1000), investment per person employed (EUR 1000), employer's social charges as a percentage of personnel costs: percentage (%), expenditure on training and courses. Destimulants: personnel costs (EUR 1 million), share of personnel costs in production (%), accidents at work;
- Env: destimulants: carbon dioxide, methane nitrous oxide, hydrofluorocarbones (CO2 equivalent), sulphur oxides (SO2 equivalent), carbon monoxide, ammonia.

We transform the explanatory variables into integrated, using the following formulas:

$$E_{ij};\ S_{ij}; Env_{ij} = \sum_{i=1}^{n} \frac{xij}{\max xij} + \sum_{i=1}^{n} \frac{\min xij}{xij};\ E_{ij};\ S_{ij}; Env_{ij} \in [0; 1] \quad (1)$$

where:

E_{ij}; S_{ij}; Env_{ij} stands for the normalized value of the *j*-th variable in the *i*-th year,

x_{ij} is the diagnostic variable in *i*-year,

SD_i indicates integrated variable in *i*-year.

We use the following formula to create the SD:

$$SD = E + S + Env = \sum_{i=1}^{n} \frac{E_{ij}}{n} + \sum_{i=1}^{n} \frac{S_{ij}}{n} + \sum_{i=1}^{n} \frac{Env_{ij}}{n};\ SD \in [0;1] \quad (2)$$

2) We created MSP, SSP and EnvSP (Figure 1) indicators based on formula (3), (4) and (5).

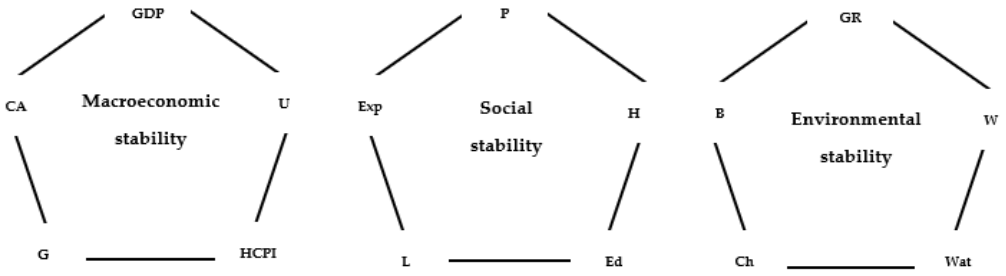


Figure 1. Macroeconomic stability, social stability, environmental stability.

Source: own elaboration.

$$MSP= [(\Delta GDP \cdot U)+(U \cdot HICP)+(HICP \cdot G)+(G \cdot CA)+(CA \cdot \Delta GDP)] \cdot k \quad (3)$$

where:

GDP - gross domestic product,

U - unemployment rate,

HICP - Harmonised Indices of Consumer Prices,

G - government deficit,

CA - current account,

$k = \frac{1}{2} \sin 72° = 0{,}475.$

$$SSP= [(\Delta P \cdot H)+(H \cdot Ed)+(Ed \cdot L)+(L \cdot Exp)+(Exp \cdot \Delta P)] \cdot k \quad (4)$$

where:

P - number of population,

H - healthy life year,

Ed - expenditure on education,

L – wages,

Exp - social protection expenditure,

$k = \frac{1}{2} \sin 72° = 0{,}475.$

$$EnvSP= [(\Delta GR \cdot W)+(W \cdot Wat)+(Wat \cdot Ch)+(Ch \cdot B)+(B \cdot \Delta GR)] \cdot k \quad (5)$$

where:

GR - greenhouse gases emission,

W - generation of waste,

Wat - water made available for use,

Ch - production and consumption of chemicals,

B – biodiversity,

$k = \frac{1}{2} \sin 72° = 0{,}475.$

3) We examine the strength and direction of a linear relationship between the SD and MSP, SSP, and EnvSP. To do this, we use Pearson's R, Spearman-s Rho, Gamma and Kendall rank correlation coefficients. We adopt the following ranges of correlation strength: |rxy| = 0—no correlation; 0 <|rxy| ≤ 0.19—very weak; 0.20 ≤ |rxy| ≤ 0.39—weak; 0.40 ≤ |rxy| ≤ 0.59—moderate; 0.60 ≤ |rxy| ≤ 0.79—strong; 0.80 ≤ |rxy| ≤ 1.00—very strong.
4) We use the OLS method to estimate models, which is given by equation:

$$SD = \propto_0 + \propto_1 \cdot MSP + \propto_2 MSP_{(t-1)} + \propto_3 \cdot SSP + \propto_4 \cdot SSP_{(t-1)} + \propto_5 \cdot EnvSP + \propto_6 \cdot EnvSP_{(t-1)} + \varepsilon_i \quad (6)$$

where:
β_0 is the intercept,
β_1, β_2, β_3 is the slope,
ε_i denotes the *i*-th residual,
i is an observation index.

5) We create the structural equation model and use the SUR method to estimate it:

$$\begin{cases} E = \hat{\beta}_0 + \hat{\beta}_1 MSP_i + \hat{\beta}_2 SSP_i + \hat{\beta}_3 EnvSP_i + \hat{\beta}_4 S + \hat{\beta}_5 Env + e_i \\ S = \hat{\beta}_0 + \hat{\beta}_1 MSP_i + \hat{\beta}_2 SSP_i + \hat{\beta}_3 EnvSP_i + \hat{\beta}_4 E + \hat{\beta}_5 Env + e_i \\ Env = \hat{\beta}_0 + \hat{\beta}_1 MSP_i + \hat{\beta}_2 SSP_i + \hat{\beta}_3 EnvSP_i + \hat{\beta}_4 E + \hat{\beta}_5 S + e_i \end{cases} \quad (7)$$

4. Research results

Table 2 presents SD in the Visegrad Group from 2008 to 2020. All countries show a positive trend, which is a favourable situation. The activities in the Visegrad Group from 2008 to 2020 undertaken for the sustainable development of energy enterprises are effective. The highest dynamics of SD is in Poland (SD = 0.0159 time + 0.6204). Hungary has the lowest dynamics of SD (SD = 0.001 time + 0.7267). The highest average level of SD in the period from 2008 to 2020 is in Poland and Hungary (mean = 0.73), and the lowest average level is in Slovakia (mean = 0.68). The maximum level of SD is in Poland (0.85, 2020), and the minimum is in Slovakia (0.62, 2008).

The highest level of the average SD is in Poland and Hungary because the energy sector has been undergoing a deep transformation for several years related to reducing the general share of conventional energy based on coal in favour of new technologies, particularly energy from renewable sources. In turn, the lowest average level of the SD indicator in Slovakia may be because, in recent years, this country has focused on nuclear energy; thus, the indicator level after 2020 should significantly improve.

Table 2.
The sustainable development of energy enterprises indicator in the Visegrad Group from 2008 to 2020

Czechia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,64	0,67	0,72	0,73	0,74	0,73	0,68	0,70	0,64	0,69	0,72	0,75	0,76

Descriptive statistics

Mean	Sd	Median	Min	Max
0,71	0,04	0,72	0,64	0,76

Hungary

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,72	0,73	0,75	0,74	0,73	0,73	0,72	0,73	0,73	0,72	0,73	0,76	0,75

Descriptive statistics

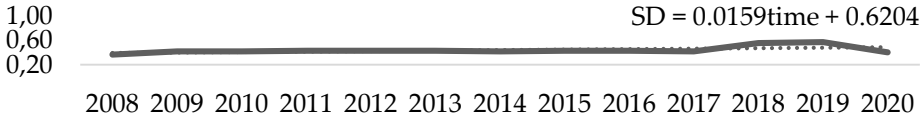
Mean	Sd	Median	Min	Max
0,73	0,01	0,73	0,72	0,76

Poland

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,67	0,65	0,69	0,67	0,68	0,69	0,72	0,75	0,73	0,76	0,80	0,85	0,85

Descriptive statistics

Mean	Sd	Median	Min	Max
0,73	0,06	0,72	0,65	0,85



Slovakia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,62	0,64	0,66	0,62	0,67	0,66	0,74	0,67	0,67	0,68	0,73	0,76	0,77

Descriptive statistics

Mean	Sd	Median	Min	Max
0,68	0,05	0,67	0,62	0,77

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 3 shows MSP in the Visegrad Group from 2008 to 2020. All countries show a positive trend. The policy in the Visegrad Group from 2008 to 2020 undertaken for the macroeconomic stabilization of energy enterprises is efficient. The highest dynamics of MSP are in Czechia (MSP = 0.0143 time + 0.4037). The lowest dynamics of MSP is in Hungary (MSP = 0.0021time + 0,5162). The highest average level of MSP from 2008 to 2020 is in Hungary (mean = 0.53), and the lowest is in Poland and Slovakia (mean = 0.44). The maximum level of MSP is in Chechia (0.61, 2017), and the minimum is in Slovakia (0.32, 2009).

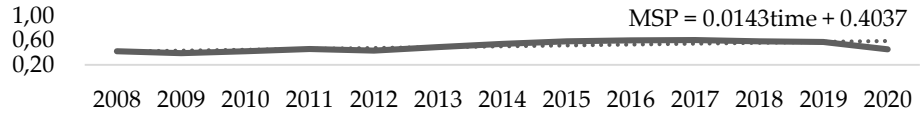
Table 3.
The macroeconomic stability indicator in the Visegrad Group from 2008 to 2020

Czechia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,42	0,39	0,42	0,46	0,43	0,49	0,54	0,58	0,60	0,61	0,58	0,57	0,45

Descriptive statistics

Mean	Sd	Median	Min	Max
0,50	0,08	0,49	0,39	0,61



Hungary

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,51	0,52	0,53	0,54	0,53	0,53	0,52	0,53	0,53	0,52	0,53	0,56	0,55

Descriptive statistics

Mean	Sd	Median	Min	Max
0,53	0,01	0,53	0,51	0,56

Poland

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,37	0,42	0,42	0,43	0,43	0,43	0,42	0,43	0,43	0,42	0,56	0,57	0,40

Descriptive statistics

Mean	Sd	Median	Min	Max
0,44	0,06	0,43	0,37	0,57

Slovakia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,38	0,32	0,35	0,35	0,46	0,50	0,51	0,47	0,46	0,49	0,49	0,46	0,44

Descriptive statistics

Mean	Sd	Median	Min	Max
0,44	0,06	0,46	0,32	0,51

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 4 presents SSP in the Visegrad Group from 2008 to 2020. In Czechia, Hungary and Poland is a positive trend. The policy in these countries from 2008 to 2020 undertaken for the social stability of energy enterprises is effective. The highest dynamics of SSP are in Hungary (SSP = 0.0076 time + 0.439). The lowest dynamics of SSP is in Czechia (SSP = 0.0004time + 0.4562). In Slovakia is a negative trend (SSP = -0.0024time + 0.5166), which points to the need for increased attention to social stability in this country. The highest average level of SSP in the period from 2008 to 2020 is in Slovakia (mean = 0.50), and the lowest average level is in Czechia (mean = 0.46). The maximum level of SSP is in Hungary (0.57, 2019), and the minimum is in Hungary (0.40, 2020).

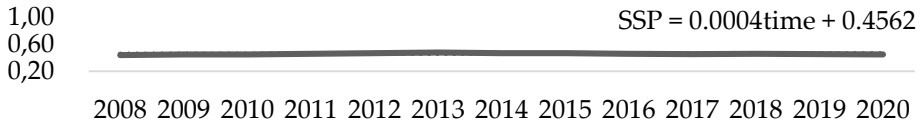
Table 4.
The social stability indicator in the Visegrad Group from 2008 to 2020

Czechia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,44	0,45	0,45	0,46	0,47	0,48	0,47	0,47	0,46	0,45	0,46	0,46	0,45

Descriptive statistics

Mean	Sd	Median	Min	Max
0,46	0,01	0,46	0,44	0,48



Hungary

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,41	0,44	0,46	0,47	0,48	0,49	0,51	0,52	0,53	0,56	0,57	0,57	0,40

Descriptive statistics

Mean	Sd	Median	Min	Max
0,49	0,05	0,49	0,40	0,57

Poland

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,44	0,46	0,49	0,46	0,47	0,48	0,45	0,47	0,49	0,48	0,47	0,49	0,47

Descriptive statistics

Mean	Sd	Median	Min	Max
0,47	0,02	0,47	0,44	0,49

Slovakia

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,52	0,52	0,51	0,50	0,50	0,50	0,50	0,49	0,49	0,49	0,48	0,48	0,51

Descriptive statistics

Mean	Sd	Median	Min	Max
0,50	0,01	0,50	0,48	0,52

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 5 shows EnvSP in the Visegrad Group from 2008 to 2020. In Czechia, Hungary and Poland is a positive trend. The activities in these countries from 2008 to 2020 undertaken for the environmental stability of energy enterprises brought positive results. The highest dynamics of EnvSP is in Czechia (EnvSP = 0.0036 time + 0.3645). The lowest dynamics of SSP are in Hungary (EnvSP = 0.0015 time + 0.452). In Slovakia is a negative trend (EnvSP = -0.0018 time + 0.5043), which means that attention should be paid to improving environmental stability in this country. The highest average level of EnvSP in the period from 2008 to 2020 is in Slovakia

(mean = 0.49), and the lowest average level is in Czechia (mean = 0.39). The maximum level of EnvSP is in Slovakia (0.51, 2012, 2013), and the minimum is in Czechia (0.35, 2008).

Table 5.
The environmental stability indicator in the Visegrad Group from 2008 to 2020

Czechia												
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,35	0,37	0,37	0,38	0,39	0,39	0,40	0,40	0,41	0,41	0,42	0,41	0,37
Descriptive statistics												
				Mean	SD	Median	Min	Max				
				0,39	0,02	0,39	0,35	0,42				
1,00 0,60 0,20							EnvSP = 0.0036time + 0.3645					
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020												
Hungary												
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,44	0,44	0,45	0,47	0,46	0,47	0,47	0,48	0,48	0,47	0,46	0,47	0,45
Descriptive statistics												
				Mean	SD	Median	Min	Max				
				0,46	0,01	0,47	0,44	0,48				
1,00 0,60 0,20							EnvSP = 0.0015time + 0.452					
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020												
Poland												
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,41	0,45	0,44	0,46	0,45	0,46	0,44	0,46	0,46	0,47	0,48	0,48	0,45
Descriptive statistics												
				Mean	SD	Median	Min	Max				
				0,45	0,02	0,46	0,41	0,48				
1,00 0,60 0,20							EnvSP = 0.0032time + 0.432					
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020												
Slovakia												
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0,48	0,49	0,50	0,50	0,51	0,51	0,50	0,50	0,49	0,48	0,48	0,48	0,48
Descriptive statistics												
				Mean	SD	Median	Min	Max				
				0,49	0,01	0,49	0,48	0,51				
1,00 0,60 0,20							EnvSP = -0.0018time + 0.5043					
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020												

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 6 presents the Pearson's R, Spearman-s Rho, Gamma and Kendall rank correlation coefficients between SD and MSP, SSP and EnvSP in the Visegrad Group from 2008 to 2020. There is a positive or negative relationship between these variables and different levels of

correlation coefficients regarding the strength of impact. The strong or very strong correlation is bolded in the table ($p < 0.05$). The highest positive level of correlation is in Hungary (Gamma = 0.96, between SD and MSP), and the lowest positive level of correlation is in Poland (Gamma and Kendall rank = 0.44, between SD and SSP). The highest negative level of correlation is in Slovakia (Spearman-s Rho = -0.62, between SD and SSP), and the lowest is in Slovakia (Gamma, Kendall rank = -0.49, between SD and SSP).

Table 6.
The Pearson's R, Spearman-s Rho, Gamma and Kendall rank correlation coefficients in the period from 2008 to 2020, $p < 0.05$ (n = 13)

Country	Correlation	SD		
		MSP	**SSP**	**EnvSP**
Czechia	Pearson's R	-0.06	0.27	0.14
	Spearman-s Rho	-0.02	0.24	0.08
	Gamma	-0.05	0.19	0.07
	Kendall rank	-0.05	0.18	0.07
Hungary	Pearson's R	**0.88**	-0.08	-0.07
	Spearman-s Rho	**0.92**	0.05	-0.01
	Gamma	**0.96**	0.03	-0.01
	Kendall rank	**0.86**	0.03	-0.01
Poland	Pearson's R	**0.55**	0.40	0.53
	Spearman-s Rho	0.26	**0.59**	0.55
	Gamma	0.26	**0.44**	**0.47**
	Kendall rank	0.23	**0.44**	**0.47**
Slovakia	Pearson's R	0.55	-0.49	-0.53
	Spearman-s Rho	0.46	**-0.62**	-0.46
	Gamma	0.31	**-0.49**	-0.38
	Kendall rank	0.31	**-0.49**	-0.38

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 7 shows the results of the OLS regressions between SD and MSP, MSP(t-1), SSP, SSP(t-1), EnvSP, and EnvSP(t-1) in the Visegrad Group from 2008 to 2020. The results of the OLS estimation include no autocorrelation, collinearity, homoscedasticity, and normal distribution of variables. The relationship between the examined variables is positive or negative, with a different level of strength.

In all countries, in the period from 2008 to 2020, the MSP (or MSP(t-1)) and En-vSP (or EnvSP(t-1)) influence SD, the SSP (or SSP(t-1)) has an influence on SD only in Czechia and Hungary. The highest positive level of relationship is in Czechia (3.480, between SD and EnvSP(t-1)), and the lowest positive level of relationship is in Hungary (0.036, between SD and SSP(t-1)). The highest negative level of relationship is in Slovakia (−3.368, between SD and EnvSP(t-1)), and the lowest negative level of relationship is in Hungary (−0.086, between SD and SSP).

The coefficient determination ranges from 0.739 (Slovakia, which means a satisfactory fit to the model's data) to 0.985 (Hungary, a very good fit to the model's data).

Table 7.
The Results of the OLS regressions in the period from 2008 to 2020 ($p < 0.05$):
$SD = \propto_0 + \propto_1 \cdot MSP + \propto_2 \cdot MSP_{(t-1)} + \propto_3 \cdot SSP + \propto_4 \cdot SSP_{(t-1)} + \propto_5 \cdot EnvSP + \propto_6 \cdot EnvSP_{(t-1)} + \varepsilon_i$

Country	Independent variable	Coefficient	Std. error	p-value	R^2
Czechia	const	0.156	0.242	0.5441	0.920
	MSP	−0.320	0.116	0.0324	
	$MSP_{(t-1)}$	−0.445	0.155	0.0287	
	SSP	1.346	0.685	0.0472	
	$SSP_{(t-1)}$	−2.255	0.682	0.0163	
	$EnvSP_{(t-1)}$	3.480	0.493	0.0004	
Hungary	const	0.455	0.073	0.0004	0.985
	MSP	0.868	0.046	<0.0001	
	SSP	−0.086	0.014	0.0004	
	$SSP_{(t-1)}$	0.036	0.013	0.0269	
	EnvSP	−0.335	0.136	0.0435	
Poland	const	−0.571	0.321	0.1094	0.842
	$MSP_{(t-1)}$	0.879	0.153	0.0003	
	EnvSP	2.003	0.712	0.0203	
Slovakia	const	2.114	0.390	0.0004	0.739
	MSP	0.534	0.137	0.0036	
	$EnvSP_{(t-1)}$	−3.368	0.815	0.0025	

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

Table 8 presents the results of the SUR estimation between E, S, Env and MSP, SSP, EnvSP, and E, S, Env (depending on the model type) in the Visegrad Group from 2008 to 2020.

In all countries, there is a high differentiation in the factors that affect E, S, and Env. The relationship between the examined variables is positive or negative, with a different level of strength.

In all countries, from 2008 to 2020, Env influences E, and E influences S and Env. The highest positive level of relationship is in Slovakia (3.318, between E and EnvSP), and the lowest is in Poland (0.275, between S and E). The highest negative level of relationship is in Slovakia (−9.639, between Env and EnvSP), and the lowest negative level of relationship is in Czechia (−0.265, between S and MSP).

Table 8.
Results of SUR regressions in the period from 2008 to 2020 ($p < 0.05$):
$$\begin{cases} E = \propto_0 + \propto_1 \cdot \mathrm{MSP} + \propto_2 \cdot SSP + \propto_3 \cdot \mathrm{EnvSP} + \propto_4 \cdot S + \propto_5 \cdot Env + \varepsilon_i \\ S = \propto_0 + \propto_1 \cdot \mathrm{MSP} + \propto_2 \cdot SSP + \propto_3 \cdot \mathrm{EnvSP} + \propto_4 \cdot E + \propto_5 \cdot Env + \varepsilon_i \\ Env = \propto_0 + \propto_1 \cdot \mathrm{MSP} + \propto_2 \cdot SSP + \propto_3 \cdot \mathrm{EnvSP} + \propto_4 \cdot E + \propto_5 \cdot S + \varepsilon_i \end{cases}$$

Country	Dependent variable	Independent variable	Coefficient	Std. error	p-value	R^2
Czechia	E	const	-1.615	0.299	0.0004	0.725
		SSP	1.654	0.450	0.0058	
		S	1.461	0.209	6.40E-05	
		Env	1.020	0.136	3.71E-05	
	S	const	0.844	0.080	2.29E-06	0.703
		MSP	-0.265	0.078	0.0079	
		E	0.538	0.092	0.0002	
		Env	-0.610	0.101	0.0002	
	Env	const	1.566	0.248	0.0001	0.690
		EnvSP	-1.549	0.489	0.0114	
		E	0.937	0.129	4.63E-05	
		S	-1.402	0.206	7.77E-05	

Cont. table 8.

Hungary	E	const	1.151	0.212	0.0004	0.972
		MSP	2.715	0.263	2.79E-06	
		S	-1.350	0.169	2.27E-05	
		Env	-1.191	0.068	2.91E-08	
	S	const	0.864	0.097	8.99E-06	0.958
		MSP	1.790	0.279	0.0001	
		E	-0.655	0.082	2.27E-05	
		Env	-0.825	0.057	1.57E-07	
	Env	const	1.005	0.141	5.48E-05	0.990
		MSP	2.231	0.240	6.50E-06	
		E	-0.820	0.047	2.91E-08	
		S	-1.171	0.081	1.57E-07	
Poland	E	const	0.165	0.094	0.1070	0.546
		Env	0.805	0.127	5.37E-05	
	S	const	0.494	0.117	0.0014	0.512
		E	0.275	0.154	0.0021	
	Env	const	-0,124	0.136	0.3814	0.546
		E	1.135	0.178	5.37E-05	
Slovakia	E	const	-1.010	0.531	0.0864	0.440
		EnvSP	3.318	1.028	0.009	
		Env	0.288	0.073	0.0029	
	S	const	1.419	0.242	0.0001	0.367
		E	-0.930	0.307	0.0115	
	Env	const	3.563	0.791	0.0015	0.810
		MSP	1.002	0.282	0.0063	
		EnvSP	-9.639	1.635	0.0002	
		E	1.672	0.393	0.0021	

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 1.02.2023.

The coefficient determination ranges from 0.367 (Slovakia, which means an unsatisfactory fit to the model's data) to 0.972 (Hungary, which means a very good fit to the model's data).

5. Discussion

Sustainable development of enterprises takes place in strictly defined socio-economic conditions. Like most researchers, we underline that it is a complex and holistic idea and depends on internal and external factors (Pieloch-Babiarz et al., 2021; Udemba et al., 2021; Dias, 2015; Taticchi, Demartini, 2021; Costa et al., 2022).

Our research results are in line with research conducted so far in the field of sustainable development of energy companies in the V4 countries. Similarly to other researchers, we obtained results indicating positive, small dynamics of sustainable development of energy enterprises and their diversification in the surveyed countries (Sulich et al., 2021; Kacperska et al., 2021; Wach et al., 2021; Uğurlu, 2022; Gostkowski et al., 2021).

The correlation results indicate that the level of statistically significant correlation is different and small between SD and SME, SSP and EnvSP. In the Czech Republic, there was no statistically significant relationship. In turn, the correlation coefficients are statistically

significant between SD and SME in Hungary (the level of dependence is high), in Poland between SD and SSP, but the level is at an average level, and between SD and EnvSP, and in Slovakia between SD and SSP. Sustainable development of the energy sector in these countries, therefore, also depends on other factors, including geopolitical conditions and the current policy of the state authorities (Drljača, 2012; Giovannoni, Fabietti, 2013; Silvestre, Ţîrcă, 2019; Thacker et al., 2019).

The central research hypothesis is true because the impact of different dimensions on SD varies in strength and direction. The results of the OLS estimation indicate that all dimensions of stability have a statistically significant impact on SD. Moreover, there are relationships between the values of stabilization indicators from the previous period. The direction and strength of these relationships vary. The largest number of indicators affect SD in the Czech Republic and Hungary, while in Poland, SD is affected by MSP(t-1), EnvSP, and in Slovakia, MSP and EnvSP(t-1). One of the most important factors is macroeconomic stabilization (Udemba et al., 2021; Comporek et al., 2022; Cader et al., 2021), and therefore the governments of these countries should implement a stable monetary and fiscal policy, stimulate economic growth and ensure an appropriate level of employment.

The first research sub-hypothesis is true. Therefore, let us confirm the results of research to date, which indicate that the sustainable development of energy enterprises has small growth dynamics. The highest level of dynamics of sustainable development of energy enterprises was observed in Poland and the lowest in Hungary. Across all countries, there was a slight decline in sustainability in the year the Covid-19 pandemic began. We confirm other researchers' analyses which show that the Covid-19 pandemic hurts economic and social development (Kacperska et al., 2021; Sulich et al., 2021).

We can confirm the second research sub-hypothesis because, from 2008 to 2020, there were positive dynamics of macroeconomic stabilization in all countries as well as social and environmental stability (Slovakia is an exception). However, it should be emphasized that the general socio-economic situation in Slovakia is good, although the Covid-19 pandemic has resulted in a slight increase in unemployment and a decrease in economic activity.

We also accept the third research sub-hypothesis. The results of the SUR estimation indicate a large variation in the impact of macroeconomic, social and environmental stability on the filters of sustainable development of energy companies (economic, social and environmental) in the Visegrad countries. We have noticed that the individual pillars are, to a different extent, dependent on each other, so social or environmental development affects economic development and vice versa. In Poland, social and social development is influenced by economic development and economic development by environmental development. On the other hand, in other countries, the basic element affecting E, S and Env is MSP, i.e. there is a statistically significant relationship between macroeconomic decisions and the development of the energy sector.

Our models can help to formulate the theoretical and practical implications. They have limitations related to the selection of analytical indicators for models, the method of determining indicators, the research period, or the research sample itself. Nevertheless, it is important both from the point of view of decisions made by enterprises and economic practice.

Our research allows us to indicate important theoretical and empirical implications. Theoretical implications include the creation of an original definition of sustainable development and, reviewing the literature on the subject, developing an indicator assessment and models of sustainable development. Among the empirical implications, one should distinguish those that are important for national policy and those for business managers. From the state's point of view, a more responsible environmental policy should be implemented, actions should be taken to change the energy balance, and the development of renewable energy sources should be supported. The energy policy should neutralize or limit the risks associated with potential crises in the country and internationally; this is also part of the implementation of the main goal of the energy policy, i.e. guaranteeing energy security while ensuring the competitiveness of the economy and reducing the impact of the energy sector on the environment. In addition, good economic and social situations should be used to implement renewable energy sources. The research results are important for the managers of enterprises because they must consider issues related to their financial and property situation and analyze macroeconomic indicators, social issues and environmental protection regulations.

The direction of development of policies supporting sustainable development should be coordinated with economic, social and environmental policies. What is more, these countries are forced to focus on renewable and anatomic energy sources in the current geopolitical conditions.

The results of our research indicate that the energy sector in the analyzed countries is developing gradually (Silvestre, Ţîrcă, 2019; Thacker et al., 2019; Rokicki, Perkowska, 2020; Uğurlu, 2022). It is necessary to introduce reforms, change energy policy and transform economies to alternative energy sources (Siksnelyte et al., 2018; Kochanek, 2021). Energy transformation is especially important in the historical moment in which the region is connected with the Ukraine war. It is necessary to take political action, reform the energy sector and implement innovative solutions.

6. Conclusions

The sustainable development of energy enterprises in the Visegrad Group countries has a slight positive trend, which is a positive phenomenon. It is necessary to implement reforms aimed at developing alternative energy sources. We have noted that macroeconomic, social and

environmental stabilization impact on sustainable development varies in the countries surveyed, which may indicate that their socioeconomic and environmental potentials are different.

Theoretical implications include the introduction of its definition of sustainable development of enterprises, social and environmental stability and the created econometric models. The empirical implications include that the research results can support state managers and enterprises in their development strategies.

Further research will be devoted to analyzing the sustainable development of energy companies in developed countries in the European Union, and we will conduct comparative analyses between countries.

Abbreviations

SD - sustainable development of energy enterprises.
E - economic development of energy enterprises.
S - social development of energy enterprises.
Env - environmental development of energy enterprises.
MSP - macroeconomic stability.
SSP - social stability.
EnvSP - environmental stability.
GDP - gross domestic product.
U - unemployment rate.
HICP - Harmonised Indices of Consumer Prices.
G - government deficit.
CA - current account.
H - healthy life year.
Ed - expenditure on education.
L - wages.
Exp - social protection expenditure.
GR - greenhouse gases emission.
W - generation of waste.
Wat - water made available for use.
Ch - production and consumption of chemicals.
B - biodiversity.

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EFFECT OF ARTIFICIAL INTELLIGENCE ON THE ECONOMY

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Purpose: The purpose of this article is to investigate the diverse effects of artificial intelligence (AI) on the economy, with the aim of offering a comprehension of its consequences on different industries and socioeconomic factors. This research endeavours to enhance understanding of the transformative impacts of AI on global economies by investigating the correlation between the adoption of AI and economic dynamics, thereby providing valuable insights.
Design/methodology/approach: The research paper utilizes an interdisciplinary methodology that integrates approaches to examine the diverse impacts of artificial intelligence on the economy.
Findings: The article presented a nuanced analysis of the multifaceted consequences of adopting AI technology in various aspects including macroeconomics, industry-specific implications, labour market dynamics, socioeconomic factors, and policy considerations. The research outcomes emphasized the significance of a comprehensive and equitable approach to the integration of AI, considering ethical considerations, policy frameworks, and targeted initiatives aimed at ensuring the fair distribution of the advantages and opportunities created by AI.
Research limitations/implications: The relationship between the adoption of AI and macroeconomic factors may require a more complex analytical framework. Investigating the possible harmonization and joint efforts between AI and human workers is an avenue that should be explored in future research. To achieve a more thorough comprehension of the multifaceted effects of AI on the economy, upcoming studies should aim to overcome these limitations.
Originality/value: The article offers a distinctive perspective by employing a comprehensive and interdisciplinary approach, as well as by considering the broad socioeconomic implications. Its significance lies in providing guidance to policymakers, businesses, researchers, educators, and the wider public, facilitating a more profound comprehension of the impact of AI on economies, and ultimately promoting responsible and fair integration of AI technologies.

Keywords: artificial intelligence, economy, labour market, socioeconomic factors.

Category of the paper: Literature review.

1. Introduction

In a time marked by remarkable technological progress, the incorporation of AI into different aspects of human existence has emerged as a powerful and transformative influence (Gruetzemacher, Whittlestone, 2021; Littman et al., 2021; West, Allen, 2018; Xu et al., 2021; Bilan et al., 2022). The consequences of AI reach beyond the domains of creativity and ease, extending into the fundamental structure of global economies and society (Bughin et al., 2018; Jason, Seamans, 2019; Szczepański, 2019; Kuzior, Kwilinski, 2022). As AI technologies become more widespread, the complex connection between AI and the economy has garnered the interest of scholars, policymakers, businesses, and society. This article endeavours to thoroughly examine this dynamic connection, aiming to uncover the diverse effects of AI on the economy.

In recent decades, there has been a notable transformation of AI from a theoretical concept to a practical reality, showcasing its capabilities in challenging commonly accepted norms across diverse industries. The combination of machine learning, data analysis, and automation has paved the way for improved productivity, operational efficiency, and accelerated innovation (Tariq, Poulin, Abonamah, 2021; Sakiewicz et al., 2021; Ober, Kochmańska, 2022). However, this technological revolution also prompts critical inquiries regarding its potential to reshape economic structures, redefine labour markets, and impact societal well-being. As AI technologies continue to advance and integrate into various sectors, it is crucial to comprehend not only the opportunities they offer but also the obstacles they present to economic stability, inclusivity, and sustainability (Kuzior, 2017; 2021; 2022; Marszałek-Kotzur, 2022; Postrzednik-Lotko, 2020; Osika, 2022).

The primary goals of this article are two-fold: firstly, to examine the various impacts of artificial intelligence on the economy and secondly, to provide insight into the multifaceted consequences of adopting AI in terms of socioeconomic fairness and employment markets. By employing a multidisciplinary approach that combines quantitative analysis and theoretical synthesis, this study strives to contribute to a comprehension of the complex relationship between AI and economic results.

To achieve these goals, this article explores the theoretical underpinnings, including economic theories related to technological innovation, dynamics of the labour market, and the diffusion of innovation. The paper presents the empirical findings and discussions, offering insights into macroeconomic patterns, industry-specific effects, transformations in the labour market, socioeconomic implications, policy considerations, and global variations.

Overall, the examination of the impact of artificial intelligence on the economy is a significant undertaking in a period characterized by swift technological progress. Through comprehending the intricacies of this intricate association, this paper aims to educate and direct individuals with a vested interest in promoting the responsible implementation of AI, fostering inclusive economic expansion, and ensuring long-term sustainable development.

2. Methods

The article employs qualitative research methods, literature review and secondary data analysis, to provide a comprehensive analysis of the multifaceted impact of artificial intelligence on the economy. A systematic review of relevant academic literature and industry reports is conducted to gather existing insights into the impact of AI on the economy. Data from existing sources, such as government reports, and industry publications, is analysed to uncover trends related to AI's economic impact.

3. Results

There are theoretical foundations of economic theories related to technological innovation, labour market dynamics, and innovation diffusion. These areas are crucial to understanding the complex interaction between technology, work and innovation in management and organization.

Technological innovation is the cornerstone of economic growth and development (Kuzior, 2014). Several economic theories provide insight into its dynamics. Schumpeter's Theory of Innovation proposed by Joseph Schumpeter emphasizes the role of entrepreneurs in driving economic progress through the introduction of new and disruptive technologies (Sweezy, 1943). Schumpeter's concept of "creative destruction" suggests that innovation leads to the replacement of old technologies, which leads to economic transformation.

Endogenous Growth Theory developed by economists such as Paul Romer posits that technological progress is not just a by-product of economic activity but can be affected and accelerated by factors such as research and development investments, education, and the fallout of knowledge (Schilirò, 2019).

Diffusion of Innovation Theory building on the work of Everett Rogers focuses on the process by which innovations diffuse within a society or market. It highlights the importance of adopters' characteristics, communication channels, and perceived attributes of innovations in influencing their spread (Rogers, Singhal, Quinlan, 2019).

The labour market is highly influenced by technological innovation, which can lead to shifts in job roles, employment patterns, and skill requirements. Several economic theories shed light on these dynamics as follows.

Technological Unemployment theory, often associated with the Luddite movement, suggests that technological progress can displace workers, leading to unemployment in some industries (Jason, Seamans, 2019). However, history has shown that while some jobs may be lost, new ones are also created as technological progress stimulates economic growth.

Skills Biased Technological Change (SBTC) theory proposes that technological innovations tend to supplement high-skilled workers while replacing low-skilled workers. SBTC contributes to wage inequality, as those with relevant skills benefit most from technological advances (Berman, Bound, Machin, 1998).

Job polarization theory suggests that technological innovation can lead to a decrease in medium-skilled jobs, while an increase in demand for both low-skill, routine tasks and high-skill, non-routine tasks (Battisti, Gatto, Parmeter, 2022). This phenomenon has implications for income distribution and the structure of the labour market.

Diffusion of innovation refers to how new technologies, products or ideas spread across markets and societies. Several theories explain this process.

Diffusion of Innovation Theory developed by Everett Rogers classifies innovation adopters into different groups based on their willingness to adopt new ideas (Rogers, Singhal, Quinlan, 2019). It highlights factors such as comparative advantage, concordance, complexity, observability, and experimentability that influence the adoption rate.

The theory of network effects suggests that the value of innovation increases the more people adopt it (Network Effect Theory, 2006). This creates a positive feedback loop, which speeds up the propagation process. Social media platforms and communication technologies often exemplify the power of network effects.

Diffusion across the country theory focuses on how innovations spread across different countries (Eaton, Kortum, 1999). It considers factors such as cultural norms, regulatory environments, economic conditions, and the role of multinational corporations in facilitating global outreach.

Exploration of these theoretical underpinnings can provide valuable insights into how organizations address the challenges and opportunities presented by technological innovation, labour market dynamics, and innovation diffusion. Moreover, understanding these theories can help design effective strategies to foster innovation, manage human capital, and adapt to evolving market conditions.

The adoption of artificial intelligence can influence macroeconomic patterns in multiple ways. Empirical evidence indicates that AI can improve productivity and foster innovation, thus contributing to economic growth (Hatzius et al., 2023). The implementation of AI-powered technologies has the potential to generate efficiency improvements across various industries, thereby promoting higher rates of growth in gross domestic product (GDP). According to research conducted by PricewaterhouseCoopers (PwC), the implementation of AI is projected to lead to a potential increase of up to 14% in global GDP by 2030. This increase in economic output is estimated to amount to approximately $15.7 trillion, thereby positioning AI as the most significant commercial prospect within the contemporary rapidly evolving economy (PwC, 2017). It is anticipated that the most significant benefits from AI will likely be observed in China, with a projected increase of up to 26% in its GDP by the year 2030, and in North America, which has the potential to experience a 14% boost (PwC, 2017). The sectors poised

to experience the largest advancements include retail, financial services, and healthcare, as AI is expected to enhance productivity, improve product quality, and stimulate consumption (PwC, 2017). Goldman Sachs Research suggests that the integration of tools that leverage advancements in natural language processing into various sectors of the economy and society may result in a substantial 7% surge in global GDP, equivalent to nearly $7 trillion, and a corresponding 1.5 percentage point boost in productivity growth over a decade (Goldman Sachs, 2023). According to the recent investigation of McKinsey & Company, the implementation of generative AI across the 63 use cases it analysed could result in an annual increase of approximately $2.6 trillion to $4.4 trillion (McKinsey & Company, 2023). The potential influence of Generative AI as a special kind of technology on productivity can contribute trillions of dollars in value to the global economy. Consequently, the overall impact of artificial intelligence could be enhanced by 15 to 40 per cent (McKinsey & Company, 2023). However, there are apprehensions regarding the possibility of job displacement because of automation, which could subsequently lead to alterations in employment trends and modifications in consumer expenditure patterns.

The consequences of AI implementation vary across different industries. For instance, manufacturing and logistics sectors may witness heightened automation of production and supply chain operations. Healthcare could derive advantages from AI-enabled diagnostic tools and personalized treatment strategies. Financial services might experience enhancements in risk evaluation and fraud identification through the utilization of AI algorithms. In accordance with the McKinsey & Company report, Generative AI is a special kind of technology that will make a big difference in many different types of businesses (McKinsey & Company, 2023). PwC outlines healthcare; automotive; financial services; transportation and logistics, technology, communications, and entertainment; retail, energy and manufacturing sectors as ones that provide the greatest opportunity for AI (PwC, 2017). These industries might see the most changes and improvements because of generative AI, which could make up a big part of their money earned. These impacts are reliant on the degree of AI preparedness and the distinctive characteristics of each industry.

The adoption of AI technology is causing significant changes in the labour market. The implementation of generative AI holds the capacity to revolutionize the nature of work, enhancing the abilities of workers by automating certain tasks they perform individually (McKinsey & Company, 2023). Specifically, there is a tendency for routine and repetitive tasks to be automated, which may result in job displacement in specific industries. The implementation of generative AI holds the capacity to revolutionize the nature of work, enhancing the abilities of workers by automating certain tasks they perform individually (McKinsey & Company, 2023). The implementation of Generative AI has the potential to significantly enhance labour productivity in various sectors of the economy. However, for this to be realized, it is imperative to allocate resources towards supporting workers during the transition of their work activities or career changes (McKinsey & Company, 2023).

Conversely, there is a growing need for individuals with expertise in AI development, data analysis, and problem-solving (Hedlund, Persson, 2022). Furthermore, AI platforms are exerting an impact on the gig economy by connecting freelancers with suitable projects (Adolfsson, 2020).

The socioeconomic consequences of integrating AI into society are complex and varied. Although AI has the potential to enhance productivity and improve overall well-being, there are apprehensions regarding its impact on employment, income inequality, and the potential for biased decision-making within AI systems (McKinsey Global Institute, 2018; Andersson, 2022; The White House, 2022; Darvas, Savona, 2022; Varsha, 2023). Consequently, it is crucial to adequately train and prepare the workforce for the changes brought about by AI, as well as to ensure fair and equal access to the benefits it offers (Bühler, Jelinek, Nübel, 2022; Morandini et al., 2023; Manjarrés et al., 2021).

Policy considerations are a central concern for policymakers as they navigate the complexities and possibilities associated with the integration of AI. Striking a delicate balance between promoting innovation and mitigating potential adverse outcomes is paramount. These deliberations primarily encompass matters about the safeguarding of data privacy, ethical implications of AI, protection of intellectual property rights, and the implementation of programs aimed at reskilling and retraining the workforce (Sartor, Lagioia, 2020, pp.79-81; Bankins, Formosa, 2023; Li, 2022).

The adoption of AI differs worldwide due to factors including technological infrastructure, regulatory environments, and investment in research and development. Developed economies with well-established AI ecosystems may encounter distinct outcomes compared to developing economies that are still in the process of enhancing their AI capabilities (Aly, 2020).

4. Discussion

The labour market has experienced substantial disruption and transformation due to the introduction of AI. This research demonstrates that the automation of routine and repetitive tasks has resulted in job displacement, but it has also led to the creation of new roles that demand higher cognitive and creative skills. These changes have far-reaching implications beyond unemployment rates, affecting income inequality, skill requirements, and the need for worker retraining initiatives. To ensure a harmonious integration of technological advancements and workforce resilience, policymakers and business leaders must work together to develop effective strategies (Delponte, 2018; United Nations, 2021).

The integration of AI into production processes has shown promise in improving productivity and stimulating economic growth. By facilitating more precise decision-making, effective allocation of resources, and streamlined operations, AI technologies contribute to

optimizing business performance. This study highlights the necessity of ongoing investment in research and development to fully harness the transformative potential of AI (QuantumBlack by McKinsey, 2022). At the same time, it emphasizes the significance of addressing potential obstacles such as data privacy issues and ethical considerations.

The transformative effects of AI are reconfiguring various industries and market structures. Conventional business models are being confronted, which has given rise to agile and innovative startups that capitalize on AI-generated insights to attain a competitive advantage (Kuzior, Sira, Brożek, 2023). This discourse highlights the necessity for established companies to adopt AI as a strategic priority, fostering an environment of flexibility and trial and error (Atsmon, 2023). Additionally, regulatory frameworks must adapt to guarantee equitable competition, safeguard intellectual property rights, and protect consumer well-being in this dynamically evolving landscape (European Commission, 2022).

The impact of AI reaches beyond the boundaries of individual nations, exerting influence on global economic dynamics and geopolitical relationships. This research advocates for the implementation of proactive policies aimed at fostering AI research, attracting skilled professionals, and facilitating international cooperation to position countries at the forefront of the AI-driven economy. Additionally, the establishment of ethical considerations and standards is imperative in guiding the global dissemination of AI and mitigating potential adverse effects.

The article illuminates the changing landscape of employment because of the integration of AI. This necessitates discussions regarding the possible displacement of specific job positions and the consequent requirement for retraining and enhancing the skills of the workforce. It is imperative to carefully analyse the ramifications of these changes on income inequality, wage systems, and social welfare initiatives. Additionally, it is crucial to explore the potential emergence of novel job classifications that are directly tied to AI development, upkeep, and supervision to comprehensively comprehend the overall impact on employment.

In the context of economic development, the ethical aspects of implementing AI have significant implications (Leslie, 2019; Stanford University HAI, 2021). The findings of this study emphasize the necessity of adopting responsible practices, promoting transparency, and establishing accountability to cultivate trust among consumers, businesses, and the broader society. It is crucial to take measures such as rectifying biases in AI algorithms, ensuring equitable access to the advantages of AI, and protecting individual rights to effectively leverage the potential of AI while minimizing any unintended negative outcomes.

Analysing the connection between advancements in AI, investments in research and development, and sustainable economic development can provide valuable insights into the potential long-term viability of AI as a catalyst for economic growth (Kuzior, Kwilinski, Tkachenko, 2019; Kwilinski, Tkachenko, Kuzior, 2019). Engaging in discussions regarding the environmental impact of AI technologies and how they align with broader sustainability objectives will be crucial in achieving a harmonious equilibrium between economic advancement and ecological conservation.

To sum up, this article conducts an analysis of the impact of artificial intelligence on the economy, delving into the potential for transformation and the obstacles that arise from integrating AI. The discussions presented to highlight the necessity for cooperative endeavours between governments, industries, and academia to navigate the changing economic terrain and optimize the beneficial effects of AI on society. With AI continuously shaping industries and redefining established economic frameworks, proactive and adaptable approaches will be essential for capitalizing on its potential for long-term economic development and the welfare of individuals.

5. Summary

The article explores the profound influence of AI on various economic facets and the broader implications for society. Highlighting the transformative potential of AI, the article delves into the theoretical foundations of economic theories related to technological innovation, labour market dynamics, and innovation diffusion and into the impact on macroeconomic patterns, industry-specific effects, transformations in the labour market, socioeconomic implications, policy considerations, and global variations. Additionally, the article discusses potential challenges related to labour market disruption and transformation; productivity enhancement, economic growth and sustainability; industry disruption and market dynamics; global competitiveness and technological leadership and ethical and social considerations stemming from the rapid integration of AI into economic systems. By examining both the opportunities and challenges, the article contributes to a comprehensive understanding of AI's role in shaping the economic landscape and offers insights for policymakers, businesses, and individuals navigating this evolving terrain.

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ETHICAL IMPLICATIONS AND SOCIAL IMPACTS OF INTEGRATING ARTIFICIAL INTELLIGENCE INTO SUSTAINABILITY EFFORTS

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Purpose: The article undertakes a comprehensive investigation into the intricate network of ethical implications and societal impacts that ensue from the integration of artificial intelligence (AI) into initiatives geared towards promoting sustainability. The article seeks to elucidate the complex interplay between AI technologies and sustainability initiatives.
Design/methodology/approach: The methodology of this article involves a systematic and thorough literature review process as well as analysis and generalization.
Findings: The paper contributes to a nuanced understanding of the ethical and societal implications of integrating artificial intelligence into sustainability efforts, offering valuable insights.
Originality/value: The paper holds value for researchers, policymakers, practitioners, and educators involved in artificial intelligence development, sustainability efforts, and ethical considerations.

Keywords: Artificial intelligence, sustainability, ethical implications, social impacts.

Category of the paper: Literature review.

1. Introduction

In the realm of sustainability, the incorporation of artificial intelligence offers a substantial potential for addressing environmental concerns, managing resources, education, and fostering social development in unprecedented manners (Pedemonte, 2020; Wright, 2023, Bilan et al, 2022; Skrynnyk et al., 2022). Nonetheless, as researchers embark on this technological shift towards a more sustainable future, it is crucial to carefully analyse the moral considerations and societal consequences associated with the implementation of AI in sustainability initiatives

(European Parliament, Directorate-General for Parliamentary Research Services, Fox-Skelly et al., 2020; Genovesi, Mönig, 2022).

Sustainability has become a key worldwide goal, aiming to reconcile economic development, environmental preservation, and social fairness for the benefit of present and future generations (Talan et al., 2020, Kuzior, 2014, 2010, 2007; Ciążela, 2006). Innovations in the field of green economy, green energy and fair society started to play a huge role (Vasylieva et al., 2019; Kuzior, Lobanova, 2020; Kuzior et al., 2022; Tutak et al., 2020; Chen et al. 2023; Dzwigol et al., 2021; Kwilinski et al., 2023; Starchenko et al. 2021; Sakiewicz et al., 2020; Kochmańska, 2019; Kochmańska, Karwot, 2015). Over the past years, artificial intelligence has been utilised to bolster sustainable efforts, providing evidence-based insights, predictive models, and automation to facilitate impactful decision-making (Bracarense et al., 2022; Standford University…, 2023; United Nations, 2022; Vinuesa et al., 2020).

This article aims to examine the complex connection between artificial intelligence, sustainability, ethics, and society. It is also vital to elucidate the profound impact that AI can have on sustainable practices, while still acknowledging the significant ethical and social considerations that come with its integration.

The integration of AI into sustainability initiatives holds significant potential to transform our approach to environmental issues and resource management (Francisco, 2023; Microsoft Corporation, n.d.; Yadav, Singh, 2023). Within the realm of AI-driven sustainability, it is crucial to acknowledge and confront the ethical predicaments that emerge during its execution (Bostrom, Yudkowsky, 2014; Hogenhout, 2021; Li, An, Zhang, 2021; McKinsey Company, 2019). The integration of AI into sustainability efforts has significant social consequences, in addition to ethical concerns (Bryson, 2019; Conklin et al., 2021; Oliver, 2022).

2. Methods

To fulfil the aim of the article, the research employs techniques such as literature review to gather, analyse, and synthesise relevant information from a wide range of sources; analysis to identify patterns, trends, relationships, and associations within data; generalisation to make broader statements or inferences based on the analysis of specific data or observations and tabular data presentation to organize and display data in a structured form.

The literature review is based on the Scopus database (TITLE-ABS-KEY ("cognitive technolog*" OR "artificial intelligence" OR "machine learning" OR "deep learning" OR "natural language processing" OR "robotics") AND TITLE-ABS-KEY ("sustainable development" OR "sustainability") AND TITLE-ABS-KEY (ethic*)) AND (LIMIT-TO (OA,

"all")) AND (LIMIT-TO (LANGUAGE, "English")) is the used searched query to gain 174 documents as a result.

Thus, the following questions emerge:

RQ1 – Is there any evidence of the connection between the area of application and the use of AI technologies?

RQ2 – What is the link between AI and SDGS?

RQ3 – What is the promise of AI in sustainability?

RQ4 – What are ethical considerations in AI-driven sustainability?

RQ5 – What are the social impacts of AI integration?

3. Results and discussion

The incorporation of artificial intelligence into sustainability initiatives has garnered increasing attention and scholarly investigation across diverse fields of study.

RQ1 regards the existence of evidence about the connection between the area of technology adoption and the use of AI technologies. Analysing the sample of selected articles from the areas of AI application perspective, papers considering Sustainable Development Goals (SDGs)have been the most numerous, representing 72,48% (126). The use of AI in healthcare has been found in 8,63% (15) of the articles. AI ethics has been discussed in 2,30% (4) papers. Regarding other areas such as algor-ethics, decision-making, education, and human-computer interaction, they have been cited by 1,15% (2). The rest of the areas have been represented in only one article. Figure 1 shows these percentages. The literature review of the selected articles through the AI lens shows that techniques of general AI have been addressed by 80,94% (140) of the selected articles. Both machine learning and robotics have been the focus of 8,67% (15), while representation learning had the attention of 12.20% (5). Deep learning, the combination of machine and deep learning and natural language processing have been addressed by just 0,57% (1) These percentages can be observed in Figure 2. The sample of selected articles has been initially examined according to the themes of the studied fields separately.

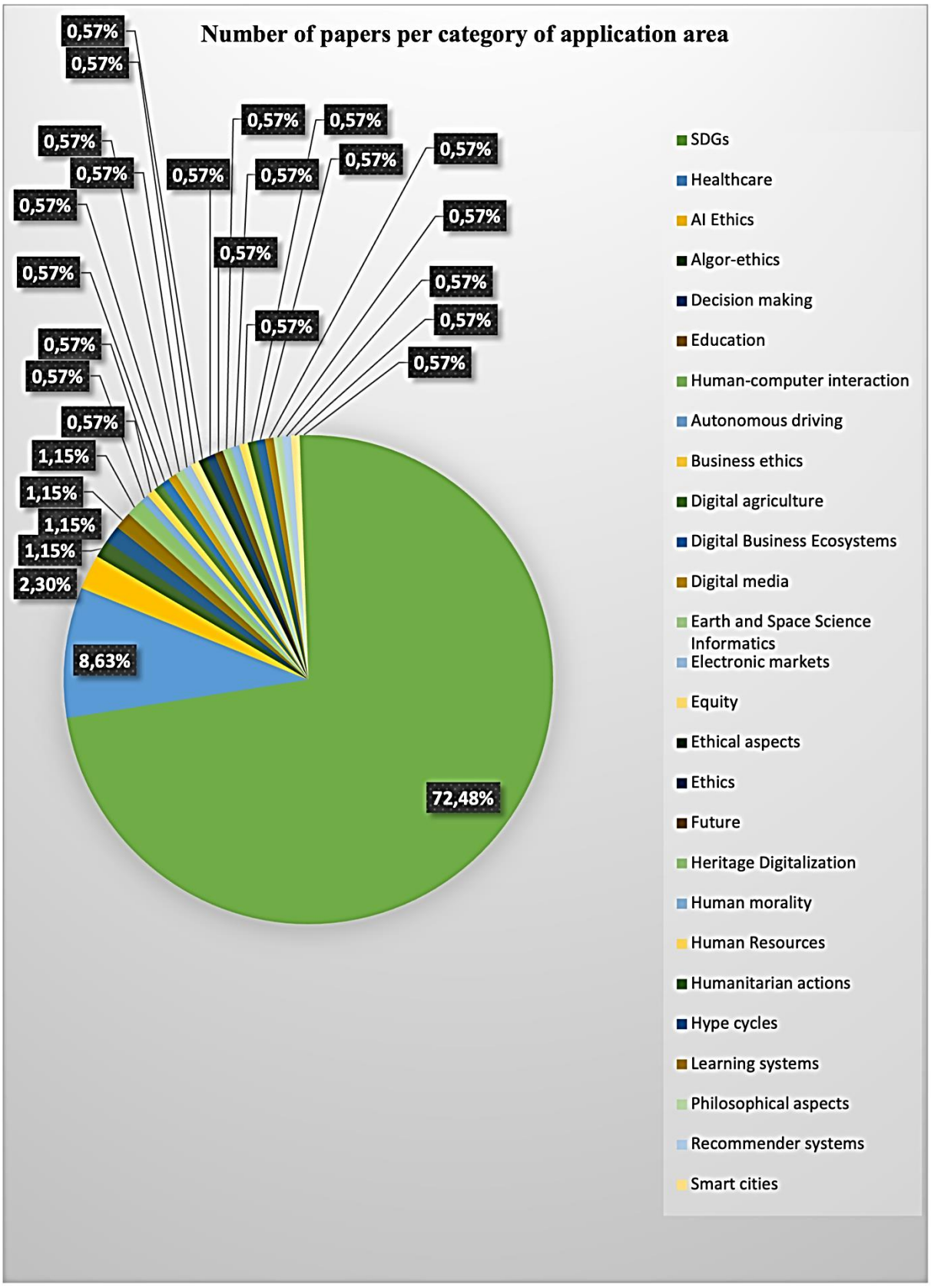

Figure 1. The number of papers of the sample studied per areas of adoption.

Source: developed by the authors.

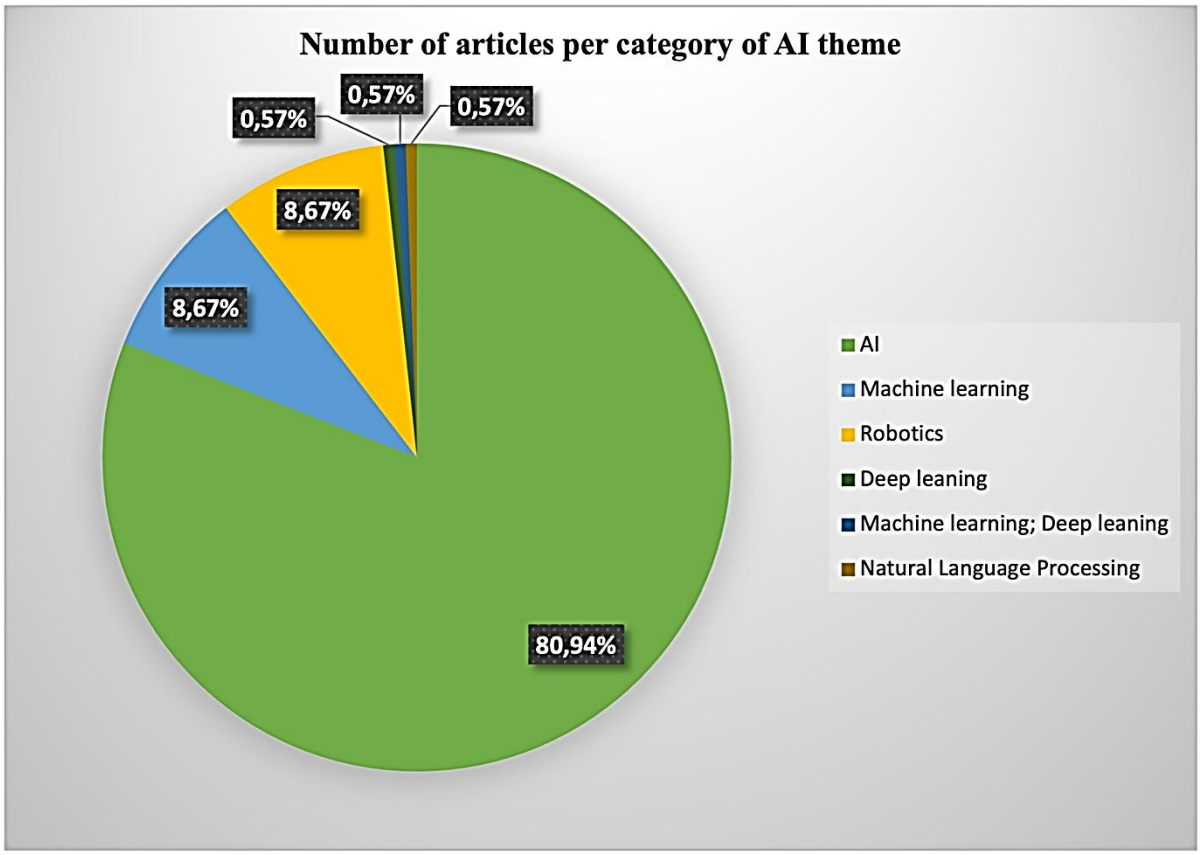

Figure 2. Number of articles by category of AI discipline found in the sample studied.

Source: developed by the authors.

Paying attention to the fact that research showed the link between SDGs and AI is a crucial and promising one, as AI has the potential to significantly contribute to achieving these global goals. RQ2 concerns the potential of AI in promoting sustainability. SDGs 17 (75 articles), 9 (38 articles), 4 (33 articles), 8 (28 articles), and 12 (22 articles) have been referenced the most. The data is represented in Table 1.

The role of AI in the mentioned SDGs is as follows. Goal 17: AI can facilitate collaborations between governments, businesses, academia, and civil society in addressing global challenges, fostering innovative solutions, and sharing knowledge to achieve the SDGs.

Goal 9: AI innovations drive advancements in various industries, facilitating technological progress and infrastructure development, which can contribute to economic growth and sustainable development.

Goal 4: AI technologies offer personalized learning experiences and educational content recommendations, supporting inclusive and equitable education, and enhancing learning outcomes for individuals with diverse needs.

Goal 8: AI's potential in automating repetitive tasks can free up human resources to focus on higher-value work, thus fostering economic growth and job creation in new and innovative industries.

Goal 12: AI is used to optimize resource use, minimize waste generation, promote circular economy practices, enhance supply chain management, and facilitate sustainable production

processes across industries, thus fostering more responsible and sustainable patterns of consumption and production.

Table 1.
Number of times SGDs have been mapped in the articles

SDG	Title of the SDG	Number of times
Goal 1	No poverty	9
Goal 2	Zero hunger	5
Goal 3	Good health and well-being	7
Goal 4	Quality education	33
Goal 5	Gender equality	4
Goal 6	Clean water and sanitation	1
Goal 7	Affordable and clean energy	3
Goal 8	Decent work and economic growth	28
Goal 9	Industry, innovation and infrastructure	38
Goal 10	Reduced inequalities	13
Goal 11	Sustainable cities and communities	15
Goal 12	Responsible consumption and production	22
Goal 13	Climate action	15
Goal 14	Life below water	3
Goal 15	Life on land	1
Goal 16	Peace, justice and strong institutions	17
Goal 17	Partnership for the goals	75

Source: developed by the authors.

As people embrace the transformative power of AI, it is essential to acknowledge and address the ethical concerns and societal consequences that arise from its integration into sustainability initiatives. The article also explores the ethical considerations and social impacts associated with incorporating AI into our pursuit of sustainability (RQ4 and RQ5).

As the use of AI becomes increasingly important in promoting sustainable practices, it is essential to thoroughly analyse the ethical issues related to its integration. The utilization of AI technologies is growing to optimize the management of resources, support environmental preservation, and enhance decision-making in sustainability projects (Jarosz, 2023; Kar et al., 2022; Mrówczyńska et al., 2019).

Data privacy and security are major concerns when it comes to AI systems, as they heavily rely on large amounts of data for learning and prediction purposes (Elliott and Soifer, 2022; The Economic Times, 2023). Within the realm of sustainability, these datasets may contain sensitive information about individuals, communities, and ecosystems. Therefore, it is crucial to prioritize the maintenance of data privacy and security and to establish the theoretical and methodological bases for employing parametric artificial intelligence technologies to safeguard the security of sustainable societal progress (Kwilinski et al., 2019). To prevent unauthorized access, data breaches, and potential misuse of personal information, responsible and ethical practices must be implemented in the collection, storage, and utilization of data (United Nations Development Group, n.d.). The implementation of robust data protection measures, consent mechanisms, and anonymization protocols is vital in safeguarding individual privacy and cultivating public trust in AI-driven sustainability endeavours (European Commission, 2019).

Algorithmic bias and fairness are significant issues in the field of artificial intelligence (Myers, Nejkov, 2020). AI algorithms can be influenced by biases that are present in the data they are trained on. This can have negative implications in the context of sustainability, as biased AI models may unintentionally contribute to environmental injustices and worsen existing inequalities in vulnerable communities (European Union Agency for Fundamental Rights, 2022). To tackle this challenge, developers must actively work to identify and address bias in AI systems. This can be achieved through the utilization of diverse and representative datasets, conducting regular assessments to identify bias, and employing algorithms that prioritize fairness and equity (Schwartz et al., 2022).

The lack of transparency and accountability in certain AI models gives rise to concerns regarding their ability to be understood and held responsible (Larsson, Heintz, 2020; Loi, Spielkamp, 2021). In sustainability initiatives, it is crucial to ensure that AI-driven decisions can be explained and comprehended by stakeholders. Transparent AI systems enable individuals and communities to grasp the rationale behind decisions that impact their lives, fostering trust and acceptance (Rubin, 2020). Additionally, it is imperative to establish mechanisms for holding AI accountable, as it should not be deployed without oversight and accountability (Busuioc, 2020).

AI systems, despite their advanced capabilities, have the potential to generate unforeseen outcomes. Within the realm of sustainability, these unintended consequences may encompass unanticipated environmental ramifications, unforeseen disruptions in ecological systems, or inadvertent social repercussions (Galaz et al., 2021). Consequently, it is imperative to undertake thorough risk assessments before incorporating AI into sustainability endeavours and to maintain continuous vigilance in monitoring for unexpected effects.

The incorporation of AI in sustainability endeavours carries various societal ramifications that necessitate thorough examination. Although AI offers considerable potential in promoting environmental preservation and efficient resource utilization, it also presents certain societal obstacles that require careful attention.

Job displacement and economic inequality are significant societal issues that arise from the integration of AI (Sholler, Macinnes, 2022). The increasing prevalence of AI-driven automation across industries has the potential to render certain job positions obsolete or require fewer human workers. Consequently, this may result in disruption within the workforce and contribute to disparities in economic conditions, especially for individuals employed in sectors heavily affected by automation.

To alleviate these consequences, it is imperative to adopt proactive strategies that focus on reskilling and upskilling the labour force for new positions that are compatible with AI technologies (Kuzior et al., 2021; The White House, 2022). Allocating resources towards educational and training initiatives aimed at equipping individuals with the requisite proficiencies for employment in the AI era can contribute to the promotion of economic fortitude and the mitigation of inequality.

The incorporation of AI often necessitates access to powerful computational resources, high-speed internet connectivity, and proficiency in managing intricate algorithms (National Artificial Intelligence…, 2023). In areas or communities with limited access to these resources, there exists a potential for exclusion from the advantages offered by AI-driven sustainability endeavours.

To tackle the issue of unequal access to technology, it is imperative to prioritize the development of digital literacy and equal availability of AI technologies and data (Imran, 2022). By fostering partnerships between governmental entities, businesses, and civil society, the gap can be narrowed, thereby guaranteeing that the transformative abilities of AI are accessible to individuals across various geographical locations and socioeconomic backgrounds.

The attainment of successful incorporation of AI in sustainability initiatives is contingent upon social acceptance and cultural considerations. Diverse societal perspectives and attitudes towards AI may lead to certain communities expressing hesitancy or concerns regarding the adoption of AI technologies in their everyday lives or environmental practices (Bao et al., 2022).

The implementation of AI technologies has the potential to cause changes in power dynamics both on a societal and organizational level (Kuzior et al., 2019). The utilization of AI enables decision-makers to efficiently access and analyse large quantities of data, granting them previously unattainable insights and influence (Mikalef, Gupta, 2021). However, this centralization of power may raise apprehensions regarding the transparency and accountability of decision-making processes.

Promoting democratic and participatory decision-making processes in the implementation of AI for sustainability can assist in addressing potential power disparities. Involving various stakeholders through extensive consultations and integrating a wide range of perspectives can bolster the credibility and efficacy of AI-driven approaches.

4. Conclusions

The promise of AI in sustainability is vast and transformative. AI technologies offer innovative solutions to address complex environmental challenges, optimize resource management, and drive social progress. However, to fully realize this promise, it is essential to address ethical considerations, mitigate potential social impacts, and ensure responsible AI deployment.

As we embrace the potential of AI in advancing sustainable development, it is crucial to address ethical implications, ensure equitable access to AI technologies, and promote responsible AI governance. By harnessing the power of AI while upholding ethical principles

and inclusivity, people can collectively work towards building a more sustainable and prosperous future for all. Ethical considerations play a central role in the pursuit of sustainability through AI. The incorporation of artificial intelligence in sustainability initiatives has notable societal consequences that necessitate attention to facilitate a just and equitable shift towards a sustainable tomorrow.

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DETERMINANTS OF BANK MARKET VALUATION: A REVIEW OF THE LITERATURE

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Purpose: Well-functioning banks are essential for the proper development of any economy. In addition, with the development of capital markets, capitalisation has been growing on local stock exchanges. However, the number of listed banks is still limited. These observations make it important to isolate the factors that shape market valuation of banks. This paper reviews the empirical literature on market valuation of banks and classifies the determinants of valuation.
Design/methodology/approach: Review of the literature based on an analysis of 30 publications on the market valuation of banks.
Findings: The factors that affect bank market valuation can be divided into a number of categories. The first category focuses on the connections between market value and financial aspects of banks. The relationship between the components of bank corporate governance and market valuation is discussed in the second group. We can distinguish between elements relating to boards, ownership structure, and other corporate governance elements in this group. The final section of the literature focuses on external variables that are unrelated to specific bank choices. Additionally, it is clear that Tobin's Q and MTB ratio serve as the two primary indicators of bank market valuation.
Research limitations/implications: There are not many research looking at the factors that affect the market value of banks in emerging markets. A study of the market value of banks from these economies could be an important issue for future research.
Practical implications: Knowing the elements that influence the market value of banks may be useful for investors considering investing in bank shares**.**
Originality/value: This literature review focuses on isolating external and internal factors that the empirical literature has examined in the context of bank market valuation. This allows us to capture a potential research gap in this topic.

Keywords: banking; market value of bank, literature review.

Category of the paper: literature review.

1. Introduction

A number of studies has examined the market valuation of publicly traded non-financial institutions (Boubakri et al., 2018; Ferris, Park, 2015; Gunasekarage et al., 2007). Research focused on market valuation of banks is still limited. With the development of capital markets, more and more companies are listed on stock exchanges, but the number of listed banks is still limited. The market value of a bank may be helpful in determining whether investors are willing to invest in it (Vo 2017), so it is important to isolate factors that determine a valuation.

This review of the literature lists the most relevant publications on the market value of banks and classifies valuation determinants. There have been no similar literature reviews found, ensuring the originality of this work. Identified factors shaping the market value of banks fall into several categories.

The first group focuses broadly on bank financial variables and market value. Financial variables are seen as indicators based on the financial statement of banks. The second group of papers investigates the effect of various corporate governance elements on market valuation of banks. Some of these papers are on board-related indicators, including CEOs. Another body of corporate governance literature focuses on the type of the major shareholder and ownership concentration One of the analyzed studies examines the role of shareholder protection laws in shaping bank market value. Corporate governance research also includes elements unrelated to ownership structure or boards. These elements are bank sustainability reports, intellectual capital components and Environmental, Social and Corporate Governance (ESG) activities. The last group of papers studies external determinants, which are not influenced by financial or corporate governance variables: the role of institutional reforms and the effect of policy uncertainty. In most studies cited in this review, the market value of a bank is measured using the Tobin's Q ratio, the market-to-book ratio, or both. Analyzed studies employ a single-country, cross-country or a regional analyse.

2. Bank financial variables and market valuation

In the banking literature, a substantial amount of effort has been devoted to the determination of the relationship between market valuation and bank financial variables. A frequently discussed topic is the impact of different types of diversification on valuation. Researchers often consider a diversification of revenue (Baele et al., 2007; Elsas et al., 2010; Guerry, Wallmeier, 2017; Sawada, 2013; Vo, 2017) or geographical diversification (Yildirim, Efthyvoulou, 2018). Another set of studies based on bank financial indicators examines the relationship between loan growth rate and market value (Hoang et al., 2020; Niu, 2016). A less

frequently discussed topic is the effect of bank size (Avramidis et al., 2018; Sakawa et al., 2020) and association of market value with efficiency (Fu et al., 2014), market power (Fang et al., 2014) and market discipline (Haq et al., 2019).

Revenue diversification is often examined on the basis of single-country dataset. Vo (2017) checks the relationship between revenue diversification and the market value of Vietnamese commercial banks over the period 2006-2013. Market valuation is measured by Tobin's Q ratio and market-to-book ratio. The results show a negative relationship between bank diversification strategy and stock market valuation. This implies that investors prefer banks that focus on traditional activities. At the same time, additional research reveals that investors prefer diversification of large banks. Sawada (2013) conducts very similar research on Japanese banking sector. Market valuation is measured by the same indicators as Vo (2017) uses. The sample includes 113 publicly traded banks and bank holding companies from Japan over the period 1999-2011. In contrast to Vo (2017) research, Sawada (2013) shows that higher degree of revenue diversification is related to a higher valuation. A positive effect of revenue diversification on valuation is stronger for bank holding companies than for independent banking organizations. Guerry and Wallmeier (2017) examine the effect of income diversification on bank valuation using a much larger sample of banks from 35 countries. The sample covers the period 1998-2012 and includes banks of various types: commercial banks, bank holdings & holding companies, investment banks, cooperative banks, savings banks, and real estate & mortgage banks. The main dependent variable is Tobin' Q ratio. As an alternative measure of valuation authors use a market-to-book ratio. The results depend on the subperiod. In the first subperiod 1998-2006, a higher diversification measure affects valuation negatively. On the contrary, during subperiod 2007-2013, there is a positive link between income diversification and market value. The authors consider the results for regional differences between the US, Europe and Japan. They find a diversification discount in all three regions.

Laeven and Levin (2007) use measures of diversification based on asset diversity and income diversity. As a measure of market valuation they use an excess value which is the difference between actual Tobin's Q and activity-adjusted Tobin's Q. They use a large sample of financial conglomerates from 43 countries over the period 1998-2002. The results indicate that both income and asset diversity are negatively linked to excess value. This means that financial conglomerates that engage in multiple activities are being valued lower than those that focus on individual activities. Fang et al. (2014) capture diversification in two dimensions. Using the sample of banks from Central European countries over the period 1997-2008, they show that both loan and asset diversification are negatively associated with Tobin's Q. Baele et al. (2007) introduce more than two measures of diversification. The main aim of the research is to analyze long-term performance of banks using Tobin's Q ratio. Baele et al. (2007) use four measures of diversification based on loans, assets, non-interest income and total operating income. The dataset covers 143 banks from 17 European countries over the period

1989-2004. As a measure of a long-term performance Baele et al. (2007) use a modified version of Tobin's Q. Results show that a higher share of non-interest income in total income enhances long-term profitability measured by Tobin's Q ratio. Revenue diversification may affect market valuation indirectly. Elsas et al. (2010) examine a relationship between revenue diversification and market valuation on the sample that covers 380 large banks from nine developed countries over the period 1996 – 2008. They show that there is no significant relationship between diversification and valuation measured by market-to-book-ratio. To overcome this issue, Elsas et al. (2010) consider a spread, which is the difference between return of assets and cost of equity. Revenue diversification enhances spread. Spread has a strong, positive effect on market valuation and, in consequence revenue diversification increases bank market valuation. This result is robust for alternatives measures of diversification and for alternative subsamples.

In some studies, diversification refers to a number of subsidiaries. Yildirim and Efthyvoulou (2018) consider the impact of geographic diversification on market valuation of banks. Three measures of geographic diversification are used: inter-regional diversification, intra-regional diversification and the sum of these two. Inter-regional diversification refers to a diversification across different regions. Intra-regional diversification refers to a diversification within a single region, where the bank is already present. Yildirim and Efthyvoulou (2018) examine 160 largest banks across the world over the period 2004 – 2013, originating from both developed and emerging countries. The main measure of market valuation is Tobin's Q. For robustness test, they use market-to-book ratio. Two key results emerge for Tobin's Q as a dependent variable. Firstly, geographic diversification is positively linked to market valuation for banks from emerging markets, but not for banks from developed markets. Secondly, while higher levels of intra-regional diversification improve market valuation, higher levels of inter-regional diversification have a negative effect on the valuation of banks from emerging markets. The results for market-to-book-ratio support earlier findings. Chahine (2007) considers the diversity of activities conducted by commercial banks as a diversification measure. The main explanatory variable is an activity-based diversification index, which equals to the total number of activities as reported by commercial banks in their annual reports. The sample includes 41 banks from countries belonging to the Gulf Cooperation Council over the period 2002 – 2004. Unlike other studies, Chahine (2007) uses price-to-book and price-to-earnings as measures of bank valuation. The findings show a positive effect of activity-based diversification index on both prices-to-book and price-to-earnings indexes.

In the banking literature, a loan growth rate is also a topic addressed in relation to market valuation. Niu (2016) examines the relationship between loan growth rate and market valuation. The sample includes 632 bank holding companies from US in the period 2002 – 2013. Niu (2016) uses Tobin's Q ratio and market-to-book-ratio as measures of valuation. The results suggest that faster loan growth is associated with higher measures of market value. When the main sample is divided into size groups, there is a positive relationship between loan growth rate and market value at small and medium banks, but not at large banks. Niu (2016) checks

whether the positive relation between loan growth and valuation holds under different market conditions. To do this, Niu (2016) divides the sample period into three periods: before crisis, during the crisis, and after crisis. The outcomes reveals that faster loan growth is related to higher market valuation in each period. The effect of loan growth on market valuation is also studied on a smaller sample of bank from one country. Hoang et al. (2020) focus on eight commercial banks from Vietnam over the period 2012-2019. As a proxy of bank valuation, Tobin's ratio is used. The results show that faster loan growth rate enhances the Tobin's Q ratio. Further investigation indicates that a positive link between loan growth and Tobin's Q exists in private and small banks, but the relationship is not significant in state-owned and large banks.

Another factor examined in the context of market valuation is bank size. Sakawa et al. (2020) check whether the valuation of large Japanese commercial banks is negatively associated with their size, as is the case with US banks. The authors focus on Japanese "too-big-to-fail" banks. "Too-big-to-fail-banks" are defined as banks that have an impact on national economic system and whose failure could result in a financial crisis. The sample includes 135 publicly listed banks over the period 1987-2017. To examine the relationship between size and market valuation, the pre-crisis period 1987-2006 is compared with the entire period 1987-2017. Market valuation is measured by Tobin's Q ratio and market-to-book ratio. The findings suggest that market valuation of Japanese "too-big-to-fail" banks is not significantly related to their size, both during the pre-crisis period 1987-2006 and over the entire period of 1987-2017. The effect of bank size on market value may be non-linear. In bank holding companies from US over the period 2001-2015 the relationship between bank size and Tobin's Q is inverse-U shaped (Avramidis et al., 2018).

Bank-specific factors which affects bank market valuation are market power (Fang et al., 2014) and efficiency (Fu et al., 2014). Market value is also used to estimate a charter value of bank (Haq et al., 2019). Fang et al. (2014) examine the role of market power in shaping market valuation in 68 banks from Central and Eastern European countries over the period 1997-2008. Market power is measured at the individual bank level by the Lerner index. The findings reveal that higher degree of market power significantly enhances Tobin's Q of banks. Fu et al. (2014) examine profit and cost efficiency of 688 commercial banks from 12 Asia-Pacific economies over the period 2003-2010. Two dependent market-based variables are used: Tobin's Q ratio and market-to-book ratio. The results suggest that market valuation is positively linked to improvements in both cost and profit efficiency. The results remain very similar for market-to-book ratio. Haq et al. (2019) study the link between a charter value and market discipline. The charter value is estimated by Tobin's Q ratio. Haq et al. (2019) use deposit growth, subordinated debt and interbank deposits as a market discipline. The sample includes 16 domestic banks from Australia and Canada over the period 1995-2011. On average, market discipline increases the charter value. The shape of this relationship depends on bank specific characteristics like bank capital, contingent liabilities, fee income and the Global Financial Crisis (GFC). Interbank deposits enhance charter value when banks have higher bank capital.

A higher fee-based income reduces charter value. In addition, a positive relation between market discipline and bank charter value is weaker in the post-GFC period.

The opacity of banks in the post-crisis period became an increasingly popular topic. Zheng and Wu (2023) define bank opacity as the degree of uninformativeness in the evaluation of bank asset quality. Using a sample of bank holding companies in the United States, authors find a negative relationship between opacity and valuation during the 2007-2009 crisis.

Some studies consider multiple financial factors in order to isolate those which influence bank market value. Simoens and Vennet (2021) investigate the determinants of the market-to-book ratios of 112 European and US banks over the period 2007-2017. Several key conclusions emerge from the study. For the entire sample, the most important driver of market value is profitability. Higher bank profitability increases market-to-book ratio of European and US banks. For European banks, a higher share of non-performing loans reduces bank market valuation. For both European and US banks, adequate provisioning of loan losses is positively linked with bank market value. Simoens and Vennet (2021) find a negative relationship between low policy rates and market value of banks from European markets. Table 1 provides a summary of papers that are presented in this section.

Table 1.
Comparison of the studies based on the financial indicators of banks

Authors	Topic	Country	Sample size	Period
Vo, 2017	Diversification and market valuation	Vietnam	all banks listed on the Ho Chi Minh City stock exchange	2006-2014
Sawada, 2013	Diversification and market valuation	Japan	113 bank and bank holding companies	1999-2011
Guerry, Wallmeier, 2017	Diversification and market valuation	35 countries	18221 bank-year observations	1998-2012
Laeven, Levin, 2007	Diversification and market valuation	43 countries	3415 bank-year observations	1998-2002
Fang et al., 2014	Diversification and market valuation	11 Central and Eastern European countries	68 banks	1997-2008
Baele et al., 2007	Diversification and market valuation	EU15 countries, Norway, Switzerland	255 banks	1989-2004
Elsas et al., 2010	Diversification and market valuation	Canada, France, Germany, Italy, UK, USA, Spain and Switzerland	380 banks	1996-2008
Yildirim, Efthyvoulou, 2018	Diversification and market valuation	56 countries	160 banks	2004-2013
Chaine, 2007	Diversification and market valuation	Gulf Co-Operation Council countries	41 banks	2002-2004
Niu, 2016	Loan growth and market valuation	US	632 bank holding companies	2002-2013
Hoang et al., 2020	Loan growth and market valuation	Vietnam	8 banks	2012-2019

Cont. table 1.

Sakawa et al., 2020	Bank size and market valuation	Japan	135 banks	1987-2017
Avramidis et al., 2018	Bank size and market valuation	US	Bank holdings companies listed on NYSE, AMEX and NASDAQ	2001-2015
Haq et al., 2019	Market discipline and market valuation	Australia and Canada	16 banks	1995-2011
Fu et al., 2014	Efficiency and market valuation	12 Asia-Pacific countries	688 banks	2003-2010
Simoens and Vennet, 2021	Determinants of bank market valuation	16 European countries and US	112 banks	2007-2017

Source: Author's own study.

3. Corporate governance elements and market value

In recent years, bank corporate governance mechanism have been become increasingly important for the proper functioning of economic systems (Andries et al., 2018). Market valuation of banks has been started to be analyzed in a relation with numerous elements of corporate governance elements. Corporate governance studies focus on the link between board-related factors, including CEOs. and market value of banks (Alharbi et al., 2002; Arouri et al., 2014; Belkhir, 2009; Elnahass et al., 2022; Ghosh, 2017; Onali et al., 2016; O'Sullivan et al., 2016; Zulkafali, Samad, 2007). The second topic discussed in the banking literature is the effect of ownership structure on market valuation (Arouri et al., 2014; Busta et al., 2012; Caprio et al., 2007; Zulkafali, Samad, 2007). In addition to these two areas, studies investigate the role of corporate governance elements that are neither related to boards nor ownership structure (Azmi et al., 2021; Carnevale, Mazzuca, 2014; Nsour et al., 2021).

3.1. Boards and CEOs

The existing body of the literature tends to focus on the relationship between boards traits and bank profitability measured by ROA (Farag, Mallin, 2017; Chen, Ebrahim, 2018; Kick et al., 2017; Sarkar et al., 2019). There are fewer studies on the market value of banks. The literature on the banking corporate governance investigates whether gender of board members is linked to market valuation of banks. Alharbi et al. (2002) use a sample of 153 banks for the period 2007-2017 for 12 developing countries. Alharbi et al. (2002) employ a Tobin's Q ratio as a measure of market value. The results show that the presence of women directors on the board increases market value. Alharbi et al. (2002) show evidence that women as independent members are positively linked to market value, whereas women acting as a chairperson have no association with market value. Ghosh (2017) checks whether gender diversity impacts bank profitability measured by Tobin's Q. The sample includes 40 banks from

India over the period 2003-2012. Ghosh (2017) considers the share of women directors on the board and cases woman as CEO. In addition, Ghosh (2017) divides females directors into executives and non-executives, to determine which category matters for bank valuation. The results suggest that the presence of women directors does not have a significant relationship with market valuation. These findings remain unchanged when executive members are compared to non-executive.

Authors usually consider more board-related traits than gender. Zulkafali and Samad (2007) employ a dataset based on 107 banks from nine Asian emerging markets in 2004. They use market value measured by Tobin's ratio to determine bank corporate profitability. As board variables, they use CEO duality, board independence and board size. The findings suggest that the number of independent directors on the board and CEO duality do not affect Tobin's. CEO duality has no significant relationship with Tobin's Q but it is negatively related with ROA. Finally, board size has no significant relationship with either Tobin's Q or ROA. Elnahass et al. (2022) construct a complex board index to check whether compensation schemes of boards affect stock market valuation. Board compensation is measured as the level of total compensation which includes directors' annual salaries, meeting and committee fees, bonuses and in-kind benefits. Elnahass et al. (2022) employ a sample of 27 Islamic banks and 43 conventional banks from 11 countries over the period 2010-2015. Unlike the research of other authors, Elnahass et al. (2022) use a market capitalization to measure bank market value. Results indicate that higher director compensation is significantly and positively valued by the market. For Islamic banks, there is an insignificant relationship between board compensation and market capitalization. For conventional banks, Elnahass et al. (2022) find a positive association between board compensation and bank value. The authors test the effect of bank age by comparing matured banks with young banks. In case of conventional banks, the effect of board compensation on market valuation is the same in both young and matured banks. For Islamic banks, there is a positive relation between board compensation and bank value in young banks, but not in matured ones.

Studies on links between board characteristics and market value are also conducted for banks from the Gulf Cooperation Council (GCC) and for bank holding companies from US. Arouri et al. (2014) explore the effect of board composition on bank market valuation measured by Tobin's Q and market-to-book-ratio, using a sample of 68 listed banks from GCC countries in 2010. Board-related variables include board size and CEO duality. Board size and CEO duality do not have a significant effect on bank value, which implies that bank boards in GCC countries are not be an effective mechanism to ensure better corporate governance. O'Sullivan et al. (2016) examine the relationship between board characteristics and market valuation of 150 US bank holding companies over the period 1999-2009. The authors consider the following board traits: CEO tenure, average of the tenure of each board member (BOD tenure), CEO duality, board size and the proportion of outsiders on the board. The outcomes imply that a larger board increases Tobin's Q. Both CEO tenure and BOD tenure have a positive effect on

market value. An event when the CEO is the chair of the board (CEO duality) does not affect Tobin's Q. O'Sullivan et al. (2016) test whether the effect of board characteristics on Tobin's Q is different during the crisis period. While a larger board enhances the market value of bank holding companies during the normal times, the link becomes negative. The explanation of this result is that large boards are unable to respond quickly to bank problems. The proportion of outsiders, CEO duality, CEO tenure and BOD tenure have no effect on Tobin's during the crisis.

In presented papers, the board size is one of the many factors studied. In some research, the board size is the main topic. Belkhir (2009) investigates the relationship between board size and market profitability measured by Tobin's Q in US banking organizations: bank holding companies and savings-and-loan holding companies over the period 1995-2002. Belkhir (2009) finds that larger boards improve market valuation. The relation between board size and market profitability is similar in both bank holding companies and savings-and-loan holding companies. Some authors focus on the role of CEOs. Onali et al. (2016) consider the role of CEOs in shaping the market value of banks. Their study sample includes 109 banks from 15 EU countries over the period 2005-2013. Onali et al. (2016) examine CEO power, which consists of factors such as the equity stake of the CEO in the bank, CEO unforced turnover and CEO tenure. Market value of banks is measure by Tobin's Q ratio and market-to-book ratio. Results indicate that CEO ownership decreases current market value and the market value of the next year. For unforced CEO turnover there is a small, positive effect on the current market value and future valuation up to one year. Longer CEO tenure is associated with lower present and future market value.

3.2. Ownership structure

Another element of corporate governance is the ownership structure of banks. Busta et al. (2012) examine the relationhip between ownership concentration and market value of banks. In addition, they study the role of the institutional environment in shaping this relationship. The sample consists of 358 commercial banks from 17 Western European countries over a period 1993-2005. To investigate whether the relationship between ownership concentration and market value is influenced by the institutional environment, Busta et al. (2012) specify four dummy variables corresponding to the main legal origins including the French, English, German and Scandinavian systems. The results indicate that a higher level of ownership concentration is associated with lower market value measured by Tobin's Q. When sub-sampling is considered, higher ownership concentration results in a lower bank valuation particularly in countries from the German legal family, while the effect of ownership concentration on valuation is positive in Scandinavian countries.

Zulkafali and Samad (2007) examine the effect of ownership concentration and type of major shareholder on market value measured by Tobin's Q. The sample includes 107 banks from seven Asian countries in 2004. The findings show that a higher level of ownership concentration is negatively related to Tobin's. When an origin of shareholder is considered,

the presence of both foreign and government investors decreases market valuation. Onali et al. (2016) consider a type of a major shareholder as well. Using the sample of 109 banks from 15 EU countries over the period 2005-2013, they show that the state shareholder has no significant impact on either current or future market profitability. Results are held for both Tobin's Q and market-to-book ratio. Abraham (2013) focuses on a smaller sample of ten publicly traded banks from Saudi Arabia over two-year period. Abraham (2013) tries to identify differences between foreign and domestic banks in terms of performance metrics. One of the performance metrics is market valuation measured by Tobin's Q ratio. Abraham (2013) shows that domestic banks have superior market value in relation to foreign ones. Caprio et al. (2007) use a much larger sample that consists of 244 banks across 44 countries at the end of 2001. The research focuses on shareholder's cash-flow rights and shareholder protection laws. Bank market value is measured by Tobin's Q ratio and market-to-book ratio. The findings suggest that a higher level of cash-flow rights by a controlling shareholder increases bank market value. In addition, weak legal protection of minority shareholders decreases valuation. Greater cash-flow rights by a controlling shareholder is positively associated with valuation of banks in countries with weak legal protection of minority shareholders. Last but not least, Arouri et al. (2014) check the effect of different types of shareholders (family, institutional, government, foreign) on market valuation. They consider banks from countries belonging to the Gulf Cooperation Council in 2010. The study finds that family ownership has a positive influence on bank market valuation measured by Tobin's Q and MTB ratio. The findings reveal that there is a positive link between the foreign ownership and market valuation for both measures. The presence of an institutional investor in the ownership structure boosts market valuation. Conversely, state ownership has no relation with bank value.

3.3. Other elements of corporate governance

Corporate governance in banking includes also elements unrelated to ownership structure or management boards: sustainability reports (Carnevale, Mazzuca, 2014), intellectual capital (Nsour et al., 2021), ESG activities (Azmi et al., 2021; El Khoury et al., 2023) or Corporate Governance Responsibility (Komath et al., 2023).

Carnevale and Mazzuca (2014) study the importance of publishing sustainability reports by banks in shaping their market value. The sample includes 176 listed banks from 14 Western European countries over the period 2002-2011. The market value of banks is measured using quarterly stock prices. The descriptive statistics show that banks that do not publish sustainability reports have higher stock prices than banks publishing sustainability reports. The regression results reveal that there is a relationship between publishing sustainability reports and stock prices which means that investors appreciate the additional information offered by the sustainability reports.

Nsour et al. (2021) check whether there is a link between intellectual capital measured by Value Added of Intellectual Capital and financial performance of commercial banks from Jordan over the period 2010-2018. The financial performance equals to Tobin's Q. Value Added by Intellectual Capital is a complex variable computed as the sum of three components: human capital, structural capital and employed capital. It can be concluded that only human capital efficiency and capital employed efficiency have statistically significant effect on Tobin's Q. In addition, human capital efficiency has a greater impact on Tobin's Q than capital employed efficiency. This may suggest that banks should focus on human resources to build up their knowledge and capabilities.

Azmi et al. (2021) consider the link between ESG activity and bank market valuation. The studied sample includes 251 banks from 44 emerging markets over the period 2011-2017. The market valuation is measured by Tobin's Q ratio. For full ESG variable, a non-linear relationship is confirmed: low levels of ESG positively affect market value measured by Tobin's Q, while higher levels of ESG decreases Tobin's Q. Further, Azmi et al. (2021) separate ESG into individual measures of environmental, social and governance characteristics. When the individual ESG dimensions are considered, the results indicate that only environmental factors are relevant i.e. they are positively linked to market value. El Khoury et al. (2023) investigate the impact of ESG on valuation using the sample of 46 banks from Middle East, North Africa and Turkey between 2007-2019. A negative impact is observed for full ESG variable. When components of ESG are considered separately, social factors have a concave relationship with Tobin's Q, environmental elements have a convex relationship, while corporate governance factors are not significantly linked to market value. The relationship between ESG and market value is also examined using a single-country approach. Menicucci and Paolucci (2023) consider the Italian banking sector over the period 2016-2020. The sample includes 105 banks. The findings suggest that ESG policies have a negative impact on market value. When ESG dimensions are measured individually, none of the components is significantly related to Tobin's Q.

A topic closely related to ESG is Corporate Governance Responsibility (CSR). CSR is the concept that a company should play a good role in the community and take into account the environmental and social consequences of business actions. Komath et al. (2023) use Refinitiv's CSR strategy scores to analyze the market value of 2342 banks in 43 countries over the period 2017-2021. The authors discover a positive relationship between CSR strategy scores and the market value, implying that investors reward banks with effective corporate governance mechanisms.

4. External elements and market valuation

External determinants of market valuation are related with factors which are not influenced by a specific bank's decision and policies, but by events outside of banks. Fang et al. (2014) examine the role of institutional reforms in affecting valuation measured by Tobin's Q ratio. The sample includes 60 banks from 11 Central and Eastern European (CEE) countries over the period 1997-2008. Fang et al. (2014) consider banking, security market and legal reforms. The findings suggest that the bank valuation increases significantly after CEE countries reform their legal institutions and liberalize the banking system. Conversely, valuation decreases after stock market reforms. The second topic related with government policies and regulatory frameworks is the economic policy uncertainty (EPU). He and Niu (2017) investigate the effect of economic policy uncertainty on bank market valuation. The studied sample consists of bank holding companies from US through the period 1990-2015. The bank market valuation equals Tobin's Q ratio. The EPU measure is based on frequency counts of newspaper articles that contain terms about economy, policy and uncertainty. The authors find a negative relationship between EPU index and Tobin's Q which is explained by the fact that EPU reduces bank loan growth, and lower loan growth decreases bank market value. The decreasing effect of EPU on market value is stronger for banks with higher ratio of loans to total assets.

The acts of central banks have an impact on the market value as well. Andreeva et al. (2023) examine the impact of the March 2020 European Central Bank recommendation that banks do not pay dividends or buy back shares on their market values. The recommendation referred to dividends to be paid from profits earned in 2019 and 2020. The research is conducted on the sample of 40 euro area banks in year 2020. The findings suggest a negative impact on bank share prices during the two weeks following the announcement of the recommendation.

5. Conclusions

This study presents a review of the literature on market valuation of banks and identifies factors that shape valuation. The first conclusion is that the main measure of the market value of banks is the Tobin's Q ratio. As an additional variable, authors use market-to-book ratio, usually in robustness tests. Secondly, the presented articles employ both single-country (11 papers) and cross-country analyses (19 papers). The papers are divided into several groups, based on the type of factor analyzed.

In the group of papers on the link between bank financial variables and market valuation, a diversification is the most frequently discussed topic. Researchers also study the effect of loan growth rate and bank size on valuation. Beside this, there are single studies on market power,

market discipline and bank efficiency. The second set of studies focuses on the link between corporate governance elements and market valuation. The literature on this subject is abundant, so the papers can be divided into three subgroups: board-related indicators, ownership structure and other elements of corporate governance. Papers on board characteristics examine the role of boards and CEOs in shaping market value. Researchers investigate gender diversity, tenure of CEOs and board members, board size and independence of members. Some authors consider complex board-related indicators like CEO power or board compensation. Papers on shareholders examine the effect of ownership concentration on valuation. Other ownership-related variables are type and origin of the major shareholder. In the banking empirical literature there are also studies on corporate governance mechanisms not related with boards or ownership structure. The market valuation of banks is affected by the fact that they publish sustainability reports or are involved in ESG activity. Intellectual capital also is a vital component that affect market value. The last area examines the link between market value and external factors not related with specific bank's decision. These factors are institutional reforms and economic policy uncertainty.

Based on this review, it can be concluded that the market value of banks is significantly linked to financial indicators and corporate governance components. It is crucial to combine this finding with the limitations observed. One of the limitations identified is sample sizes. In most banking sectors, only a fraction of all banks are listed on stock exchanges. It is particularly noticeable in single-country studies, which are conducted on a samples containing no more than 20 banks (Haq et al., 2019; Hoang et al., 2020). Studies based on such samples might not accurately depict the relationship between the factors studied and the market valuation. It implies that particular attention should be given when selecting econometric model for analyzing such small samples. The choice of countries from which studied banks come is another identified limitation. Numerous papers examine the market value of banks from developed countries, but there are much less research that look at transition countries. The relationships observed in banks from developed countries may not coincide with those from emerging markets. These observations suggest that researches should concentrate on studying the market value of banks from emerging countries, especially in connection with the financial and corporate governance elements.

This review of the literature has practical implications for stock market investors as well. Listed banks are among the largest entities that operate on stock exchanges. For this reason, understanding the mechanisms that affect the market value of banks is important for investors who are interested in placing their funds in bank shares.

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THE ROLE OF CROWDFUNDING PLATFORMS IN FINANCING STARTUPS IN POLAND: A CASE STUDY OF WSPIERAM.TO

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Purpose: The main purpose of the article is to examine and understand the specific role that crowdfunding platforms play in financing startups in Poland, using the case study of wspieram.to. The article also aims to shed light on the benefits and challenges of using crowdfunding platforms.
Design/methodology/approach: The article uses the prevailing literature as well as analysis and evaluation of documents, reports, and the website of crowdfunding platform – wspieram.to. The analysis was conducted in 2023.
Findings: The obtained results will help to indicate the role of crowdfunding platforms in financing start-ups in Poland on the example wspieram.to.
Research limitations/implications: The results cannot be generalized, but can form a basis for further deliberations. They shed certain light on the role of crowdfunding platforms in financing startups in Poland.
Originality/value: Studies have shown the role of crowdfunding platforms in financing startups in Poland. This article is mainly aimed at people who plan to start a business. Information on the role of crowdfunding platforms in funding can be valuable for them, helping them to understand what opportunities such platforms offer and how they can use them to raise funds to develop their business.

Keywords: crowdfunding, start-up, entrepreneurship.

Category of the paper: Case study.

1. Introduction

In a fast-paced business environment, the development of startups and innovative projects has become crucial to driving progress and socio-economic change. One of the biggest challenges faced by those looking to start a business is securing the right early-stage funding. Traditional methods of financing, such as bank loans or credit, can be difficult for many startups, especially those without a market history. In this context, the emergence of crowdfunding platforms represents a disruptive change for startup funding. Crowdfunding is

a process in which creators of projects with different themes, such as business, raise capital by engaging a large number of people who donate small amounts of money in exchange for shares in the project or other rewards. This process is done through crowdfunding platforms. Crowdfunding platforms make it easy and convenient to connect project proponents with potential investors, offering direct access to community capital. Crowdfunding platforms are an innovative tool that allows entrepreneurs to raise funds from a wide range of investors, usually via the internet. The main objective of this article is to show the role of crowdfunding platforms in the context of financing start-ups using the example of wspieram.to. Wspieram.to is a rapidly growing crowdfunding platform that enables entrepreneurs, creative projects and community organisations to raise funds from a community of investors. A case study of the wspieram.to website will provide a better understanding of the mechanisms of crowdfunding platforms and their potential in supporting the development of business projects.

2. Literature review

Crowdfunding is defined as the practice of raising funds for a project or venture through contributions from a large number of individuals, typically via an online platform (Belleflamme et al., 2014). It encompasses diverse forms such as reward-based, equity-based, lending-based, and donation-based crowdfunding. Crowdfunding refers to the efforts by entrepreneurial individuals and groups – cultural, social, and for-profit – to fund their ventures by drawing on relatively small contributions from a relatively large number of individuals using the internet, without standard financial intermediaries (Mollick, 2014). Crowdfunding is considered by many entrepreneurial, innovative and small and medium-size firms as an attractive tool for raising funds compared with other financing sources such as bank loans, for example, that usually have more requirements and conditions.

Crowdfunding is also seen as an innovative funding method that involves raising funds via the internet for both philanthropic and commercial projects (Rymarczyk, 2019). Crowdfunding has democratised access to capital, enabling entrepreneurs to bypass traditional funding channels and gain financial support from a global audience (Cumming, 2014). It stands for financing tasks, ideas, or a project via an open invitation to participate in a fundraiser, mainly over the Internet (web 2.0), so that the founders can donate, pre-purchase products, lend, or invest, guided by individual belief in a given offer, the initiator's promise, and/or an expectation of return on capital (Hossain et al., 2017). Crowdfunding, as a type of crowdorganising, includes “spot transactions, short-term relations, demand-based pricing, heterogeneous demand, and reputations established through feedback mechanism” (Powell, 2017). It has drastically changed the entrepreneurship and entrepreneurial finance ecosystem (Miglo, 2021).

Online crowdfunding portals play an important role in crowdfunding, through which it is possible to finance a project. In the case of a business project, funding will be available for: setting up or developing a new business, launching a new product or service, modernising fixed assets, e.g. purchasing new machinery and equipment, etc. A crowdfunding platform is a digital solution made available online to an open audience by a crowdfunding service provider for crowdfunding collections (KNF, 2022). The term crowdfunding platform can also refer either to the organization or to the website that brings together companies seeking investment and investors with funds to invest (Miglo, 2021). Internet-enabled crowdfunding platforms play the role of a common trusted system and induce fundraisers (creators/campaigners) and funders (backers/supporters) to join forces in an alliance that facilitates the interaction between them (Shneor, Vik, 2020). In today's digital world, crowdfunding platforms allow direct interaction between project developers and potential investors, helping to increase the availability of capital and promote a variety of initiatives.

It is also worth adding that the development of crowdfunding in Poland was also affected by the Covid-19 pandemic. The pandemic has been a challenge for companies that had to show flexibility and adapt to the constantly changing situation in order to continue to provide services and sell products. Many companies from industries such as gastronomy, tourism, culture and entertainment, or the automotive trade faced financial difficulties in the years 2020-2021 resulting from a lower demand for their products and services. The difficult economic situation forced them to search for financial support with the help of alternative financial tools, e.g., crowdfunding (Leoński, 2022).

At least several crowdfunding models can be distinguished in the literature. The most commonly mentioned models include: donation crowdfunding, equity-based crowdfunding, reward-based crowdfunding, lending-based crowdfunding, pre-sales crowdfunding, subscription-based crowdfunding. In Poland, the most popular crowdfunding models are donation crowdfunding and reward-based crowdfunding, which is stewarded by the wpieram.to platform.

3. The wspieram.to platform and its contribution to funding startups

The origins of crowdfunding in Poland can be traced back to 2011, as the first crowdfunding platform in Poland, PolakPotrafi.pl, was founded in the same year, as was the crowdfunding platform Wspieram.to, which was chosen for the study due to the fact that it has a tab dedicated to startups. In addition, the platform posts aggregated data on funded projects from all categories. Wspieram.to is part of the Crowdfunding Poland Group, an association of top Polish platforms offering tools for crowd funding, fundraising, subscription and sports funding, as well

as a platform for comprehensive education in crowdfunding and a thriving creative agency specialising in creations based on the cooperation of brands with the crowd 2.0.

The Polish donation and sponsorship crowdfunding market is dominated by a few platforms, although more crowdfunding sites are emerging all the time. According to the report of the Association of Financial Companies, in Poland "Donation and sponsorship crowdfunding in Poland", only two crowdfunding platforms: Siepomaga.pl, Zrzutka,pl. hold almost 87% of the market looking at the amounts raised between 2008 and 2022. However, it should be noted that they do not have dedicated tabs for business projects and focus mainly on charitable projects. The support.to platform is ranked 6th with a 1% share. Figure 1 shows the leaders of the crowdfunding market in Poland and through it a business project can be financed.

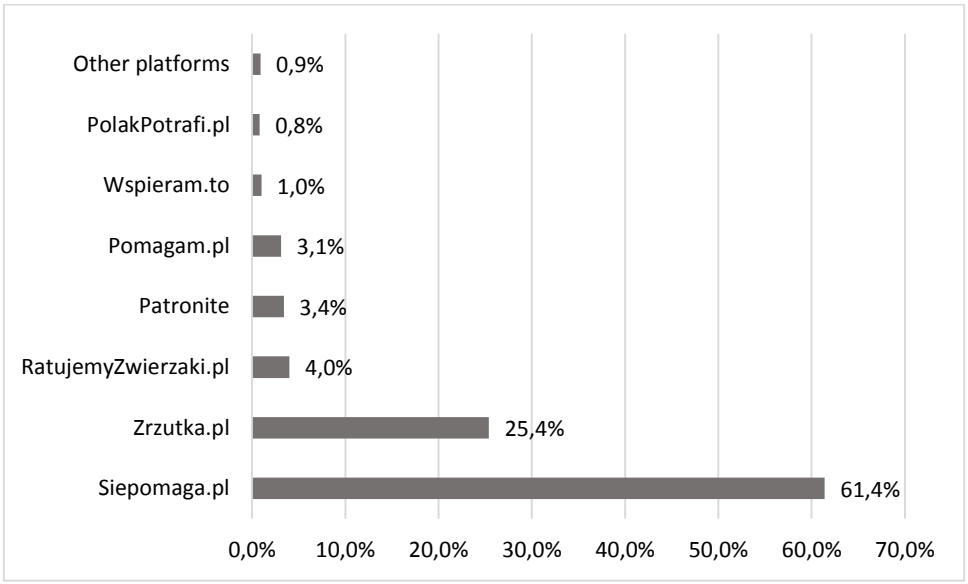

Figure 1. Leaders of the crowdfunding market in Poland by amount paid.

Source: Own elaboration based on Trzebiński (2023).

The main aim of Wspieram.to is to enable projects that might not find support in the traditional financial system. The service provides an opportunity for both young creatives who are just starting out and experienced entrepreneurs, artists, content creators and not-for-profit organisations to raise the necessary funds to develop their activities. The creator of the project sets up a crowdfunding campaign on the Wspieram.to platform, describing the details of his project, the financial goals and the rewards and benefits it offers to those who decide to support its implementation. The community has the opportunity to contribute any amount of money to support the project. There is also the option to choose one of the rewards offered by the creator, which often include exclusive content, products or invitations to events. Wspieram.to is committed to transparency and security. The platform provides information on what goals have been achieved, how much money has been raised and what projects have been completed with the support of the community. All transactions are secure and protected by the payment system.

Campaigns on Wspieram.to mainly operate on an all-or-nothing basis. It relies on the idea having to raise the entire pre-determined amount needed for the creator to receive the money. When a project does not receive full funding before the end of time, contributions are returned to the backers' balance accounts, from where they can freely dispose of them to support further creative projects. It should be noted, however, that some of the crowdfunding campaigns in the starup category were implemented in a 'flexible funding' model. In this case, the project proponent sets a financial target, but if he or she fails to meet it 100% can still get the money raised. However, if it finds that the amount is not sufficient to meet its obligations to contributors it can easily return it to them. Donors are protected by a contract signed by them committing the project developer to deliver the specified prizes on time. All clear and safe.

Wspieram.to uses a rewards-based crowdfunding model. In this case, as the name suggests, donors receive a reward from the organiser of a particular collection in return for their contributions. Usually, these prizes are non-financial in nature and are all sorts of items related to the project for which the collection was organised, they could be mugs with the logo, books, CDs, a meeting with the creator of the collection, etc.).

When analysing the wspieram.to platform, it is worth taking a closer look at the data for the startup category. Table 1 shows the most important information related to the business projects on the surveyed platform.

Table 1.
Statistics of the startups category on the platform wspieram.to

Crowdfundig campaigns	143
Successful crowdfunding campaigns	71
Unsuccessful crowdfunding campaigns	72
Percentage of funding obtained (successful campaigns)	16%
Average number of supporters of a successful campaign	60,48
Average payment size	51,75 PLN
The most successful campaign	68 616 PLN

Source: Wspieram.to (2023).

It is worth noting that just over 50% of business projects were unsuccessful. A number of factors can contribute to a lack of success, including poorly planned or timed campaigns, a lack of marketing activities associated with a crowdfunding campaign or a lack of a good business plan.

The originator of a crowdfunding collection must be heavily involved in the venture and its promotion. A lot of time has to be spent preparing the campaign and the product description, with no guarantee that the project will find interest in the public. This is because there is strong competition among the projects offered on crowdfunding portals. Originators try to encourage potential funders by various means and it is largely up to their creativity to find willing participants (Kędzierska-Szczepaniak, 2016).

It is good to outline that the sheer number of crodfunding campaigns in the statup category is small, given that the platform has been organising crowdfunding collections since 2011. The reasons for this state of affairs can be found in the low popularity of crowdfunding

platforms as a source of business financing among those wishing to set up a business. Another reason may be the large number and competition among other crowdfunding platforms.

Another point worth noting is the low percentage of funding that achieved successful collections, it was only 16%. The average number of people supporting successful campaigns was 60,48, with an average contribution of PLN 51,75. In the case of the most successful crowdfunding campaign, the initiator of the collection raised PLN 68616, which is not a large amount either.

4. Advantages of crowdfunding

Crowdfunding is a relatively easy and low-risk way to raise capital for a company. Unlike traditional methods such as bank loans or credits, no collateral or equity is required. If the crowdfunding campaign is unsuccessful, the initiator of the collection will not be liable for any debt. In the case of crowdfunding, you do not have to incur high costs, e.g. commissions or other fees.

Crowdfunding can be a good way to test a product or service that is the subject of an online fundraiser. If the online community is willing to invest in the business, this could be a good sign for the initiator of the online collection. This may mean that there is a demand for what the developer of a particular business project is offering. If a campaign on a crowdfunding platform is successful, it will mean that there is a potential market for the product or service.

The biggest advantages of online platforms include (Liebert, 2017):

1. Quick fundraising to finance a project.
2. Facilitating the implementation of project works.
3. Enabling the implementation of a new product on the market.
4. Product concept development.
5. Positive impact on marketing.
6. Acquiring additional business partners.
7. Acquiring additional (non-financial) resources.
8. More effectively creating project documentation.

Crowdfunding is a great way to solve some of the significant problems often faced by young entrepreneurs and originators. It reverses the standard model, in which costs and risks are incurred after the start of production. This allows to validate the market and idea at an early stage, thus saving time and money to build a product for which there could be no demand. Platformy umożliwiają zebranie opinii na temat naszego pomysłu i jego dopracowanie przed startem (Chojnacki, 2021).

Considering advantages of crowdfunding from the perspective of the platform wspieram.to its openness to different types of projects should be considered. Irrespective of the sector or the area, each entrepreneur has a chance to report their idea and convince the community to support it. Wspieram.to platform also assures tools and support for the entrepreneurs in conducting crowdfunding campaigns. The instructions, advice and examples of the best practices help startups in effectice promoting their projects and attracting investors. The Wspieram.to platform constitutes therefore valuable tool for the entrepreneurs, who wis to transform their visions into reality and gain support from the community.

It seems that businss projects are not popular among the crowdfunding platforms. A certain shade on the degree of popularity of crowdfunding in Poland, as a source of startup financing, is cast by the report „Polskie startupy 2022" (Dziewit, 2022). Among the startups asked from which sources of capital they had a chance to use, the most, as many as 69% show their own resources. A significant role on the Polish market is played by the VC national funds, the capital of which was used by 29% of the startups surveyed and also domestic business angels, who supported 22% of startups, whereas 21% of respondents showed financing obtained from the National Center of Research and Development. In this place it should be emphasized that as low as only 4 % of the startups surveyed used crowdfunding as the source of financing. The results of this survey prove that crowdfunding as a source of financing business undertakings in Poland is still in the initial stage. And consequently, its role in financing start-ups is negligible. This is confirmed, for example, by the wspieram.to platform, where the number of campaigns related to business projects over the last several years has been small (143 campaigns).

The immense popularity of the Internet gives reason to believe that it is this way of financing activities that may be the primary source of capital for small businesses. In turn, the variety of crowdfunding platforms on the market makes it a flexible source of fit for both businesses and audiences (Motylska-Kuzma, 2018).

5. Conclusion

In recent years, crowdfunding platforms have started to play an increasingly important role in startup funding, changing the investment landscape and opening up new opportunities for entrepreneurs. However, it should be noted that other forms of funding are much more popular among startups. Despite the democratisation of access to capital and the many advantages of crowdfunding platforms, this instrument is still underestimated in Poland. With crowdfunding, everyone has the opportunity to support an interesting project and become part of its success. This opens the door to new innovative ideas and allows startups to grow independently of traditional funding channels. However, it should be noted that there are risks associated with

the use of crowdfunding platforms, e.g. the risk of fundraising failure or copying of an innovative idea by others,

Looking to the future, however, it seems that the prospect of crowdfunding platforms is promising. With the development of online technologies and increasing public acceptance, further development of these platforms and the evolution of crowdfunding models can be expected. In conclusion, the role of crowdfunding platforms in startup funding is dynamic and will continue to grow. This is evidenced by the increasing number of crowdfunding platforms in Poland offering various crowdfunding models enabling the financing of business projects. More and more people thinking about starting a business or launching an innovative product or service are realising the benefits of crowdfunding. It seems that crowdfunding platforms will continue to evolve and improve their operations, making this method of funding even more attractive to entrepreneurs.

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MANAGING THE QUALITY OF SERVICES OFFERED BY ACCOMMODATION FACILITIES DURING THE COVID-19 PANDEMIC AND EPIDEMIOLOGICAL THREAT

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Purpose: The COVID-19 pandemic has left a significant mark not only in the area of health but also in the functioning of the economies of various countries. Strong influences of the pandemic are visible, among others, in the activities of accommodation facilities around the world. The main objective of the article is to analyse and evaluate the opinions of respondents on the quality of services offered by accommodation providers before, during the COVID-19 pandemic during the epidemiological emergency. The judgments of respondents were confronted with their ideas about the ideal entities in this industry, offering a satisfactory quality of services and guaranteeing satisfaction.
Design/methodology/approach: The study is based on a review of available literature sources, industry reports and the results of our own empirical research carried out using the CAWI method based on a prepared questionnaire. The methodology of the empirical research was based on the SERVQUAL model and the Fiederman test.
Findings: The survey found that respondents were dissatisfied with the quality of services provided by lodging facilities, both before, during the COVID-19 pandemic and during the epidemiological emergency, with little difference between perceptions and expectations. The highest level of dissatisfaction resulting from consumer feelings characterized the period of the COVID-19 pandemic. For the respondents, the most important sphere comprising the quality of customer ser-vice was the external appearance of the accommodation facilities, and the least important was the willingness to cooperate and trust (certainty).
Originality/value: The article contributes to the expansion of the research topic of the quality gap of accommodation facilities.

Keywords: accommodation base, COVID-19, lockdown, state of epidemiological emergency, quality.

Category of the paper: Empirical research paper.

1. Introduction

The COVID-19 pandemic has had a significant impact on the activities of economic operators worldwide, particularly in temporary restrictions on the use of services from various industries. The identification of new types of the virus continues to cause public concern (Amirudin et al., 2021; Cheung, et al., 2021). According to data published by the World Bank (The World Bank Group), in 2021, almost four out of ten smaller companies in emerging markets had financial arrears or forecasted such a scenario for the following years. So far, the two-year experience in the face of the COVID-19 pandemic has shown that only active policies and public financial sup-port can stem the crisis and the observed economic slow-down and high inflation. The latest forecasts for global GDP growth in 2022 by the International Monetary Fund have been revised downwards by 0.5 percentage points to 4.4%, while the figure for 2023 is expected to be 3.8% (World Economic Outlook Update. Rising Caseloads, a Disrupted Recovery, and Higher Inflation).

Some activities or branches of the economy were particularly affected by the negative impact of the COVID-19 pandemic due to the restrictions imposed and the temporary suspension of their operations. The literature indicates that the industries most affected by the COVID-19 pandemic were tourism, transport and catering (Muangmee et al., 2021; Alkharabsheh, Duleba, 2021). Within tourism, direct restrictions on activity targeted, among others, accommodation operators (Hu et al., 2021). Following the declaration of the COVID-19 pandemic by the World Health Organisation (WHO), local and international travel bans, and airport and border closures were imposed in many countries to limit the spread of the SARS-CoV-2 virus (Bajrami et al., 2021). Not all sectors were affected, for example, those involved in digitisation and new technologies. Services provided by such opera-tors or products offered for sale do not require a fixed base (Kuzior et al., 2021). Accommodation services are a form of activity that cannot be transferred strictly to the Internet. Both the owners of accommodation facilities and the customers of the services they offer have had to adapt to the situation Akincilar i Dagdeviren (2014) point out that consumer opinions are an important factor determin-ing the demand for these services. Therefore, the main objective of the research, based on the assumptions of the SERVQUAL model and Fiederman's Anova Test, is to analyse and evaluate the opinions of respondents on the quality of services offered by accommodation providers before and during the COVID-19 pandemic and during the epidemiological emergency.

2. Literature review

2.1. The quality of the services provided

Convincing a customer to choose the service of a given entity is an extremely important, difficult and demanding process. It is necessary to have a solid foundation, in the form of a properly tailored marketing, financial or technical background. However, the most important issue is the service itself, which must be designed in a way that meets customer requirements and has the features desired by the recipients (Kowalik et al., 2018). Services, in turn, are understood as all manifestations of human economic activity, having an intangible character and characterized by interactivity between the entity providing the service and the recipient (Van Looy et al., 2013). The characteristic features of services are their intangible character, simultaneous production, distribution and consumption, diversity, perishability and impossibility to store them, as well as the impossibility to acquire ownership of them. In the services offered by accommodation facilities, it is crucial to identify the most important and less important criteria for the selection of accommodation by different customer groups. The literature mentions the quality of services offered as a factor that strongly influences consumers' decision to choose a place to stay (Alauddin, Yamada, 2019).

Service quality is one of the key drivers of sustainable business growth and competitive advantage. Research on service quality has been carried out for many years for various segments of the economy (Puriwat, 2017). Businesses known for offering high-quality services have a stronger and more sustainable competitive advantage than others (Lucini et al., 2020). In turn Chang (2008) considers the concept of service quality from the point of view of the customer, who may be guided by different values, evaluation criteria and circumstances. Nowadays it is identified in technical, economic and marketing terms (Jain, Aggarwal, 2015). It is shaped by the discrepancy between expectations and the final evaluation of the ser-vice by customers (Angelova, Zekiri, 2011). Personnel, working in the service industry, especially hospitality services, are expected to act quickly and efficiently and provide quality services. Personnel acting in this way contribute to shaping and improving the level of service quality (Pizam, Shapoval, Ellis, 2016). Wolniak and Zasadzień-Skotnicka (2009), point out that the quality of offered services is shaped by many factors, including material elements (facilities, room, equipment, staff appearance), speed of response (timeliness of services, willingness to help customers), confidence (knowledge, qualifications and experience of employees, courtesy and ability to create an atmosphere of trust and confidence), empathy (care about the customer, individual approach to customers), organization and work efficiency, or the image and culture of the organization.

Quality factors also include responsiveness, reliability and dependability, assurance (respect and friendliness of the service, possession of skills and knowledge, inspiring trust and freedom from danger and risk), empathy (ease of contact with the service provider), and the material components of the service process (Dabholkar et al., 2000).

Consumers' perception of service quality is a complex, multi-dimensional process. To quantify this process, it is common to use the SERVQUAL model (Ravichandran, 2010), based on the perception gap between received and expected service quality (developed by Parasuramana et al., 1985, 1988, 1994), which originally consisted of 10 dimensions, which were eventually reduced to five: reliability, responsiveness, empathy, assurances and tangibles (Subiyakto, Kot, 2020). The key measurement tool of the SERVQUAL method is a survey questionnaire, consisting of 22 statements, which are assessed twice by respondents. In the first stage, the requirements for an ideal ser-vice are evaluated, and in the second stage, their actual level is assessed. For the assessment of the statements, a Likert-type scale is most often used. In the third part of the questionnaire, the respondent assigns grades for the importance of service and quality dimensions (Baki et al., 2009).

The model has been subjected to extensive scrutiny in the literature over the years, with widespread agreement that the dimensions identified are important aspects of service quality, but skepticism as to whether they apply to evaluating the quality of all service industries (Douglas, Connor, 2003). Cronin & Taylor (1992) pointed out the discrepancy between expectations and performance in assessing service quality. In contrast, Kang and James (2004) argued that SERVQUAL focuses more on the process of service delivery than on other attributes, especially those related to the technical dimension. This is why, among others, Cronin and Taylor (1992), as well as Grönroos (2007) pointed out the difference between perceived service and expected service. As a result of further re-search, Grunions, Rust and Oliver (1994) proposed a three-component model explaining service quality through service product, service delivery and service environment. The indicated components are in line with the idea of technical and functional attributes derived from the model of Grönroos (2007), who focused on comparing customers' expectations of services and their previous experiences. This model has been called "total perceived service quality" and examines what the customer is really looking for and what elements they are evaluating. Quality in this model is based on two dimensions: 1) technical, which refers to the result, i.e. what is delivered to the customer, or what the customer receives as a result of the service; 2) functional, indicating how the service is provided. These dimensions affect a company’s image and perception of quality in different ways, as pointed out in studies by Grönroos (2007), James (2011).

2.2. Customer satisfaction as a special determinant of service quality

The attempt to estimate the impact of the quality of ser-vices provided by accommodation facilities on the satisfaction and subsequent loyalty of their guests began by defining the terms used. Customer satisfaction is a feeling of satisfaction or disappointment resulting from

a comparison between the performance of a product or service and the expectations of them (Yussupova et al., 2016; Makanyeza et al., 2016). Customer satisfaction is treated as a specific determinant of service quality. In the literature, it is defined as a response to the good or bad quality of a product or service. This approach is usually emotion-al (Klementova et al., 2015). Unfulfilled expectations can create a basis for negative emotions such as anger or regret (Min et al. 2015), while positive feelings generate satisfaction (Xu, Li, 2016). Customer loyalty is the intention or actual realization to purchase products or services again from the same parties and the desire to maintain a stable and long-term relationship with the seller (Flavián, Guinalíu 2006). Stum and Thiry (1991) recognize that customer loyalty concerning buying behavior manifests itself through making systematic purchases, purchasing other products or services from the same company, spreading positive opinions about the business and not succumbing to the actions of competitors. According to Reichheld, loyalty should be considered in a broader way than the repeatability of purchases. He draws attention to the willingness to make an investment or personal sacrifice to strengthen the relationship. This means that the services offered are satisfactory in terms of the values recognized rather than the price (Reichheld, 2003).

Given the above, it should be recognized that customer satisfaction is crucial for both the survival of hotels and the stability of their operations (Zeng, Gerritsen, 2014). The literature mentions some characteristics of accommodation facilities guests that influence the evaluation of satisfaction levels (Nobar, Rostamzadeh, 2018). Such characteristics include expectations, interests, nationality, seasonality, culture, travel experience and sociodemographic characteristics (Khorsand et al., 2020). According to Bitner and Hubbert (1994) the relationship between service quality and customer satisfaction should not be overlooked. Satisfaction should be analyzed as arising from each contact with the service provider, as well as the overall satisfaction resulting from the services provided. The former is related to customer satisfaction or dissatisfaction experienced with each contact with the service provider, while the latter is the sum of impressions from all contacts and experiences.

According to some authors, there are unequivocal rea-sons why companies lose customers. LeBoeuf (1987) indicates that these are: change of place of residence, establishing contacts with other companies, more favorable offer of the competition, dissatisfaction with products or services offered by the company, as well as indifference of service staff. Organizational factors can affect the provision of quality service in both negative and positive ways (Frost, Kumar, 2000).

According to the literature review, quality of service is closely related to customer satisfaction and loyalty. Increases in business costs due to the effects of the pandemic, mainly the decisions made at government levels in this regard to limit the transmission of the virus, can have a significant impact on the level of quality of the service provided by most operators. Due to the existing gap in research on the formation of the quality of services offered by operators of accommodation facilities during an epidemiological emergency, it was deemed

appropriate to conduct research, which was divided into two stages. The first stage was a pilot study on the evaluation of service quality before and during the COVID-19 pandemic. The second stage was a proper study conducted during the epidemiological emergency. The results of the studies conducted are presented in this paper. The article adopts the following research hypotheses:

H1: Pandemic COVID-19/epidemic emergency has a statistically significant impact on respondents' beliefs about the quality of services provided by accommodation facilities operators.

H2: Customers of accommodation facilities were not satisfied with the quality of services provided before and during the COVID-19 pandemic or during the epidemiological threat.

H3: The disproportion between the perception and expectations of respondents as to the quality of services provided by operators of accommodation facilities was greater during the COVID-19 pandemic than during the state of epidemiological emergency or before the out-break of the COVID-19 pandemic.

3. Research methodology

The idea of this article was to show the level of customer service quality of accommodation facilities in the con-text of the COVID-19 pandemic. To determine the quality of services provided by accommodation facilities, the study used the SERVQUAL method and Friedmann's analysis of variance. The method allows to specify the service gap, understood as the difference between an experience (perception) and customer expectation. And the application of Friedman's analysis of variance made it possible to determine how the COVID-19 pandemic affected the quality of customer service in accommodation facilities, and whether this effect was statistically significant. In this study, the authors used the triangulation method to conduct the research. Triangulation is the use of more than one approach to achieve the set research problem. Combining the results of two or more research methods (methodological triangulation) presents a more complete and reliable picture of the obtained results, and thus drawing the right conclusions (Heale, Forbes, 2013) . The first step that was implemented was a case study, through which a thorough analysis of the research problem posed was carried out. The next step was to conduct a survey, which should be considered a pilot study. The questionnaire was divided into two blocks. The first referred to the motives, preferences and behavior of customers of accommodation facilities both before and during the COVID-19 pandemic, while the second part consisted of the SERVQUAL method modified for the study, consisting of 15 questions, supplemented by a 5-point Likert scale. The survey in the form of an online questionnaire was carried out through the use of the portal https://swpanel.pl/. The survey was conducted in two rounds, first pilot surveys were conducted

during the pandemic then surveys proper during the epidemic emergency. Then the obtained results of the survey were presented using selected statistical methods.

The pilot survey was conducted in the period from 02/08/2022 to 02/18/2022 and a total of 619 people took part in it, of which the number of women participating in the survey was 423 (68% of all respondents). The most numerous group were women aged 26-35 (20%) and 18-25 (19%). In the remaining groups, the number of women did not exceed 15%, while in the study the group over 66 years of age accounted for the least women, which constituted 2% of the respondents, respectively. As in the case of women, men were dominated by people aged 18-25, however, the number of people in this group did not exceed 45 people. The number of men aged 26-35, i.e. 25% and 36-45, was at a similar level, which translates into 21% of all respondents. In the remaining age groups, the number of men did not exceed 14% of the respondents, and over 66 there were 13 more men than women.

Most of the respondents had secondary education (283). Most people from this group lived in non-tourist cities. Respondents in all types of localities were dominated by those with secondary education (283 people). The second largest group of 19% comprised the respondents with higher education (master's degree). The exception are villages of a non-tourist nature, where the second highest education was vocational (26 people, i.e. 12% of the respondents).

The monthly income most frequently indicated by the respondents was in the range of 2,001-3,000 PLN. About 6/25 of the respondents earn between 0-1,000 PLN. The third largest, indicated by the respondents, was the monthly income in the range of 1,001-2,000 PLN. The monthly income above 3,001.00 PLN was at the same level, oscillating around 15%.

The surveys proper were carried out between 18/05/2022 and 31/05/2022 and involved a total of 1,237 respondents. The number of women reached 845 which translated into 68.31% of the total respondents. The largest group was made up of people in the 18-25 age bracket, with as many as 334 respondents, a group that was by far dominated by women with 241. The number of respondents aged 26-35 was at a similar level (230 respondents. 19% of respondents were in the 36-45 age range, which translates into the third largest group of respondents. In the other groups, the number of women did not exceed 16%, and men 14%. Respondents over 66 years of age accounted for the smallest percentage of people, about 0.06% of all respondents, with the number of women in the age group in question being the lowest at 27 people.

Among the respondents, those with secondary education predominated, with 552 people, accounting for 45% of all respondents. Second among the most frequently mentioned education, respondents indicated a master's degree, which accounted for 19%. The third largest group was made up of people with vocational education (149 people), that is, about 12% of all respondents taking part in the survey.

In all types of localities, respondents were dominated by those with secondary education (552 people). The second largest group equal to 19% were respondents with higher education (master's degree). The smallest number of people with a master's degree resided in tourist

villages. In second place in tourist and non-tourist villages were people with vocational education 42 people and 10 people, respectively.

The most common monthly income indicated by respondents was in the range of PLN 2,001.00-3,000.00. About 23% of respondents earn in the range of PLN 0-1,000.00. The third highest monthly income indicated by respondents was in the range of PLN 3,001.00-4,000.00, and slightly lower by 2 was the share of respondents in the range of PLN 1,001.00-2,000.00. Both women's and men's salaries prevailed in the range of PLN 2,001.00-3,000.00.

4. Results and discussion

4.1. SERVQUAL method

The informational content of Figure 1 illustrates the degree of respondents' dissatisfaction with the quality of services provided by lodging facilities, which in both the pilot and proper surveys is at very similar levels. However, as can be seen, during the epidemiological emergency, the level of dissatisfaction improved minimally, however, as indicated by respondents' answers, it did not reach the level from before the COVID-19 pandemic. Therefore, it should be concluded that hypothesis H2 was formulated correctly: customers of accommodation facilities were not satisfied with the quality of services provided before and during the COVID-19 pandemic or during the epidemiological threat.

Comparing the results obtained from the pilot survey with the data obtained in the actual survey, it can be seen that the analyzed values have improved minimally. How-ever, it should be noted that the level of respondents' dissatisfaction is still above the pre-pandemic COVID-19 values.

The gap between respondents' perceptions and their expectations was at a very low level. The pilot study shows that the discrepancy in unweighted mean scores before the COVID-19 pandemic was in the range of (-0.04 to -0.22). In contrast, dissatisfaction among respondents intensified during the pandemic (-0.53). The survey proper shows that during the epidemiological emergency, the maximum level of dissatisfaction regarding the availability of accommodation without time limits reached a point at (-0.40).

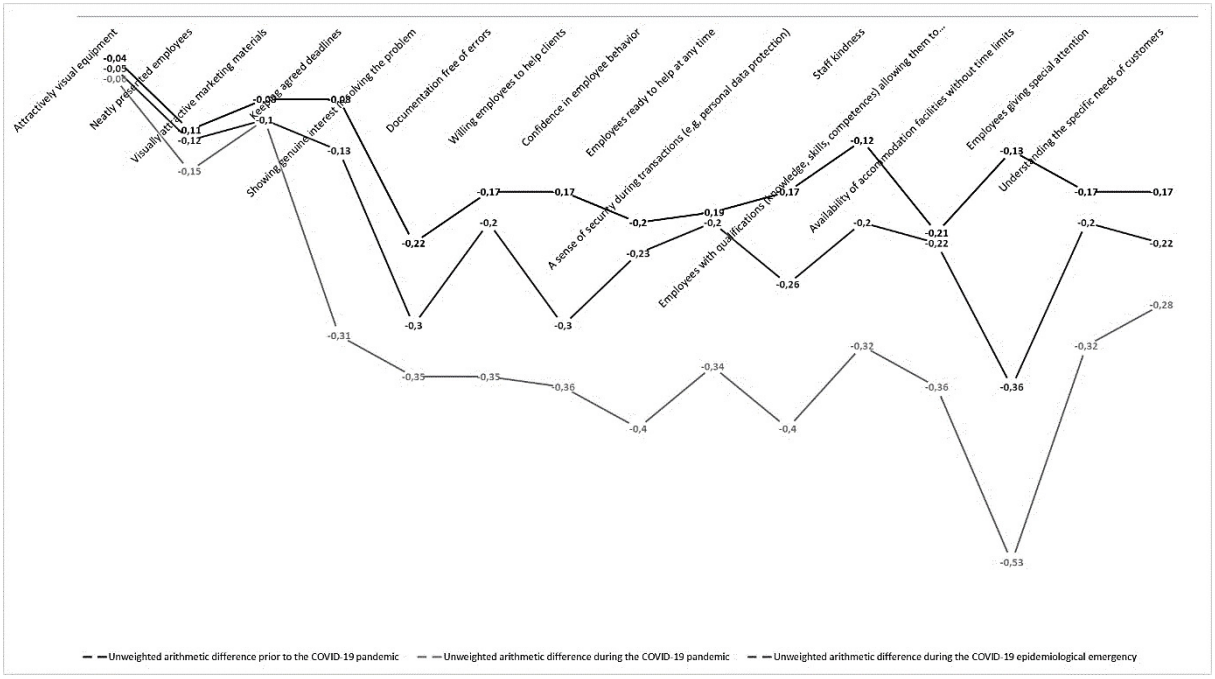

Figure 1. SERVQUAL method.

Source: Author's contribution.

In contrast, prior to the outbreak of the pandemic, dis-satisfaction related to the aspect of sincere interest in solving the problems of those using accommodation bases did not exceed (-0.20). The results obtained, both from the pilot survey and the survey proper, indicate that respondents raised the fewest objections to the provision of accommodation bases (-0.04 and -0.03, respectively). Taking into account the differences in unweighted averages, it can be indicated that of all the spheres of service quality, the sphere of concretes, which is the most resistant to external changes. before, during the COVID-19 pandemic, and in the sphere of epidemiological risk was rated best by respondents, for whom the averages are (-0.08 and -0.10 and -0.09). Respondents, on the other hand, were most dissatisfied with the sphere of empathy, the unweighted average in this area in each country was -(0.16; -0.38 and -0.26). The differences between the other spheres, i.e. reliability, willingness to cooperate or trust in each research period did not exceed (0.06).

Thus, the completed survey allowed positive verification of hypothesis H3: The discrepancy between respondents' feelings and expectations regarding the quality of services provided by accommodation facilities was greater during the COVID-19 pandemic than during the epidemiological emergency or before the outbreak of the COVID-19 pandemic.

Figure 2 shows the importance of the individual spheres of the SERVQUAL method, from the survey. Considering the data contained therein, it can be concluded that for customers of accommodation facilities, the most important sphere comprising the quality of customer service was the external appearance of accommodation facilities during the pandemic as well as the epidemiological threat (25%), which is co-created by the equipment, attractiveness of marketing materials or the appearance of employees.

Another equally important sphere shaping the quality of customer service at the level of 21% and 20 % was the sphere of reliability, consisting of such elements as meeting deadlines, or showing interest in the customers of accommodation facilities. The third most important sphere was empathy manifested, among other things, by understanding individual customer needs. The remaining two spheres were trust and willingness to cooperate in providing services, whose importance is at the level of respectively (18% and 17%) and (17% and 18 %).

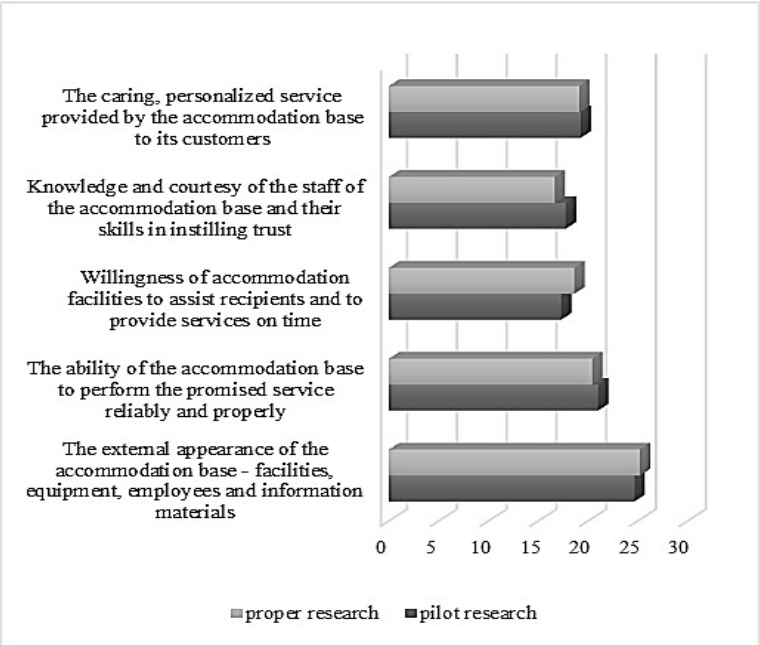

Figure 2. The importance of the areas of the SERVQUAL method.

Source: Author's contribution.

Analyzing the respondents' in Table 1answers through the prism of the importance of individual spheres, it can be seen that the respondents had the most objections to the spheres of empathy (-7.30) and reliability (-7.06), the worst quality of service in this respect is characteristic of the period of the COVID-19 pandemic.

Although the period of epidemiological risk is characterized by a lower level of dissatisfaction with the quality of services provided by accommodation facilities com-pared to the period of the COVID-19 pandemic, the spheres of empathy (-5.05) and reliability (-4.09) are still rated the worst. In this respect, the low level of ratings is influenced by the availability of accommodation facilities without time limits -7.60 (the sphere of empathy) or showing sincere interest in solving the problem -6.14 (the sphere of reliability). As in the case of unweighted aver-ages, the sphere of specifics was rated the best, the respondents are most satisfied with the visually attractive equipment (-1.26). In turn, broken down into individual periods, the average weights in this category are respectively (-1.88, -2.53 and -2.27).

Table 1.
The dimensions of the SERVQUAL method in the assessment of customers of accommodation bases

	Weighted arithmetic difference before the COVID-19 pandemic	**Weighted arithmetic difference during the COVID-19 pandemic**	**Weighted arithmetic difference during the COVID-19 epidemiological emergency**
	Sphere I-Concrete (palpability)		
Attractively visual equipment	-0.99	-1,48	-1,26
Neatly presented employees	-2,62	-3,70	-3,02
Visually attractive marketing materials	-2,03	-2,47	-2,53
MEAN	**-1.88**	**-2,55**	**-2,27**
	Sphere II-Reliability		
Keeping agreed deadlines	-1.77	-6.42	-2,74
Showing genuine interest in solving the problem	-4.72	-7.37	-6,14
Documentation free of errors	-4,20	-7.40	- 4,01
MEAN	**-3,56**	**-7.06**	- 4,29
	Sphere III-Willingness to cooperate		
Willing employees to help clients	-2.96	-6.15	- 5,59
Confidence in employee behavior	-3.38	-6.96	-4,34
Employees ready to help at any time	-3.30	-5.87	-3,69
MEAN	**-3.21**	**-6.33**	**-4,54**
	Sphere IV-Trust (certainty)		
A sense of security during transactions (e.g. personal data protection)	-3.04	-7.06	-4,28
Staff kindness	-2.18	-5,68	-3,34
Employees with qualifications (knowledge, skills, competences) allowing them to answer the questions	-3.67	-6.39	-3,74
MEAN	**-2.96**	**-6.38**	**-3,79**
	Sphere V-Empathy		
Availability of accommodation facilities without time limits	-2.43	-10.30	-7,60
Employees giving special attention	-3.23	-6.13	-3,91
Understanding the specific needs of customers	-3.33	-5.47	-4,20
MEAN	**-3.00**	**-7.30**	**-5,24**

Source: Author's contribution.

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satisfied with the visually attractive equipment (-1.26). In turn, broken down into individual periods, the average weights in this category are respectively (-1.88, -2.53 and -2.27).

4.2. Friedman test

Friedman analysis of variance was used to verify the hypothesis of equality of means in more than two populations. Table 2 shows the rank analysis.

Table 2.
Friedman's ANOVA

Variable	Pilot research				Proper research			
	N	Mean	Standard deviation	p-value	N	Mean	Standard deviation	p-value
Q1_B	619	3.64	0.86	<0.001*	1237	3,59	0,91	<0.001*
Q1_D	619	3.38	1.01		1237	3,39	0,98	
Q1_P	619	3.60	1.09		1237	3,52	1,15	
Q2_B	619	3.81	0.97	<0.001*	1237	3.71	0,95	<0.001*
Q2_D	619	3.62	1.08		1237	3.56	1,16	
Q2_P	619	3.92	1.13		1237	3,74	1,09	
Q3_B	619	3.69	0.92	<0.001*	1237	3,63	0,96	<0.001*
Q3_D	619	3.56	1.12		1237	3,49	1,04	
Q3_P	619	3.77	1.08		1237	3,68	1,09	
Q4_B	619	3.81	1.02	<0.001*	1237	3,69	0,99	<0.001*
Q4_D	619	3.59	1.05		1237	3,45	1,16	
Q4_P	619	3.89	1.14		1237	3,62	1,10	
Q5_B	619	3.63	1,12	<0.001*	1237	3,63	0,98	<0.001*
Q5_D	619	3.52	1.05		1237	3,50	1,03	
Q5_P	619	3.85	1.13		1237	3,72	1,09	
Q6_B	619	3.63	0.94	<0.001*	1237	3,61	0,99	<0.001*
Q6_D	619	3.56	1.05		1237	3,47	1,15	
Q6_P	619	3.83	1.13		1237	3,72	1,11	
Q7_B	619	3.81	0.99	<0.001*	1237	3,72	1,00	<0.001*
Q7_D	619	3.69	1.14		1237	3,62	1,07	
Q7_P	619	3.98	1.13		1237	3,80	1,10	
Q8_B	619	3.75	0.94	<0.001*	1237	3,68	0,99	<0.001*
Q8_D	619	3.54	1.05		1237	3,58	1,02	
Q8_P	619	3.95	1.13		1237	3,82	1,20	
Q9_B	619	3.48	1.03	<0.001*	1237	3,44	1,04	<0.001*
Q9_D	619	3,38	1,05		1237	3,33	1,05	
Q9_P	619	3.67	1.13		1237	3,58	1,16	
Q10_B	619	3.80	0.98	<0.001*	1237	3,67	1,04	<0.001*
Q10_D	619	3.57	1.08		1237	3,57	1,07	
Q10_P	619	3.97	1.12		1237	3,82	1,20	
Q11_B	619	3.88	0.94	<0.001*	1237	3,80	1,01	<0.001*
Q11_D	619	3.69	1.06		1237	3,65	1,10	
Q11_P	619	4.01	1.11		1237	3,89	1,17	
Q12_B	619	3.79	0.97	<0.001*	1237	3,70	1,03	<0.001*
Q12_D	619	3.63	1.05		1237	3,61	1,08	
Q12_P	619	3.99	1.05		1237	3,86	1,13	
Q13_B	619	3.70	1.025	<0.001*	1237	3,66	1,06	<0.001*
Q13_D	619	3.34	1.10		1237	3,29	1,10	
Q13_P	619	3.82	1.14		1237	3,73	1,16	

Cont. table 2.

Q14_B	**619**	**3.45**	**1,00**	**<0.001***	**1237**	**3,41**	**1,03**	**<0.001***
Q14_D	619	3.30	1.03		1237	3,34	1,03	
Q14_P	619	3.62	1.10		1237	3,54	1,12	
P15_B	619	3.64	0.98	<0.001*	1237	3,60	0,99	<0.001*
P15_D	619	3.56	1.00		1237	3,53	1,02	
P15_P	619	3.87	1.07		1237	3,75	1,12	

Source: Author's contribution.

In both the pilot study and the study proper, two statistical tests, the Kolmogorov-Smirnov test and the Shapiro-Wilk test were used to assess the conformity of empirical distributions of the studied variables with the normal distribution. A significance level of 0.05.

The informational content of Table 3 shows that the values of the mean and standard deviation in both con-ducted surveys are at similar levels. It should be noted, however, that in the state of epidemiological emergency, the results obtained are at a slightly lower level, which thus translates into better assessments of respondents as to the quality of services in accommodation bases.

Taking into account the pilot study as well as the study proper, the values of all the statistics obtained are statistically significant at the level of less than 0.001. This means that there is a statistically significant difference between the state during the pandemic/epidemic emergency and the state before the pandemic and the ideal state. The research conducted allowed positive verification of hypothesis H1: pandemic COVID-19 / epidemic emergency has a statistically significant impact on respondents' beliefs about the quality of services provided by accommodation facilities operators.

5. Discussion

One of the commercial industries most affected by COVID-19 is the hospitality segment. During the COVID-19 pandemic, many governments imposed drastic travel and movement restrictions, as well as temporary bans on lodging providers. As a result, previous research has mainly focused on assessing the impact of the COVID-19 pandemic on a particular business. In contrast, this study also addresses the state of the epidemiological threat (post-pandemic COVID-19 status). The study is divided into two parts. The pilot study focuses on analyzing and assessing changes in customer satisfaction with the quality of services provided by lodging companies during the COVID-19 pandemic. In turn, the research proper refers to perceptions of the quality of services offered by lodging establishments after the end of the COVID-19 pandemic state. The studies conducted were juxtaposed by comparing the periods studied. The research was carried out using the SERVQUAL method, modified for the purpose of the work, which made it possible to identify discrepancies between the experiences of customers

of accommodation providers and their desires. The paper also used the Friedman test, examining with it whether the periods in question have a significant statistical effect.

Madar (2017) surveyed a sample of 120 customers of Hotel "Kronwell" at the end of 2013. The responses of the respondents showed that the main factors of customer dissatisfaction were poor lighting and lack of ventilation in the rooms' toilets. In addition, most of the respondents were disappointed with the level of knowledge and the behavior of the staff, which according to them were not appropriate for high-standard hotels. The survey also identified areas of customer dissatisfaction, such as additional services (little space in the spa areas, too narrow range of treatments not suited to the customer, not sufficient variety in the restaurant menu). Research conducted by Nikolskaya et al., (2018) has shown that the quality of hotel services is linked to the need to protect the environment, as well as to the increase in tourists' demand for environmentally friendly services and goods.

The analysis of the quality of service performed on a sample of Swedish hotels in Norrköping suggests that respondents focused mostly on reliability. Furthermore, empathy and tangibles were important for the customers, followed by the willingness to cooperate. Bhuian (2021) indicates in his research that trust is a less important element influencing the quality of service in the hotel industry.

Research conducted in the hotel industry during the COVID-19 pandemic showed that travelers pay special attention to health protection and infection avoidance aspects when choosing their accommodation. Thus, hotels must comply with WHO requirements and governmental decisions too (Nilashi et al., 2021). These studies also confirm the obtained results. It should be noted, however, that a large part of respondents participating in the survey did not travel, while those who decided to travel were mainly guided by the price of accommodation.

Peres and Paladini (2022) discussed the quality of customer service in Brazilian hotels during the COVID-19 pandemic. The paper discusses the quality of service by analyzing attributes such as room, infrastructure, reservation, and staff. As the authors note, low occupancy rates in Brazilian hotels negatively affected service levels. The COVID-19 pandemic in this case contributed to the suspension of maintenance work, the reduction of food and beverage services and the reduction of access to social spheres, as well as recreational activities. In addition, staff shortages contributed to problems with the timely provision of services. Similarly, as in the research undertaken in this study, Peres and Paladini (2022) found that the COVID-19 pandemic had a negative impact on ratings of the elements that make up service quality. However, in contrast to their study, the analysis of the results in this study suggests that respondents in the COVID-19 pandemic had the most reservations about empathy and reliability.

Yusuf Günaydın (2022) conducted research on the impact of hotel service quality on hotel guest satisfaction during the COVID-19 pandemic and the impact of the "Safe Tourism" certificate on their behavior. As a result, it was found that the quality of service provided in

hotel facilities and the level of guest satisfaction during the pandemic influenced guests' willingness to visit hotels again. It was also shown that having a "Safe Tourism" certificate has a positive impact on the choice of hotel facilities for the vacation season. The study also noted that continuous measurement of service levels underlies quality improvement in hotels.

Chen, Kuo and Tsaur (2022), in their study, specifically pointed out that the hotel services industry is on the brink due mainly to the impact of the COVID-19 pandemic. In order to ward off losses, the authors proposed that luxury hotels in the post-pandemic period split into hotels offering the same services at a lower cost. The study showed that moving away from "luxury" hotels and reducing the quality of services is one way to reduce the large losses created during the COVID-19 pandemic period. However, Albattat and Amer (2016) showed that budget hotels often face numerous complaints among their customers about unclean and uncomfortable rooms, lack of hot water, unpleasant staff and bad food, which is caused by lack of resources and poor service management.

Referring to a study by Mckinsey & Company (2020) on consumer sentiment triggered by the COVID-19 pandemic and its implications for their purchases, behavior and motivation, statistics for most countries show a sharp decline in anticipated spending on tourism and hospitality activities. Pappas and Glyptou (2021), in their study, also pointed to a decline in international travel in the first quarter of 2020 relative to the previous year.

The research undertaken in this study has shown a statistically significant relationship in terms of respondents' belief in the quality of services provided by accommodation providers before and during the COVID-19 pandemic/epidemic emergency (positively verified H1). The conducted research shows that the surveyed clients of accommodation facilities were dissatisfied with the quality of services provided both before the COVID-19 pandemic, during the COVID-19 pandemic and during the epidemiological threat (hypothesis H2 was positively verified).However, it was indicated that the disparity between the feelings and expectations of respondents about the quality of services provided by accommodation facilities was greater during the COVID-19 pandemic than before its outbreak than during the state of epidemiological emergency or before the outbreak of the COVID-19 pandemic (hypothesis H3 positively verified).

A study by Shao-Cheng and Yu-Huan (2022) found a significantly negative relationship between the threat caused by the COVID-19 outbreak and the satisfaction with service in a hotel. Employees, who are under stress offer a poorer quality of service, which has a direct negative impact on hotel guest satisfaction. Similar conclusions were reached by Srivastava and Kumar (2021), who in their study showed a significant relationship between interest in hotel offerings and satisfaction with stay and service quality and the types of sanitation measures implemented related to preventing the spread of COVID-19 in hotels. They also identified practical recommendations for improving customer satisfaction in the hotel industry during a pandemic. Published research shows that service quality is one of the main factors influencing consumer satisfaction. The relationship between the quality of service and customer satisfaction

is strong, as indicated in earlier literature in many studies (Alnawas, Hemsley-Brown 2019). Service quality should be considered as a multidisciplinary factor, depending on the area studied and significantly affecting customer satisfaction.

6. Conclusion

The economic impact of the COVID-19 pandemic has been analyzed in a number of scientific studies (McCloskey, Heymann, 2020; McKibbin, Fernando, 2021; Nicola, et al., 2020). Among other things, public rescue strategies for the tourism and hospitality industry in various countries have been evaluated (Androniceanu, 2020; McCartney, 2020). The negative determinants of the pandemic on the hospitality industry have also been pointed out, as it relies heavily on human contact. Since the onset of the public health crisis, the hospitality industry has experienced serious financial losses. Many hotels have laid off thousands of employees on a permanent or temporary basis, or offered free accommodation to medy workers. Some hotels were also converted into temporary hospitals (Niestadt, 2020; Sanabria-Díazat et al., 2021). Gursoy et al. (2020) suggest that customers will not return natively when hotels reopen. Krishnan et al. (2020) also note that it may take until 2023 or later to return to pre COVID-19 levels. In light of the cited studies, it is noteworthy to assess the quality of services offered by the hotel industry from the point of view of the customers most affected by the pandemic

The COVID-19 pandemic and the introduced restrictions aimed at stopping or reducing virus transmission had a significant impact on the operation of accommodation facilities in worldwide. The introduced lockdowns, the need to close hotels or limit their occupancy as regards the number of guests, resulted in a decrease in the number of accommodation bookings or cancellation of already agreed arrivals. Accommodation establishments, regardless of any restrictions aimed at them, incurred constant costs of running their operations. The financial situation of many operators has significantly deteriorated, which has also had an impact on the quality of services provided, as observed by interviewees. Some entities were closed down as they were no longer able to operate profitably, as evidenced by the decreasing number of accommodation facilities.

In addition, currently, the operations of all businesses, including accommodation facilities, are affected by high inflation, which is reflected in increases in four important cost groups, i.e. electricity, gas, waste disposal and property tax. Increases are also visible in the prices of food or building and household materials. In addition to this, the geopolitical situation in eastern Europe also has an impact on the operation of business facilities.

This article aimed to analyse and evaluate the opinions of respondents on the quality of services offered by accommodation providers before and during the COVID-19 pandemic. The conducted empirical research confirmed that the COVID-19 pandemic/state of

epidemiological emergency has a statistically significant impact on the respondents' beliefs about the quality of services provided by these entities, which confirmed the H1 hypothesis. The second hypothesis (H2), was also verified positively, as respondents were dissatisfied with the quality of services provided by accommodation units, before, during the COVID-19 pandemic and during the period of epidemiological threat. The last hypothesis was confirmed H3, meaning that the differential between the feelings and expectations of respondents about the quality of services provided by accommodation facilities was greater during the COVID-19 pandemic than during the state of epidemiological emergency or before the outbreak of the COVID-19 pandemic. The Anova Fiederman test was used to verify the hypotheses. All considerations were based on the SERVQUAL model. The article also attempts to determine the impact of the quality of accommodation services on customer satisfaction. The aim of the article has been achieved and the research hypotheses have been verified. Accommodation facilities to reduce pandemic losses and calm their financial situation (during the COVID-19 pandemic), began to place less emphasis on the quality of services, which in turn was reflected in the opinions of respondents and was identified by them.

The research limitation may be a sample limited to those using https://swpanel.pl/. In Poland, the epidemiological state is scheduled to be lifted is April this year so the area of further research may be the state after the restrictions are lifted. The direction of future considerations should take into account the reference of the obtained results to the economic situation of individual countries and the economic and financial situation of customers, and especially taking into account a new factor the sense of security in the face of the war in Ukraine.

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HUMAN RESOURCE MANAGEMENT OF ECONOMICALLY DEPENDENT SELF-EMPLOYED AND SUBORDINATE EMPLOYEES

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Purpose: One of the significant consequences of changes in the contemporary Polish labor market is the growing importance of flexible forms of employment, including self-employment. A special type of self-employment is economically dependent self-employment (EDSE), in which the entrepreneur provides services exclusively or to a large extent to one entity in a manner similar to the performance of work under an employment relationship. The growing popularity of this type of flexible forms of relations between the employee and the employer prompted us to ask the following questions: What are the similarities and differences between organizations in terms of HRM activities with respect to EDSE and subordinate employees (SE)?
Design/methodology/approach: The researchers used the data from quantitative research (CATI), conducted on a representative sample of 380 business entities from Poland. The objective of the empirical analysis was to group the organizations according to the criterion of differentiating their HRM activities in relation to EDSE and SE.
Findings: The analysis allowed to distinguish three groups: 'Traditionalists' focusing on subordinate workers; 'Transforming' presenting a similar approach to EDSE and SE, with a slightly greater focus on SE, and 'Genuinely equal' having the same approach to EDSE and SE. The organizations mostly or to a large extent apply the principles of equality (i.e. various HRM instruments apply equally to EDSE and SE) or dedicate solutions to SE to a greater extent.
Originality/value: The value of the research is to conduct extensive research on a representative sample of Polish companies on HRM in an increasingly flexible labor market. The research contributes to the growing trend of research on subordinate and economically dependent self-employed workers, extending it to HRM perspective.

Keywords: Economically Dependent Self-Employed, Subordinate Employees, Human Resource Management, HRM Harvard model, labor market.

Category of the paper: Research paper.

1. Introduction

In recent years, the changes observed in the modern labor market are related, among others, to the greater flexibility of relations between employers and employees, and thus the greater popularity of non-standard forms of employment. This phenomenon can be confirmed by the fact that the first position in the ranking of the Society for Industrial and Organizational Psychology "Top 10 Work Trends for 2021" was occupied by the "Remote Work and Flexible Working Arrangements" trend, which has a broad array of implications for both employers and employees (SIOP, 2021). The phenomenon of greater flexibility in the labor market is also associated with the concept of gig economy and the growing interest in gig work, which is characterized as short-term, requiring the completion of finite assignments and allowing loose boundaries for when and where people must work (Watson et al., 2021). Furthermore with aging workforce, organizations to retain mature people will need to increase work flexibility or allow part-time work (Stone & Deadrick, 2015). Approximately 150 million people in North America and western Europe now work as independent contractors (Petriglieri et al., 2018). According to IZA World of Labor, the popularity of nontraditional jobs (independent contractors, temporary workers, 'gig' workers) is growing and will continue to do so due to the increase in fixed employment costs and the development of technology that allows short-term labor contracting (Oyer, 2020).

Furthermore, the COVID-19 pandemic and the global recession also contributed to an uncertain outlook for the labor market (World Economic Forum, 2020). According to the authors of the report 'Gig Economy 2021', during the lockdown resulting from the COVID-19 pandemic, the benefits of the gig economy became very clear and the gig economy stood its ground and kept the economy running. The pandemic acted as a catalyst for the hidden needs of employees seeking greater flexibility; thus the evolution towards the new ways of working such as the gig economy is clearer than ever (PwC Legal, 2021). The report of the International Labor Organization also indicates that the pandemic is fueling a rise in gig work that is expanding the pool of self-employed contractors (ILO, 2022). Current estimates show that 50% of the American workforce will be engaged in the gig economy by 2027, and the gig economy has tripled its growth rate in the last year (Swigunski, 2022).

2. Economically dependent self-employment

The broad category of gig workers includes, among others, platform workers, sharing economy workers, and also independent contractors. Due to the flexible nature of work, self-employed workers who do not employ other workers can be also classified as gig workers

(Watson et al., 2021). A specific type of self-employment is economically dependent self-employment. The emergence of this group of workers was highlighted in 1999 in a report submitted to the European Commission (European Commission, 1999).

As noted by Williams and Horodnic (2019, p. 4), there is a continuum of employment relationships, 'from pure dependent employment through more employment-like relationships and more self-employment-oriented relationships to genuine self-employment.' Economically dependent self-employment is therefore one of the forms of flexible (atypical) forms of employment and is an intermediate form between genuinely subordinate employees and genuinely independent entrepreneurs. These workers are legally independent (i.e., self-employed), but economically dependent (Maloka, Okpaluba, 2019). Therefore, this category is treated as a 'gray zone' between employment and self-employment (Millán et al., 2020), as well as a 'gray area' between labor law and commercial law (Commission of European Communities, 2006).

There is a consensus among labor market researchers that economically dependent self-employment is an intermediate category between self-employment and subordinate work. There are, however, differences regarding the uniform definition of this atypical form of employment. The discussion primarily concerns various criteria for considering the self-employed as economically dependent. For example, Eurostat takes into account economic and organizational dependency, defined on the basis of the number of clients and the percentage of income coming from a client, as well as in terms of control over working hours (Eurostat, 2018). Thus, according to Eurostat's 2017 Labor Force Survey, economically dependent self-employed were defined as self-employed without employees who worked during the last 12 months for only one client or for a dominant client, and this client decided about their working hours (Eurostat, 2018). The OECD uses similar criteria (2014), and dependent self-employed workers are defined as "own-account self-employed – i.e. independent contractors without employees who either autonomously produce and sell goods or engage with their clients in contracts for services, regulated by commercial law" (OECD, 2014). Their conditions of work and degree of subordination are similar to employees as they work mainly or exclusively for a specific client-firm (called employers), with limited autonomy and often closely integrated into its organizational structure (OECD, 2014). The International Labor Organization (2016, p. 98) also draws attention to the number of clients, pointing to the fact that dependent self-employers 'depend on one or a small number of clients for their income or receive detailed instructions regarding how the work is to be done.' Similarly, according to the Commission of the European Communities (2006), dependent self-employers remain economically dependent on a single principal or client/employer for their source of income. Summarizing the above-presented definitions, it can be assumed that economically dependent self-employers are self-employed individuals, not employing other workers, working for one or a small number of clients on whom they remain economically dependent. Additionally, their working conditions are similar to those of subordinate employees employed by their client.

The current scientific discourse on economically dependent self-employment mainly concerns issues related to labor law seen from the perspective of different countries (Hendrickx, 2018; Rosioru, 2014; Ludera-Ruszel, 2017; Musiała, 2014; Tyc, 2021; PwC Legal, 2021; van Stel et al., 2021), where scientists attempt to set the boundary between self-employment and employment. In this context, the protection of social and labour rights is also examined (Bagari, 2020; Eichhorst et al., 2013), and on the basis of Polish legal conditions, proposals are made for the direction of regulation in this area (Moras-Olaś, 2022; Krajewski, 2022). In this context, the following are also examined: social security protection (Muehlberger, Bertolini, 2008; Quinlan, 2012), parental protection (Bagari, Sagmeister, 2022), stability and security of employment (Stewart, Stanford, 2017), involuntariness of dependent self-employment (Hernanz Martín, Carrasco, 2021) and false self-employment (Nikulin, 2021), as well as differences in the scope of collective bargaining and trade union representation (Quinlan et al., 2009). Therefore, the research undertaken focuses mostly on the legal aspects of employment. Therefore, due to the fact that the modern labor market is moving towards flexibility of time and place of work, as well as the relationship between the employee and the employer, offering a wide range of alternative forms of professional life, the authors of the paper see the need to discuss the subject of human resource management under these conditions. They focus on the activities of the organization within human resource management in relation to economically dependent self-employed and subordinate employees.

3. Human resource management – now and then

HRM is a multidisciplinary concept. As Farndale and coauthors stated (2019), there is some confusion concerning HRM research. HRM as a field of research includes elements of content (what), process (how), and context (why) (De Wit, Meyer, 2010). The core content of HRM is generally well understood and includes the practices organizations adopt, such as recruitment, selection, training, reward, and performance management, either studied as individual practices or as bundles of practices in HRM systems (Farndale et al., 2019). In the paper, we focus on this approach, without analyzing how these practices affect the attitudes and behaviors of employees or the results of the team, business unit, or company, and without focusing on research regarding the context of HRM.

Over the years, debates have been held concerning HRM models. Despite stating in 2000 that the old certainties and paradigms are breaking down, Morgan emphasizes that HRM has developed its own theoretical perspectives, models, issues, and debates. Among some of the best-known HRM models, the Harvard model developed by Beera et al. (1984) is mentioned.

Guest, in turn, states that in the case of the Harvard model (similarly to the models proposed by Kochan, Katz, and McKersie (1986) from MIT), there is an attempt to capture the broad field and to address some of the interrelationships. For Beer et al., this means listing four broad areas of HRM policy and practice and four key outcomes. This approach is essentially descriptive, mapping the field, and classifying inputs and outcomes (Guest, 1997). This model proposes that HRM policy choices are determined by a combination of stakeholder interests and situational factors and have long-term consequences (Prowse, Prowse, 2010).

Truss notes that the soft-hard dichotomy in HRM exists primarily in normative human resource management models and not in what Legge (1995) describes as descriptive-functional or critical-valuating ones. Guest (1987), seeking to define HRM, distinguished two dimensions: soft-hard and loose-tight. Similarly to Storey (1992), he places existing HRM interpretations along two dimensions: soft - hard and weak - strong. Debates on the identification of the Harvard model with soft HRM and the Michigan model with hard HRM (Fombrun et al., 1985) took place only in the British context. The author refers to the works of Hendry and Pettigrew from 1990 (Truss, Gratton, 1994).

Beer and colleagues dwelt on adversarial relations between management and blue-collar/white-collar employees, and the potential for 'mutual' relations. They conceived of HRM as a series of policy choices, comprising human resource flows (selection, appraisal, development, and outflows), reward systems, work systems, and, crucially, employee influence. And they located this in a societal and political context of stakeholder interests, as well as of situational factors. Completing this was a specification of criteria for measuring the short-term effectiveness of human resource practices, commitment and competence of employees, congruence of employee goals with those of the organization (and vice versa), and cost effectiveness, and a reminder that all such policies had longer-term consequences for society, the organization, and the individual (Hendry, Pettigrew, 2006).

Boundarouk and Brewster (2016) note that the Harvard model offers a systems perspective on HRM, consisting of the fact that all the elements interact so that the whole is greater than the sum of its parts. This perspective aims to promote the unity of science and the unity and completeness of HR management. At the same time, changes in HRM and technologies taken together have stretched the geographical boundaries of HRM practices, and distances in and between organizations have become shortened. Due to technological advancements, employers can offer their employees new ways of working by eliminating physical and time barriers and relying on new organizational forms, and employees, supervisors, and managers get directly involved in co-creation of HRM. As a systematic review of the literature on employee engagement has shown, "today, more than ever, organizations understand the importance of their employees and view them as the most important asset to their businesses" (Zeidan, Itani, 2020). Even the notion of 'employees' 'shows a mismatch with organizational conventional reality, as technological developments stretched contract boundaries and impacted on time, so

it might be more appropriate to talk about ‘workers’, including those who work for but are not employed by an organization’ (Boundarouk, Brewster, 2016).

Guest states that the first key issue is the lack of theory about the nature of HRM practices, and it is not the presence of selection or training, but a distinctive approach to selection or training that matters (Guest, 1997). Both hard and soft models are designed to adapt to the strategic needs of the organization. Furthermore, although human resource management (HRM) practices have changed in almost four decades, this approach remains a good framework for research. Therefore, this study uses the division into four areas of HRM based on the Harvard model, which includes: employee influence, human resource flow, reward systems, and work systems. It is worth noting that the Harvard model was developed in the 1980s in a much less flexible labor market. Therefore, it is worth checking how the elements of this model function in the modern labor market in relation to economically dependent self-employed and subordinate employees. In Poland, subordinate employment remains the dominant form of cooperation with the employer. At the same time, in Poland, at the end of 2018, the number of self-employed amounted to 1.3 million and increased by approximately 8.3% compared to the same period in 2017. Furthermore, a slight upward trend in self-employment has been observed since 2016 (CSO/GUS, 2019).

4. Methodology

The following research question was asked in the framework of the conducted study: What are the similarities and differences between organizations in terms of HRM activities regarding economically dependent self-employed and subordinate employees? To answer the research question, the researchers used the data obtained from previous quantitative research (CATI), conducted on a representative sample of 380 medium-sized and large business entities from Poland (n = 380) that cooperate with both subordinate employees and economically dependent self-employed workers. The entities examined were verified in terms of meeting additional criteria. In each of the examined enterprises, min. 10% of the employees are employed on the basis of a full-time employment contract and min. 10% of employees are the economically dependent self-employed. In terms of the type of activity, the structure of the research sample included mostly entities represented by the health care, social assistance, and IT sector. In terms of the form of ownership of the company, the sample structure was almost proportional. Slightly more than half of the respondents (52.1%) represented the private sector, the others the public sector.

To answer the research question, an empirical analysis was carried out, which constitutes a by-product of the above-mentioned primary studies. The aim of the analysis was the clustering of the organizations according to the criterion of differentiating their HRM activities in relation

to subordinate employees and economically dependent self-employed workers. The analysis was carried out using a two-stage clustering analysis. This method enables grouping of objects when the variables are expressed on different measurement scales, in particular when they are qualitative (including nominal variables). In this study, the classification was performed on the basis of a set of 31 variables consisting of four areas of human resource management distinguished in the Harvard model (Table 1).

Table 1.
Variables consisting of four areas of human resource management distinguished in the Harvard model

Employee influence	(1) informing employees about issues concerning the organization beyond what is necessary to perform the tasks of the job, (2) the possibility for employees to express their own opinions, present their ideas, proposals, and suggestions, (3) the possibility of realization and implementation of own ideas and projects by employees, (4) having an impact on decision-making/management processes, (5) profit sharing
Human resource flow	(6) the possibility of vertical promotion of employees, (7) the possibility of horizontal promotion of employees, (8) the possibility of freely changing the project or the scope of implemented tasks
Reward systems	(9.1) base salary, (9.2) bonuses (9.3) commissions, (9.4.) awards, (9.5) special duty, (9.6) opportunities to develop competences, (9.7) praise and recognition for employees, (9.8) insurance packages, (9.9) healthcare, (9.10) sports cards, (9.11) vouchers and in-kind prizes, (9.12) modern work tools, (9.13) team building events, (9.14) prevention and well-being programs, (9.15) holiday subsidies, (9.16) additional days off work
Work systems	(10) flexible working hours, (11) task-based working time, (12) remote job, (13) part-time job, (14) fixed-term employment, (15) job-sharing, (16) job-crafting

Source: own research.

In each of those areas, the respondents were asked whether the solution applied equally to subordinate employees and economically dependent self-employed workers, or more to one of these groups, or only to one of them. It was also possible to choose ‘no’ or “such a possibility does not exist/is not used in our organization’ or “the nature of the workplace does not allow the application of a given solution’. The method used does not require the normalization of variables. Due to their non-metric nature, the classification was carried out using the reliability ratio metric. In order to assess the quality of the clustering result, a Silhouette measure was used, which measures the similarity of objects, i.e. the distance of each analyzed object in relation to the cluster to which it belongs, taking as a reference the minimum distance between the examined i-th object and all objects in any other distinguished r-th cluster. Values above 0.2 are considered to indicate a correct classification. The quality of the classification is satisfactory; the Silhouette measure is 0.21.

5. Research results

The analysis allowed to distinguish three clusters:

- Cluster 1 'Traditionalists': greater focus on subordinate employees.
- Cluster 2 'Transforming': a similar approach to subordinate employees and economically dependent self-employed workers, with a slightly greater focus on subordinate workers.
- Cluster 3 'Genuine equal': equal treatment of subordinate employees and economically dependent self-employed workers.

Conclusions on the differences between the isolated clusters can be drawn based on the basis of the analysis of the data in Table 2.

Table 2.
Comparison of clusters from the point of view of differentiating HRM practices in relation to subordinate employees and economically dependent self-employed workers

	Cl.	Only SE	To a greater extent SE	Equally SE and EDS	To a greater extent EDS	Only EDS	N/A
1. Are employees in your organization informed about issues related to the organization that go beyond what is necessary to perform tasks in a given position?	1	11.0%	10.3%	59.4%	1.3%		18.1%
	2	3.2%	6.4%	77.6%			12.8%
	3		2.9%	73.9%		5.8%	17.4%
2. Do employees in your organization have the opportunity to express their own opinions and present their own ideas, proposals, and suggestions?	1	5.2%	18.7%	67.7%	1.9%		6.5%
	2	1.9%	3.2%	92.9%			1.9%
	3			100.0%			
3. Do employees in your organization have the opportunity to realize and implement their own ideas and projects?	1	4.5%	12.9%	61.9%	0.6%	1.3%	18.7%
	2		0.6%	85.3%			14.1%
	3			97.1%			2.9%
4. Do your employees have an impact on decision-making/management processes in the organization?	1	11.6%	18.7%	29.0%	3.9%	2.6%	34.2%
	2	2.6%	1.3%	78.2%			17.9%
	3			82.6%			17.4%
5. Do your employees have the opportunity to share in the profits of the organization?	1	22.6%	9.0%	7.7%			60.6%
	2	7.1%	10.3%	30.1%			52.6%
	3		8.7%	37.7%			53.6%
6. Do employees in your organization have the opportunity to be promoted vertically (e.g., to senior management positions)?	1	58.1%	19.4%	9.0%			13.5%
	2	3.8%	17.9%	69.9%	1.3%		7.1%
	3		11.6%	79.7%		5.8%	2.9%
7. Do employees in your organization have the opportunity to be promoted horizontally (e.g., to nonmanagerial, specialist positions)?	1	53.5%	21.9%	12.9%		1.3%	10.3%
	2	3.2%	13.5%	71.8%	1.3%		10.2%
	3	5.8%	5.8%	85.5%		2.9%	
8. Do employees in your organization have the opportunity to freely change the project or the scope of tasks?	1	11.6%	10.3%	5.2%	2.6%	1.3%	69.0%
	2		1.9%	30.1%	1.3%		66.7%
	3		2.9%	76.8%			20.3%
9.1. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Base salary	1	65.2%	4.5%	27.7%		1.3%	1.3%
	2	53.2%	5.8%	35.3%	1.9%		3.8%
	3	5.8%		87.0%	1.4%		5.8%
9.2. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Bonuses	1	47.7%	14.8%	10.3%			27.1%
	2	37.8%	0.6%	37.2%			24.4%
	3	2.9%		85.5%			11.6%

Cont. table 2.

9.3. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Commissions	1	9.0%	1.3%	8.4%	2.6%	1.3%	77.4%
	2	4.5%		3.8%	1.9%	3.8%	85.9%
	3	2.9%	2.9%	62.3%		8.7%	23.2%
9.4. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Awards	1	58.1%	11.6%	5.8%			24.5%
	2	35.9%	4.5%	30.8%			28.8%
	3			82.6%			17.4%
9.5. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Special duty and seniority allowances	1	55.5%	2.6%	11.6%			30.3%
	2	64.1%	0.6%	25.0%			10.3%
	3	10.1%		37.7%			52.2%
9.6. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Opportunities to develop competences	1	54.8%	7.7%	36.1%			1.3%
	2	36.5%	7.7%	53.8%			1.9%
	3		5.8%	94.2%			
9.7. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Praise and recognition	1	17.4%	2.6%	68.4%			11.6%
	2	4.5%		88.5%			7.1%
	3			88.4%			11.6%
9.8. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Insurance packages, pension schemes	1	38.1%	6.5%	22.6%			32.9%
	2	32.7%	1.3%	29.5%			36.5%
	3	23.2%	5.8%	52.2%			18.8%
9.9 Does your organization offer the following monetary and nonmonetary incentives to its employees? – Private healthcare	1	11.6%	2.6%	17.4%			68.4%
	2	1.3%		5.1%			93.6%
	3	15.9%	8.7%	58.0%			17.4%
9.10. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Sports cards	1	7.1%	4.5%	17.4%			71.0%
	2	5.1%		5.8%			89.1%
	3	11.6%	10.1%	62.3%			15.9%
9.11. Does your organization offer the following monetary and nonmonetary incentives to its employees? - Vouchers and in-kind prizes	1	39.4%	3.2%	11.0%			46.5%
	2	33.3%		6.4%			60.3%
	3	5.8%	5.8%	63.8%			24.6%
9.12. Does your organization offer the following monetary and nonmonetary incentives to its employees? - Modern work tools, comfortable workplace	1	8.4%	1.9%	87.7%			1.9%
	2	1.3%		88.5%			10.3%
	3			100.0%			
9.13. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Team building activities and events	1	9.7%	7.7%	51.0%			31.6%
	2	3.2%		52.6%			44.2%
	3			100.0%			
9.14. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Prevention and well-being programs	1	7.7%	1.3%	7.7%			83.2%
	2			38.5%			61.5%
	3			40.6%			59.4%
9.15. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Holiday subsidies	1	50.3%	2.6%	2.6%			44.5%
	2	65.4%		6.4%			28.2%
	3	10.1%	5.8%	14.5%			69.6%
9.16. Does your organization offer the following monetary and nonmonetary incentives to its employees? – Additional days off work (paid)	1	46.5%	4.5%	7.7%	2.6%		38.7%
	2	32.1%	0.6%	28.2%			39.1%
	3	5.8%		42.0%			52.2%
10. Do employees in your organization have the opportunity to use flexible working hours?	1	9.0%	1.3%	29.7%	11.0%	3.9%	45.2%
	2	3.8%	1.3%	51.9%	4.5%	1.9%	36.5%
	3	2.9%		69.6%	5.8%		21.7%
11. Do employees in your organization have the opportunity to use task-based working time?	1	10.3%	6.5%	9.7%	3.2%	1.9%	68.4%
	2	11.5%	1.3%	20.5%	3.8%	1.3%	61.5%
	3	5.8%	2.9%	68.1%		2.9%	20.3%
12. Do employees in your organization have the opportunity to perform remote work (outside of the designated workplace)?	1	26.5%	3.2%	33.5%	1.3%		35.5%
	2	21.8%	4.5%	25.0%	0.6%		48.2%
	3		2.9%	95.7%			1.4%
13. Do employees in your organization have the opportunity to work part-time?	1	30.3%	4.5%	52.3%	3.9%	2.6%	6.5%
	2	12.8%	1.3%	81.4%	1.9%	0.6%	1.9%
	3	2.9%		85.5%			11.6%
14. Do employees in your organization have the opportunity to have a fixed-term contract?	1	30.3%	2.6%	61.3%	2.6%	2.6%	0.6%
	2	6.4%		87.8%	1.9%	1.3%	2.6%
	3	2.9%	2.9%	82.6%			11.6%

Cont. table 2.

15. Does your organization use so-called job sharing?	1	11.0%	1.3%	17.4%	1.3%		69.0%
	2	1.9%	1.3%	35.3%	1.3%		60.2%
	3		5.8%	31.9%			62.3%
16. Do employees in your organization have the opportunity to use the so-called job crafting?	1	5.8%		11.0%	2.6%	1.3%	79.4%
	2			12.8%	1.3%	1.3%	84.6%
	3			10.1%			89.9%

Cl. – cluster; SE – subordinate employees; EDS – economically dependent self-employed; N/A – this possibility does not exist/is not used in our organization/the nature of the workplace does not allow it. The darker the orange background, the higher the percentage of responses, and the darker the green background, the lower the percentage.

Source: own research.

5.1. Cluster 1 'Traditionalists': greater focus on subordinate employees

Cluster 1 is the most internally diverse. Employers usually apply "equality" principles here (although not in all areas and usually less frequently than in the other groups) or dedicate solutions to subordinate employees; less often they focus on solutions addressed exclusively or mostly to economically dependent self-employed workers. The share of the response: 'This possibility does not exist/is not used in our organization/The nature of the workplace does not allow it' is usually greater in their case than in the other groups.

The definitely equal approach (more than 2/3 of the responses for this variant) concerns the area of employee influence (the possibility of expressing their own opinions and presenting their own ideas and suggestions) and some elements of the area of reward system (motivation through modern work tools, as well as praise and recognition). The list of these variables is very short compared to the other clusters.

The solutions in the human resource flow area, i.e. promotions (vertical as well as horizontal), are in the case of the organizations from this cluster definitely dedicated to subordinate employees. In terms of the area of reward system, the organizations mostly or exclusively aim the instruments towards subordinate employees. This applies to instruments such as base salary, bonuses, awards, special duty and seniority allowances, the opportunity to improve competences, holiday subsidies, additional days off work, for which the percentage of responses providing the answer 'only subordinate employees" is approximately 50% or more. Modern work tools are definitely addressed to both groups of employees, although 10% of employers in this group (definitely more than in the other clusters) direct them mostly or exclusively to subordinate employees. They usually do not offer commissions, private healthcare, sports cards or vouchers, and any in-kind prizes (if used at all) are dedicated only to subordinate employees. Prevention and well-being programs are an instrument that is usually not used at all, and if it is used (and this is the case for less than 20% of organizations from this group), the self-employed are not distinguished (either they are treated on an equal basis with subordinate employees, or they are covered to a lesser extent or not at all).

None of the organizations in this cluster favors economically dependent self-employed workers (no answer "to a greater extent" or "only economically dependent self-employed") in relation to the area of employee influence: access to information, the possibility for employees to express and implement their own ideas and projects, the impact on management processes, share in profits, or all analyzed motivation instruments analyzed.

The organizations gathered in this cluster usually do not provide the possibility (due to the specificity of the organizations and workplaces) of profit sharing or freely changing the project or the scope of tasks, job sharing, or job crafting. On the other hand, it is the only group that includes organizations that make job crafting available only to subordinate employees (although the percentage is not too high – 6%), and additionally take into account economically dependent self-employed workers to at least the same degree. They also stand out in relation to job sharing (11% of organizations apply it only to subordinate employees). When it comes to fixed-term contracts, they usually do not delimit the rules due to the form of employment (61% of organizations), but they also exceptionally often (30%) dedicate these contracts to subordinate employees, and less often, mostly or exclusively to economically dependent self-employed workers (5%). Similar conclusions apply to part-time work (52% / 30% / 7% respectively). Remote work is not used at all by about 1/3 of organizations in this group, but the share of only subordinate employees or equally subordinate employees and economically dependent self-employed workers is similar. Flexible working hours is either not possible at all (45%) or equally applies to subordinate employees and economically dependent self-employed workers, although this aspect is distinguished (compared to other issues and other clusters) by the relatively high share of organizations that perceive it as a more adequate solution for either economically dependent self-employed (15%) or subordinate employees (10%).

5.2. Cluster 2 'Transforming': a similar approach to subordinate employees and economically dependent self-employed workers, with a slightly greater focus on subordinate workers

Organizations that find themselves in this cluster usually apply the principles of equality – various HRM instruments apply equally to subordinate employees and economically dependent self-employed workers, while quite often they limit specific solutions mostly or exclusively to subordinate employees, and at the same time rarely or not at all apply solutions dedicated only to economically dependent self-employed workers.

The definitely equal approach (more than 2/3 of the responses for this variant) concerns the area of employee influence (informing employees about issues concerning the organization beyond what is necessary to perform the tasks of the job, the possibility for employees to express their own opinions, present their ideas, proposals, and suggestions, and implementing one's own ideas), as well as motivating through modern work tools, as well as fixed-term and part-time job opportunities. Similarly to the organizations from the first cluster, none of the organizations from this cluster favors economically dependent self-employed workers (no answer "to a greater extent" or "only economically dependent self-employed") in relation to access to information, the possibility of expressing and implementing their own ideas or projects, their impact on management processes, share in profits and all analyzed motivation instruments.

Promotions (both vertical and horizontal) are equally available to both subordinate employees and economically dependent self-employed workers (70%); in about one in five organizations, they are mostly or exclusively addressed to subordinate employees, although they are also possible for the economically dependent self-employed in individual organizations (which is the specificity of this cluster). These organizations usually do not provide the opportunity to share in profits, although in every third organization subordinate employees have the same opportunities in this respect as the economically dependent self-employed, and in nearly every fifth profit sharing opportunities are mostly or exclusively addressed to subordinate employees. They usually also do not have the possibility of freely changing the project or the scope of tasks carried out, whereas every third organization allows this to the same extent in the case of both groups.

In the area of reward system, individual motivation instruments are either limited to subordinate employees or they can be used equally by subordinate employees and economically dependent self-employed workers. The organizations from this cluster usually do not use (due to the specificity of workplaces) such motivation instruments as commissions, private healthcare, sports cards, vouchers and in-kind prizes, or prevention programs (up to 94% of responses). On the other hand, base salary, as well as special duty and seniority allowances, are almost twice as often used as motivators of subordinate employees. Similarly, the equality approach and preference for subordinate employees were often (approximately 1/3 of responses) applied to bonuses, awards, insurance packages, and even more often the equality approach was applied to enabling the improvement of competences, praise and recognition, modern work tools, and team building events. Prevention and well-being programs are an instrument that is usually not used at all, and if it is used (and this is the case for 1/3 of organizations from this group), it is applied to the same degree to subordinate employees and economically dependent self-employed workers.

In the area of work system, in the organizations with this focus, task-based working time, remote work, job sharing and job crafting are usually not possible to use. At the same time, it should be noted that job sharing is available to at least an equal extent to more than 1/3 of subordinate employees and economically dependent self-employed workers, and job crafting to at least an equal extent to 15% of self-employed. In turn, the possibility of remote work is applied equally to both groups of people by one in four organizations, and also by one in four – mostly or exclusively in relation to subordinate employees, in the case of task-based working time, the analogous rates are 21% and 13%. Part-time work, as well as flexible working hours, is equally possible for both groups in half of the organizations from this cluster; part-time job is only available to subordinate employees in the case of 1/3 of employers.

5.3. Cluster 3 'Genuine equal': equal treatment of subordinate employees and economically dependent self-employed workers

Organizations in this cluster definitely apply the principles of equality, as they use various HRM instruments equally in relation to subordinate employees and economically dependent self-employed workers.

A definitely equal approach (more than 2/3 of the responses for this variant) concerns many of the HRM aspects studied in the following areas: employee influence (informing employees about organizational issues beyond the scope of tasks necessary for a given position, the possibility of expressing their own opinions, presenting their own ideas and suggestions and implementing their own ideas, having an impact on decision-making processes in the organization), human resource flow (vertical and horizontal promotion, the possibility of freely changing the project and the scope of tasks performed), work systems (fixed-term work opportunities, part-time work, remote work, task-based working time, flexible working time) and reward systems (motivating by the base salary, bonuses, awards, creating opportunities for increasing competences, praise and recognition, modern work tools, and team-building activities/events). Their scope is therefore much larger than that in the other two clusters. Some HRM solutions were declared to equally apply to subordinate employees and economically dependent self-employed workers by almost all entities from this group (in other clusters, this did not happen). This applies to: (a) providing the opportunity to express their own opinions and present their own ideas and suggestions, and (b) motivating by modern work tools and team building activities/events. Similarly, in relation to: (a) providing the opportunity to realize and implement their own ideas and projects, (b) having an impact on decision making/management processes, (c) motivating by awards, praises, and recognition, (d) remote work, and (e) part-time work, (f) fixed-term work. In addition to the equality approach, there were (although relatively rarely) organizations that did not apply the solution at all or dedicated it (mostly or only) to subordinate employees.

Slightly more often than others (although also relatively rarely), the organizations from this cluster dedicate specific practices to the economically dependent self-employed (they use them more or only in relation to economically dependent self-employed workers). However, this does not apply to the areas of reward system and work system (remote work, part-time work, fixed-term work, job sharing and job crafting), and in the case of access to information, the possibility for employees to express and implement their own ideas and projects, and having an impact on management processes, they do not favor subordinate employees (the principle of equality is most often applied). Employers in this group usually do not give the opportunity to share profits.

As pointed out, in the area of reward system, the studied organizations do not differentiate access to individual instruments depending on the form of connection with the organization (they can be equally used by subordinate employees and economically dependent self-employed workers). This also applies to reward system instruments usually not used in other organizations: private healthcare, sports cards, vouchers, and inkind prizes. They usually do not

allow (due to the specificity of workplaces) commissions, special duty and seniority allowances, holiday subsidies, job sharing, or job crafting. Prevention programs and additional days off are instruments that are usually not used at all, and if they are used, they are applied equally to subordinate employees and economically dependent self-employed workers.

6. Conclusions

The results obtained from quantitative research can be graphically presented on a continuum from organizations using HRM instruments only for subordinate employees, through those offering them equally to subordinate employees and economically dependent self-employed workers, to organizations using HRM instruments only for economically dependent self-employed (Figure 1). Greater dimming of the shape means a higher frequency of occurrence of a given type of organization.

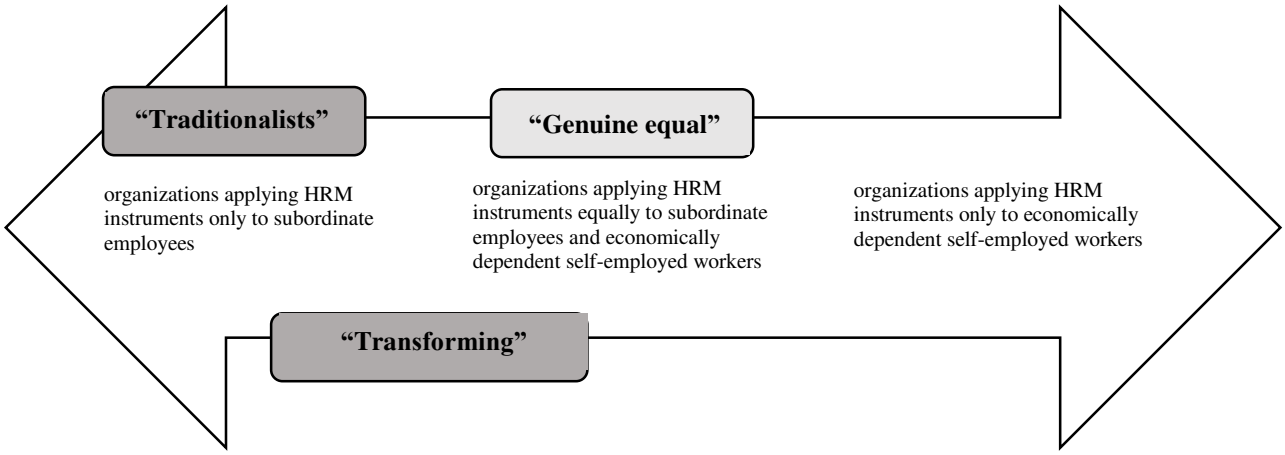

Figure 1. Breakdown of organizations in terms of the application of HRM instruments to subordinate employees and economically dependent self-employed workers.

Source: own research.

The surveyed organizations are generally located in the middle and left part of the continuum, which means that they mostly or exclusively apply equality principles (i.e., they apply various HRM instruments equally to subordinate employees and economically dependent self-employed workers) or they dedicate solutions to subordinate employees to a greater extent. None of the analyzed HRM instruments is addressed exclusively or predominantly to the economically dependent self-employed. The results of the research allowed us to distinguish three clusters of organizations differing in their approach to the differentiation of subordinate employees and economically dependent self-employed workers in the area of human resources management. The first cluster includes 40.8% of employers, the second – a similar share (41.1%), and the third – 18.2%. (1) The authors described

organizations that focus more on subordinate employees (first group) as "Traditionalists." These are mainly health care entities, and also quite often construction sector entities, and generally entities quite diverse in terms of industry and job profile. They more often have B2B employees than subordinate employees, while the turnover of employees mainly concerns workers under an employment contract. The length of service of subordinate employees working there is extensive and the length of service of economically dependent self-employed workers moderate. They rarely use a participatory approach to empowering employees. (2) "Transforming" organizations - applying a similar approach to subordinate employees and economically dependent self-employed workers, with a slightly greater focus on subordinate employees (second cluster) - are almost exclusively healthcare entities, with Polish capital, more often public than nonpublic, whose advantage is primarily related to intangible resources, in which the length of service of employees under employment and B2B contracts is long (usually over 5 years). In the last year, the turnover of employees in these organizations applied to both forms of employment to a similar extent. The organizations from this cluster employ the most employees (in both formulas), with a B2B dominance. They rarely use a participatory approach to management empowering employees. (3) The same approach to subordinate employees and economically dependent self-employed workers (third cluster) is the domain of "Genuine equal." This approach is used especially by IT and commercial companies, representing professional, scientific, and technical activities, and partly also healthcare - nearly one third of employees occupy IT positions. Companies with foreign capital (usually majority), nonpublic, less frequently large entities, with the lowest average employment but the largest share of B2B and usually over 5 years of service of employees from both groups (with a slightly lower average for B2B) represent this cluster more often than the other clusters. Their advantage is primarily related to intangible resources. They more often give independence and co-decision-making power to their employees, and the turnover in the last year mainly concerned subordinate employees.

The research results may indicate that organizations focusing more and slightly more on subordinate employees (clusters 1 and 2) in the case of some HRM instruments clearly differentiate their availability to employees depending on the form of cooperation. Thus, subordinate employees in these organizations are offered a wider range of opportunities, especially in the field of vertical and horizontal promotions as well as some monetary and nonmonetary motivators. The most equal approach in these two clusters, i.e. the use of HRM elements equally in relation to subordinate employees and economically dependent self-employed workers, is applied in the areas of employee influence, work system, and, in the case of non-monetary incentives, within the reward system area. This may partly be due to the fact that, in the case of those HRM instruments which are not linked to additional costs for organizations, companies are more likely to offer the same opportunities to economically dependent self-employed workers as to subordinate employees. On the other hand, in the case of these instruments which require additional financial outlays from the organization (mainly

in the area of reward systems: bonuses, awards, special duty and seniority allowances, vouchers or holiday subsidies), enterprises generally offer them only to subordinate employees. These differences usually do not occur in cluster 3, where organizations strongly apply the principles of equality; various HRM instruments (from each of the four areas) apply equally to subordinate employees and economically dependent self-employed workers. It is worth noting that this cluster is dominated by non-public IT, commercial companies, representing professional, scientific, and technical activities. The equal approach of these organizations, i.e., offering the employee similar working conditions regardless of the form of cooperation, may partly result from the greater difficulties of these organizations in attracting competent employees in the labor market and an attempt to create a more attractive offer in order to maintain current employees as well as to compete for highly qualified candidates. The research results are worth comparing with a few similar studies. However, these studies do not relate to the organizational perspective (as in this study), but to the employee perspective of comparing self-employment and full-time work. Millan et al. (2020) compared dependent self-employed, workers, self-employed and paid employed in terms of job control, job demands, and job outcomes. The results show that hybrid work relationships are endowed with the least favorable attributes of both groups: lower job control than self-employed workers, higher job demands than paid employees and, overall, worse job outcomes than both. Other studies, in turn, compared the working conditions of economically dependent self-employed with the genuine self-employed The results indicate that the economically dependent self-employed have poorer job prospects and less ability to use their skills and discretion than the genuine self-employed. However, in terms of the working time quality, they have better conditions than the genuine self-employed. Both groups have similar working conditions in terms of their physical and social environment and intensity of work (Horodnic et al., 2020). Studies are also being undertaken comparing workers in traditional and non-traditional employment relationships in terms of expressing voice, effectiveness of their voice in influencing management decisions, determinants, and outcomes of their voice (Oyetunde et al., 2021). On this basis, it can be assumed that there is a need for a more detailed understanding of the working conditions of dependent self-employed.

Zhang et al. (2015) note the erosion of the traditional, ‘standard employment relationship” and point to its inevitable decline in a competitive and changing global economy. However, one can only partially agree with their recommendations that HRM strategies should focus on enhancing the employability and providing employment-friendly HRM practices through offering lengthy notice periods of termination to allow employees to look for new jobs or receive training elsewhere and fostering social security and inclusion. In the case of agency workers studied, priorities and approach on the part of employers are different than in the case of Polish employers, especially those from the third cluster, who are very likely to deal with knowledge workers characterized by very high competences.

The article is also part of a broader academic discourse on HRM practices towards non-traditional workers, including gig workers. Researchers ask questions about the intersections between HRM and the employment of contract-based gig workers (Kuhn et al., 2021). They envisage a significant extension of the HR architecture model (Luo et al., 2021) and propose to extend the HR model by reconsidering the rationale for, and nature of, HRM practices associated with contractors (Keegan, Meijerink, 2023). In the context of the increasing complexity of dynamic HRM systems, HRM practices are constantly changing and need to be reintegrated into coherent and strategically focused systems (Snell, Morris, 2021).

The modern labor market is heterogeneous and subject to many changes. In enterprises, subordinate employees and economically dependent self-employed workers increasingly function side by side. Although legal aspects are quite commonly addressed in research, empirical studies that show similarities and differences in human resource management architecture with respect to these categories of employees are extremely rare. The presented paper addresses this issue by examining human resource management aimed at subordinate employees and economically dependent self-employed workers. At the results same time, the obtained pave the way for future research. It would be interesting to examine the perception and assessment of HRM practices used in particular types of organizations, as well as individual and organizational outcomes, including the motives of employees who decided to cooperate with the employer on a full-time or contractual basis. When analyzing the motives underlying management decisions, it is worth referring to the words of Morgan, who notes that when analyzing publications from recent years, it can be seen that there is a fundamental lack of consideration of some of the changes that have affected contemporary organizations, such as growing globalization, the Internet, regulations, and deregulation, and a different moral climate. Instead, the majority of these publications tend to discuss organizations as if they were still embedded in the traditional model of being a real place where people gather, while with current technological progress, many organizations are virtual ones (Morgan, 2000). Kowalski and Loretto refer to changing workplaces in the context of new challenges for employees and employers, as stakeholders attempt to navigate the introduction of new technologies amidst a dynamic business environment, keeping in mind the need to adapt to the migrant worker population or the ongoing skills shortage (Kowalski, Loretto, 2017). In the Polish context, it would be worth recognizing whether and how virtualization of the working environment, additionally dynamized by the COVID-19 pandemic and the influx of immigrants from war-torn Ukraine, is affecting the optics of Polish employers in the context of the study.

The article also contains practical implications for HR practice. It can provide guidance for organisations that have so far employed only subordinate employees, but changes in the labour market have contributed to greater employment flexibility and to start working with economically dependent self-employed workers as well. The article clearly shows how other organisations differentiate their HRM activities towards these two groups of employees, which can provide a basis for comparing their own organisation's activities. Furthermore, the results

of the survey clearly indicated that organisations applying HRM instruments equally to subordinate employees and economically dependent self-employed workers ('Genuine equal') are only 18.2 %. Thus, the practical conclusion can be drawn that such an equal approach by organisations towards different employee groups can be a strong incentive for potential employees within the Employee Value Proposition and can thus serve organisations in building a competitive advantage in the area of employer branding. This, in turn, can contribute to building employee loyalty and commitment.

The question arises as to whether the results of this research on a representative sample of Polish companies can be useful in a broader European context. It seems that although human resource management in Europe still is not a universal concept (Gooderham, Morley, Brewster, Mayrhofer, 2004; Morley, 2004) this research in each European country can stimulate discussion and future research on the issues. The research carried out for the purposes of this article contributes to the growing trend of research on subordinate employees and economically dependent self-employed workers in Poland, extending it to the perspective of human resources management. The methodological contribution of the paper can matter to a large group of scholars who could apply the methodological framework developed and used in the paper to study approaches in the field of human resource management in other countries, other contexts, and other conditions.

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MACROECONOMIC CONDITIONS OF SUSTAINABLE DEVELOPMENT OF TRANSPORT ENTERPRISES – THE CASE OF FRANCE, GERMANY AND POLAND

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Purpose: The paper's primary purpose is to assess macroeconomic conditions' impact on the sustainable development of transport companies in France, Germany and Poland from 2008 to 2020. The study is important for the stable development of the transport sector and for ensuring a balance between socioeconomic and environmental development.
Design/methodology/approach: The research goal was achieved thanks to creating sustainable development indicators using the normalization method of variables; additionally, econometric models were developed using the Ordinary Least Square (OLS) and the Seemingly Unrelated Regression (SUR) methods.
Findings: The analysis results indicate that in France, Germany and Poland, there is a positive trend in the sustainable development of transport companies. What is more, its high rates also remain at the time of the outbreak of the Covid-19 pandemic. Economic growth is an essential macroeconomic condition which positively affects sustainable development and its pillars.
Research limitations/implications: The research limitations are related to data availability at the level of sectors, the selected research period, the selection of variables, and the normalization method. Moreover, the econometric methods were selected for estimating equations.
Practical implications: The empirical implications include that the research results can help those in power (formulation of specific legal regulations and conditions for sustainable development of enterprises). Furthermore, those managing enterprises should focus not only on the company's internal situation but also on analyzing macroeconomic factors continuously.
Social implications: Social development is crucial for the sustainable development of enterprises. Therefore it is necessary to take measures to develop human capital.
Originality/value: The study's novelty is the comparative assessment of the sustainable development of the transport sector in France, Germany and Poland. In addition, it should be noted that modern statistical methods were used for the analyses.

Keywords: sustainable development, transport enterprises, macroeconomic conditions.

Category of the paper: research paper.

1. Introduction

Sustainable development of enterprises (SD) occurs in three economic, social and environmental pillars. Its basis is improving business entities' financial and property situation, developing human and intellectual capital and reducing the negative impact on the natural environment. Undertaking synchronized actions in these three pillars is part of the general economic development strategy and is important for the current and future generations (Pieloch et al., 2021; Christensen et al., 2022).

SD of the transport sector is particularly important due to its role in the country's stable socio-economic development. It should be noted that this sector is one of the largest polluters of the environment due to the high emissivity of harmful substances (Aminzadegan et al., 2022).

Researchers emphasize that the SD of transport companies has recently shown positive dynamics due to changes in laws and regulations in the field of environmental protection, technological progress, and the introduction of eco-innovations, including electric vehicles (Nundy et al., 2021; Comporek et al., 2022; Guo et al., 2022).

There has yet to be a consensus on the consequence of individual macroeconomic indicators on the direction of transport sector development. Some scientists emphasize that economic growth can negatively impact the natural environment and positively affect social development (Comporek et al., 2021; Koengkan, Fuinhas, 2022).

The paper aims to assess the impact of macroeconomic conditions, including GDP per capita, exports and imports of goods and services, wages and salaries, unemployment rate, and inflation (HICP), on the sustainable development of transport companies in France, Germany and Poland in 2008-2020. The research covers the period from the financial crisis to the Covid-19 pandemic.

The main research hypothesis follows: "The GDP growth is the most significantly important indicator for the sustainable development of transport enterprises in France, Germany and Poland from 2008 to 2020".

The article supplements the literature on the topic significantly from the economic theory and practice perspective. A novelty is an attempt to assess the situation in the sustainable development of transport companies in the period of gradual recovery from the financial crisis. The analyzed countries differ in socio-economic development and conditions for the development of the transport sector. The paper shows how the transport sector in Poland fares compared to the best-developed economies of the European Union.

The manuscript includes an introduction, theoretical background, research methodology, results, discussion and conclusions. The paper uses Polish and foreign literature on the subject, collected based on the Web of Science and Scopus databases and statistical data from the Eurostat database. To verify the research hypotheses, the author created the synthetic indicators of sustainable development of transport enterprises based on the standard method of

standardization and unitarization and used the ordinary least square method (OLS) and seemingly unrelated regression (SUR) to assess the relationship between sustainable development and macroeconomic indicators.

2. Theoretical background

Sustainable development is a model for harmonizing social, economic and environmental systems (Kryk, 2003; Misztal, 2022). The goal of SD is to use and influence natural resources and to organize social life in such a way as to maintain a high quality of life (Borys, 2005; Costa, 2022; Sun et al., 2023). The concept concerns many aspects of human activity and its relationship with the environment, and its implementation requires cooperation between states, institutions, enterprises and ordinary people.

SD entails the need to use natural resources rationally, following the standards and principles of environmental protection. The concept requires the development of innovations, including environmental innovations, information technology and new techniques for products and services (Duran, 2015; Lazaretti et al., 2020).

Sustainable enterprise development is adopting business strategies and actions that meet the enterprise's and its stakeholders' needs today while protecting, maintaining and increasing the human and natural resources needed in the future (International Institute for Sustainable Development 1992). It is based on three economic, social and environmental pillars and entails implementing innovations and modern technologies (Hilson, Murcka, 2000; Singh et al., 2008; Ozturen, Ozgit, 2022). It means that the company is on the path to sustainable development (Dvořáková, Zborková, 2013).

SD of the enterprise is a concept that considers the interests of the current and future stakeholders of the enterprise (Grudzewski et al., 2010; Zhang et al., 2022). The implementation of the concept of sustainable development should be considered holistically, and it requires thinking not only in terms of life cycle costs and individual processes but also performed activities (Eckert, Giacona, 2023).

The company's sustainable development is next to corporate social responsibility, corporate ecological responsibility, and green development. Due to this and the scope and approach to its implementation, tasks, goals and principles, there are many different definitions of the term in the literature (Table 1).

According to many researchers, the practical implementation of the principles of sustainable development allows for gaining a competitive advantage and increasing market share (Grabara et al., 2015). It is necessary to meet the following postulates: determining the impact of the enterprise on its environment, building the image based on a positive impact on the environment and society, achieving the best possible financial results, multidimensional management, testing

different business models and scenarios, implementation of continuous learning processes organization, searching for and mitigating threats in the area of achieving sustainable goals development (Burchell, 2008; Albloushi et al., 2023).

Table 1.
Selected definitions of sustainable development of enterprises

Author	Definition of "sustainable development of enterprise"
J. Elkington (1998)	Focus not only on maximizing profits, but equally on environmental and social issues.
M.E. Porter, M.R. Kramer (2002)	Sustainable development includes activities that aim to increase environmental performance and health and safety performance.
T. Dyllick, K. Hockerts (2002)	Sustainability is meeting the needs of current stakeholders without compromising the needs of future stakeholders.
C. Laszlo (2008)	A sustainable company becomes restorative – putting back on balance more than it takes from the Earth, and doing good for society.
E. Majewski (2008)	It includes everyone and everything, and its implementation requires the cooperation of people and institutions representing different professions, starting points and visions of the future.
D. Kiełczewski (2010)	It means socio-economic development in harmony with the protection of the natural environment.
W.M. Grudzewski (2010)	A sustainable enterprise is the concept of the company of 'tomorrow,' flexibly adapting to the constant turbulent changes in the environment and able to function in chaos and crisis.
L. Zu (2013)	Sustainable enterprise incorporates principles of sustainability into each of its business decisions, it supplies environmentally friendly products or services that replaces demand for nongreen products and/or services, it is greener than traditional competition, and has made an enduring commitment to environmental principles in its business operations.
T. Trojanowski (2015)	Sustainable development is a way to reduce the destructive economic activity of enterprises.
A. Pabian (2017)	A sustainable enterprise operates on the basis of sustainable resources. These resources include people, infrastructure, durable and non-durable assets, as well as any outgoing goods.
S. Singh (2018)	It requires that the triple bottom lines of long-term economic prosperity, social equity, and environmental responsibility be included in the business practice and management of enterprises
F. Hou (2019)	The sustainable development of an enterprise should not only consider the maximization of short-term shareholder wealth but also consider the importance of capital demand to the sustainable operation and investment of the enterprise from a strategic perspective
A.J. Costa (2022)	The concept of sustainable development should apply to the external environment of the organization, in other words to a certain region [country, state] in a certain period of time.
H. Sun et al. (2023)	Sustainable development capability is also a part of enterprise values and business methods.

Source: own elaboration based on the literature of the subject.

Sustainable transport means effective public, domestic and international transport that is economically beneficial and minimizes the harmful impact of vehicles on the environment. It focuses on both the control of harmful exhaust emissions and the promotion of means of transport using renewable energy. Sustainable transport also assumes limiting the destruction of urban space due to the dominance of individual car transport. Sustainable transport is achieved by limiting car traffic and developing a network of bicycle routes and public transport (Kuc-Czarnecka et al., 2023; Mohamad Taghvaee et al., 2023).

A large responsibility is on the transport companies, which should strive to reduce pollutant emissions; this is what the transition to the electrification of transport leads to, turning to greener solutions for shipping and storing goods. Moreover, it is necessary to develop environmentally friendly means of transport, such as rail and river transport, which are alternatives to traditional means of transport (Hussain et al., 2023).

Researchers emphasize that in many aspects, the sustainable development of the transport sector takes place (Kharlamova et al., 2022). Companies take active steps to reduce emissions. The economic, social and environmental indicators of transport companies in the European Union countries are improving.

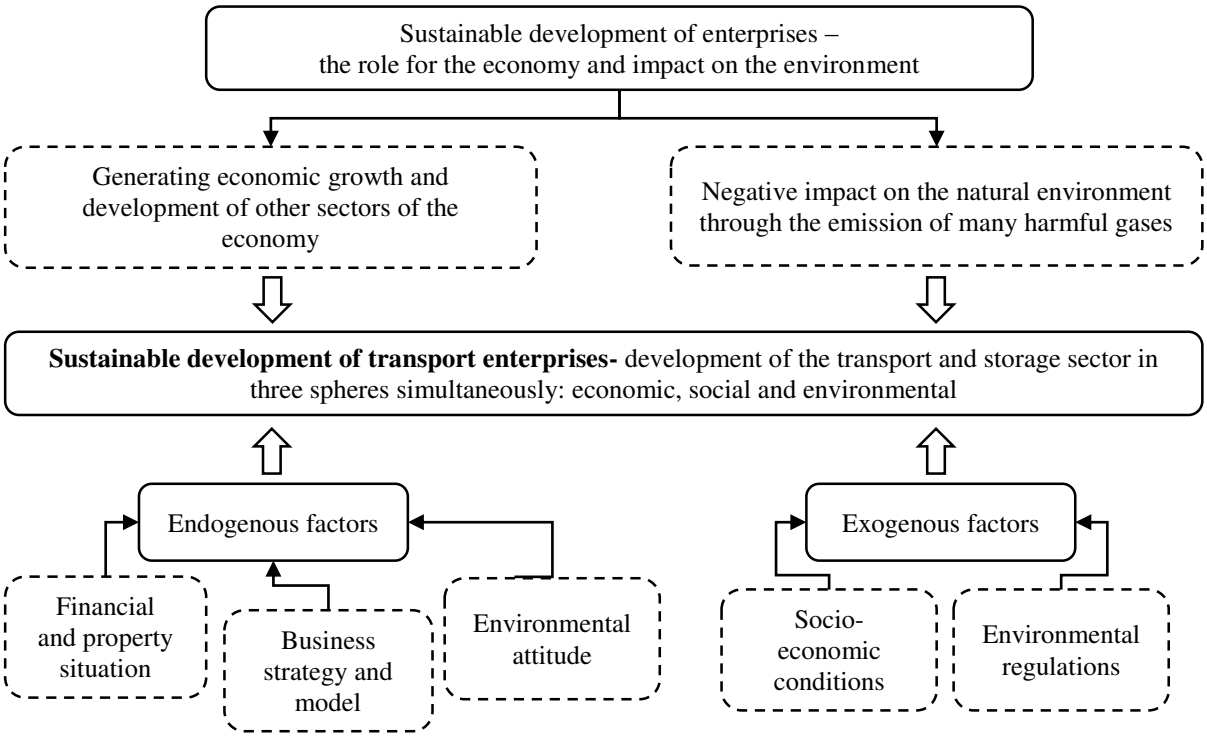


Figure 1. Sustainable development of transport enterprises and its determinants.

Source: own elaboration.

There needs to be a consensus on the impact of individual factors determining the sustainable development of transport (Pieloch et al., 2021; Comporek et al., 2022). It is emphasized that several external and internal factors condition this development. External factors include issues related to the socio-economic development of countries, legal regulations in the field of environmental protection, transport regulations, and customer expectations. Internal factors include enterprises' financial and property situation, development models and strategies, internal possibilities and capabilities in implementing innovative solutions.

3. Research methodology

The study's main aim is to assess the impact of selected socio-economic conditions on the sustainable development of Polish transport companies from 2008-2020. The Author chose three countries called the Weimer group, France, Germany and Poland as a research sample. The selection of such a research group results from the desire to compare the Polish economy with the two most developed countries of the European Union.

The research period covers the period from 2008 to 2020, i.e. the time from the financial crisis to the Covid-19 pandemic, which will allow us to notice the situation of sustainable development and its three pillars of economic, social and environmental transport companies.

The data for the analysis were taken from the Eurostat database, and they are annual data; the availability of economic, social and environmental data conditions their collection.

In connection with this research goal, the following research hypothesis is as follows "The GDP growth is the most important indicator for the sustainable development of transport enterprises in France, Germany and Poland from 2008 to 2020". Such a hypothesis results from economic growth being crucial for the transport sector's development. Moreover, its level has a special impact on the sector of transport enterprises, as its financial and property situation is significantly correlated with the situation in other sectors of the economy.

Moreover, the following sub-hypotheses were put forward:

- The dynamics of the ecological development of transport enterprises is higher than the social and economic development in the analyzed countries in the years 2008-2020.
- The beginning of the Covid-19 pandemic did not significantly affect the level of sustainable development indicators and the economic, social and environmental pillars.
- There is a strong diversification as to the impact of individual macroeconomic indicators on individual pillars of sustainable development of transport companies.

The study was conducted in the following stages:

- Stage 1: Creation of synthetic indicators of economic, social and environmental development, and based on them, the indicator of sustainable development of transport enterprises. These indicators are based on the following diagnostic variables:
  - economic development (E), based on stimulants: Enterprises - number Turnover or gross premiums were written - million euros Production value - million euros Gross operating surplus - million euros Total purchases of goods and services - million euros;
  - social development (S), based on stimulants: Wages and Salaries - million euro Social security costs - million euro Gross investment in tangible goods - million euro Employees - number Apparent labour productivity (Gross value added per person employed) - thousand euro Investment per person employed - thousands of euros and destimulants: Personnel costs - one million euros;
  - environmental development (Env): destimulants: greenhouse gas emissions.

Normalization of diagnostic variables was based on the following formulas:

- for the stimulants:

$$z_{ij} = \frac{x_{ij}}{\max\limits_{i}\{x_{ij}\}},\ z_{ij} \in [0;1]; \tag{1}$$

- for the destimulants:

$$z_{ij} = \frac{\min\limits_{i}\{x_{ij}\}}{x_{ij}},\ z_{ij} \in [0;1] \tag{2}$$

where:

z_{ij} stands for the normalized value of the *j*-th variable in the *i*-th year;

x_{ij} is the value of the *j*-th variable in the *i*-thyear;

$\min\limits_{i}\{x_{ij}\}$ is the lowest value of the *j*-th variable in the *i*-th year;

$\max\limits_{i}\{x_{ij}\}$ is the highest value of the *j*-th variable in the *i*-th year.

- To calculate the indicator of SD, E, S, and Env I assume the same impact of different indices on the aggregate measure and use the following formula:

$$SI_i = \frac{1}{n}\sum_{j=1}^{n} z_{ij},\ (i = 1,2,\dots,\ n) \tag{3}$$

where:

SI_i stands for the indicator in the *i*-year;

n is the number of metrics;

others as above.

- Stage 2: I created a model for assessing the impact of selected macroeconomic variables on the sustainable development of transport companies:

$$\widehat{SD_\iota} = \beta_0 + \beta_1 \cdot \widehat{GDP_\iota}\mathrm{i} + \beta_2 \cdot \widehat{Exp_\iota}\mathrm{i} + \beta_3 \cdot \widehat{Imp_\iota}\mathrm{i} + \beta_4 \cdot \widehat{W_\iota}\mathrm{i} + \beta_5 \cdot \widehat{Un_\iota}\mathrm{i} + \beta_6 \cdot \widehat{HICP_\iota}\mathrm{i} + \varepsilon_\mathrm{i} \tag{4}$$

- Stage 3: A model of interdependent equations was created, which I estimated using the Seemingly Unrelated Regression (SUR) method, based on the formula:

$$\begin{cases} \widehat{E_\iota} = \beta_0 + \beta 1 \cdot \widehat{GDP_\iota}\mathrm{i} + \beta 2 \cdot \widehat{Exp_\iota}\mathrm{i} + \beta 3 \cdot \widehat{Imp_\iota}\mathrm{i} + \beta 4 \cdot \widehat{W_\iota}\mathrm{i} + \beta 5 \cdot \widehat{Un_\iota}\mathrm{i} + \beta 6 \cdot \widehat{HICP_\iota}\mathrm{i} + \\ \qquad \beta_7 \cdot \hat{S}\mathrm{i} + \beta_8 \cdot \widehat{Env_\iota}\mathrm{i} + \varepsilon_i \\ \widehat{S_\iota} = \beta_0 + \beta 1 \cdot \widehat{GDP_\iota}\mathrm{i} + \beta 2 \cdot \widehat{Exp_\iota}\mathrm{i} + \beta 3 \cdot \widehat{Imp_\iota}\mathrm{i} + \beta 4 \cdot \widehat{W_\iota}\mathrm{i} + \beta 5 \cdot \widehat{Un_\iota}\mathrm{i} + \beta 6 \cdot \widehat{HICP_\iota}\mathrm{i} + \\ \qquad \beta_7 \cdot \hat{E}\mathrm{i} + \beta_8 \cdot \widehat{Env_\iota}\mathrm{i} + \varepsilon_i \\ \widehat{Env_\iota} = \beta_0 + \beta 1 \cdot \widehat{GDP_\iota}\mathrm{i} + \beta 2 \cdot \widehat{Exp_\iota}\mathrm{i} + \beta 3 \cdot \widehat{Imp_\iota}\mathrm{i} + \beta 4 \cdot \widehat{W_\iota}\mathrm{i} + \beta 5 \cdot \widehat{Un_\iota}\mathrm{i} + \beta 6 \cdot \widehat{HICP_\iota}\mathrm{i} + \\ \qquad \beta_7 \cdot \hat{E}\mathrm{i} + \beta_8 \cdot \hat{S_\iota}\mathrm{i} + \varepsilon_i \end{cases} \tag{5}$$

where:

GDP - gross domestic product (mln euro);

Ex - exports of goods and services;

Im - Imports of goods and services;

W - wages and salaries;
Un - unemployment rate;
HICP - harmonized price index.

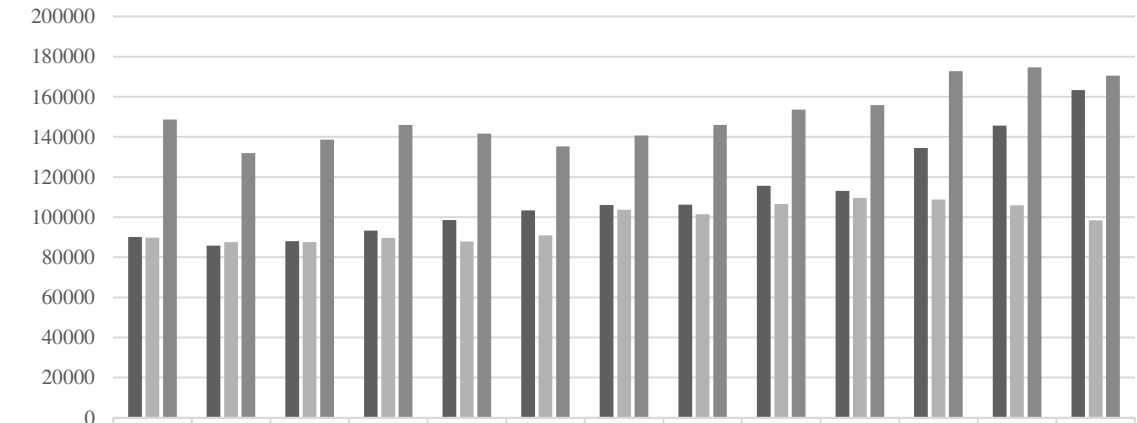
The formula for the SUR estimator is as follows:

$$\sqrt{R}\cdot(\hat{\beta}-\beta)\xrightarrow{d} N(0,(\frac{1}{R}\cdot X^{T}\cdot\left(\sum -1\otimes I_{R}\right)\cdot X)^{-1} \quad (6)$$

where:
R - the number of observations,
Ω - covariance matrix,
X - equations,
IR - the R-dimensional identity matrix;
$\otimes$ denotes the matrix Kronecker product;
$\hat{\sum}$ - the matrix;
y - vector.

4. Research results

Figure 1 presents the number of transport companies in France, Germany and Poland from 2008 to 2020. Throughout the period, the largest number of enterprises is registered in Poland, followed by France, and the smallest in Germany. It should be noted that the number of transport companies is increasing in all three countries.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
France	90073	85773	88059	93230	98574	103315	106036	106298	115627	113151	134457	145696	163436
Germany	89734	87489	87535	89704	87819	90871	103727	101415	106559	109660	108834	105903	98486
Poland	148756	131974	138649	145939	141739	135210	140736	145993	153586	155910	172850	174666	170508

Figure 1. The number of transport enterprises (research sample) from 2008 to 2020.

Source: Source: https://ec.europa.eu/eurostat/databrowser/, 20.06.2023.

The indicators of economic, social and environmental development and selected descriptive statistics are presented in Table 1. In France, the highest median level is for the social indicator and the lowest for the environmental indicator; in Germany for the economic indicator and the lowest for the environmental indicator. In Poland, the values of the indicators are lower than in the other two countries, with the highest median for the social indicator and the lowest for the environmental one.

In the discussed period, all pillars show a positive trend, which should be assessed positively, as the economic, social and environmental situation of enterprises is improving, which is the result of an improvement in the financial situation in the sector and changes in legal regulations in the field of environmental protection.

Table 1.
Economic, social, environmental and sustainable development of transport enterprises from 2008 to 2020 and its descriptive statistics

Years	France				Germany				Poland			
	E	**S**	**Env**	**SD**	**E**	**S**	**Env**	**SD**	**E**	**S**	**Env**	**SD**
2008	0,77	0,84	0,58	**0,73**	0,82	0,79	0,73	**0,78**	0,64	0,68	0,60	**0,64**
2009	0,72	0,84	0,62	**0,73**	0,73	0,77	0,80	**0,77**	0,53	0,60	0,59	**0,57**
2010	0,78	0,86	0,62	**0,75**	0,78	0,80	0,78	**0,79**	0,59	0,64	0,56	**0,59**
2011	0,81	0,88	0,61	**0,77**	0,81	0,80	0,82	**0,81**	0,64	0,70	0,55	**0,63**
2012	0,84	0,86	0,63	**0,78**	0,81	0,78	0,72	**0,77**	0,64	0,70	0,55	**0,63**
2013	0,85	0,89	0,65	**0,79**	0,84	0,78	0,71	**0,78**	0,65	0,71	0,58	**0,65**
2014	0,86	0,86	0,68	**0,80**	0,89	0,81	0,80	**0,84**	0,69	0,76	0,56	**0,67**
2015	0,89	0,90	0,68	**0,82**	0,91	0,85	0,70	**0,82**	0,72	0,80	0,54	**0,68**
2016	0,89	0,88	0,69	**0,82**	0,91	0,84	0,73	**0,83**	0,76	0,69	0,47	**0,64**
2017	0,91	0,92	0,70	**0,84**	0,96	0,89	0,69	**0,85**	0,82	0,75	0,42	**0,66**
2018	0,92	0,91	0,72	**0,85**	0,97	0,91	0,67	**0,85**	0,97	0,88	0,41	**0,75**
2019	0,98	0,96	0,70	**0,88**	0,97	0,95	0,72	**0,88**	0,99	0,90	0,92	**0,94**
2020	0,81	0,88	1,00	**0,89**	0,87	0,90	1,00	**0,92**	0,98	0,92	1,00	**0,97**
Max	0,98	0,96	1,00	0,89	0,97	0,95	1,00	0,92	0,99	0,92	1,00	0,97
Min	0,72	0,84	0,58	0,73	0,73	0,77	0,67	0,77	0,53	0,60	0,41	0,57
Mean	0,85	0,88	0,68	0,80	0,87	0,84	0,76	0,82	0,74	0,75	0,60	0,69
Mediana	0,85	0,88	0,68	0,80	0,87	0,81	0,73	0,82	0,69	0,71	0,56	0,65
St.d.	0,07	0,03	0,10	0,05	0,07	0,05	0,08	0,04	0,15	0,10	0,17	0,12

Source: https://ec.europa.eu/eurostat/databrowser/, 20.06.2023.

Figure 2 shows the sustainable development of transport companies from 2008 to 2020. The results of the study indicate that there is a positive SD trend in France, Germany and Poland. Interestingly, in 2020, i.e. in the year of the Covid-10 pandemic, this indicator did not deteriorate, and in the case of Poland, it even increased. To a large extent, this is due to the reduction in the emission of harmful substances into the natural environment due to restrictions on conducting business activities and temporary lockdowns.

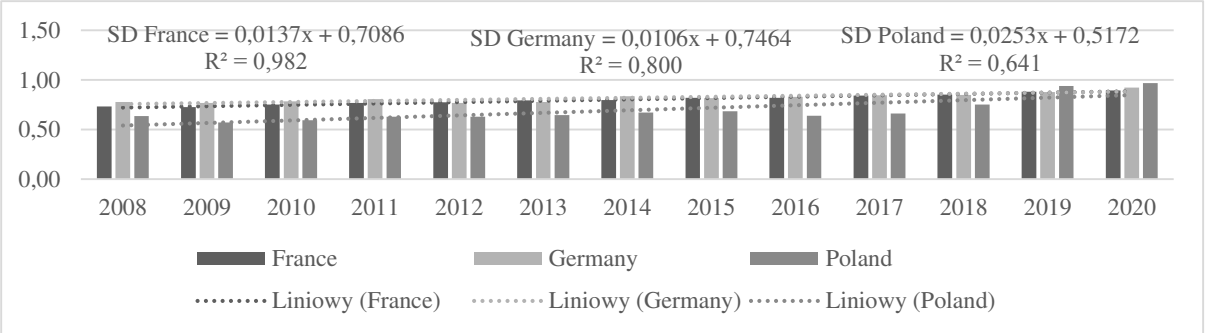


Figure 2. Sustainable development of transport enterprises from 2008 to 2020.

Source: Source: https://ec.europa.eu/eurostat/databrowser/, 20.06.2023.

The results of the OLS estimation are presented in Table 2. A clear, statistically significant impact of GDP on the sustainable development of transport enterprises in France, Germany and Poland was recorded in each analyzed country. In addition, in the case of France, a negative impact of exports on the SD value of transport enterprises was noted, while in Poland, sustainable development also depends on the value of this indicator in the previous period, which indicates the continuity of processes related to the sustainable development of the transport sector taking place in this country.

Table 2.
The OLS estimation

Country		*Coefficient*	*Std. Dev.*	*p-value*
France	const	−0,110683	0,0720993	0,1558
	GDP	5,42438e-07	6,47090e-08	<0,0001
	Exp	−4,10844e-07	1,20725e-07	0,0067
	R^2=0,964470			
	LM = 7,60104; p = P(Chi-kwadrat(5) > 7,60104) = 0,179637			
	Chi-kwadrat(2) = 0,125789; p = 0,939042			
	LMF = 0,739604; p = P(F(1, 9) > 0,739604) = 0,41211			
Germany	const	0,476896	0,0547967	<0,0001
	GDP	1,16400e-07	1,84275e-08	<0,0001
	R^2 =0,783891			
	LM = 1,64139; p = P(Chi-kwadrat(2) > 1,64139) = 0,440127			
	Chi-kwadrat(2) = 2,73033; p = 0,255338			
	LMF = 0,0495607; p = P(F(1, 10) > 0,0495607) = 0,828311			
Poland	const	−0,167350	0,0947324	0,1111
	GDP	1,01965e-06	2,76507e-07	0,0050
	$SD_{(t-1)}$	0,643625	0,195316	0,0093
	R^2= 0,906512			
	LM = 7,08206 p = P(Chi-kwadrat(5) > 7,08206) = 0,214608			
	Chi-kwadrat(2) = 3,12508; p = 0,209602			
	LMF = 2,57012; p = P(F(1, 8) > 2,57012) = 0,147567			

Source: https://ec.europa.eu/eurostat/databrowser/, 20.06.2023.

Table 3 presents the results of estimating interdependent equations using the SUR method. They show that the individual pillars of sustainable development depend on various macroeconomic factors. Moreover, the level of economic growth is also crucial for developing

the sector in its three dimensions, and this may be because this sector plays for economic development and how strongly it depends on the financial situation of other sectors.

Table 3.
The SUR estimation: dependent variables: E, S, Env

Country	Variable		Coefficient	Std. D.	P-value	R2
France	E	const	−0,307241	0,0545062	0,0003	0.98
		Env	−0,324455	0,0309831	2,43e-06	
		GDP	5,55886e-07	1,93112e-08	3,59e-010	
		Un	0,0182773	0,00368869	0,0008	
	S	Const	0,644328	0,0525159	2,37e-07	0.89
		E	0,438793	0,0441894	1,70e-06	
		Un	−0,0142293	0,00423029	0,0072	
	Env	const	−2,07130	0,491697	0,0040	0.97
		E	−2,42080	0,323779	0,0001	
		GDP	2,29712e-06	2,77312e-07	7,29e-05	
		Ex	−1,54630e-06	6,14003e-07	0,0399	
		Un	0,0832354	0,0170099	0,0018	
		HICP	0,0202278	0,00895590	0,0585	
Germany	E	const	0,317308	0,0842674	0,0044	0,967772
		GDP	5,50828e-07	1,14798e-07	0,0010	
		Wag	−6,88582e-07	2,22041e-07	0,0127	
		Env	−0,283526	0,0413290	7,39e-05	
	S	const	−0,749984	0,155946	0,0013	0,976978
		GDP	1,67868e-07	4,22586e-08	0,0041	
		Im	6,19601e-07	1,48793e-07	0,0031	
		Unep	0,0827545	0,0121518	0,0001	
		HICP	−0,0183637	0,00627481	0,0191	
	Env	const	1,45504	0,160095	3,79e-06	0,682976
		GDP	4,72741e-07	8,52760e-08	0,0002	
		E	−2,40988	0,388184	0,0001	
Poland	E	const	0,311942	0,0766714	0,0048	0,995605
		GDP	−2,64879e-06	8,09858e-07	0,0137	
		Im	3,19255e-06	6,22500e-07	0,0014	
		Wag	5,25476e-06	1,30361e-06	0,0050	
		Un	−0,0107163	0,00253885	0,0039	
		S	0,373762	0,104924	0,0092	
	S	const	−0,457819	0,187475	0,0372	0,940299
		GDP	3,93154e-06	8,07355e-07	0,0009	
		Ex	−2,63182e-06	9,47812e-07	0,0215	
		Un	0,00982750	0,00501692	0,0818	
	Env	const	−1,73286	0,326079	0,0003	0,784380
		GDP	1,66351e-05	2,49399e-06	5,57e-05	
		Im	−2,40964e-05	3,85149e-06	9,43e-05	

Source: https://ec.europa.eu/eurostat/databrowser/, 20.06.2023.

The research results indicate that macroeconomic conditions are statistically significant for the sustainable development of enterprises. A positive phenomenon is that the dynamics of sustainable development are positive in the analyzed period. The key issue for the stable development of the transport sector is to conduct a rational and sustainable macroeconomic policy.

5. Discussion

The sustainable development of transport enterprises in France, Germany, and Poland showed a positive trend from 2008 to 2020. The level of this development is varied, with the Polish transport sector showing the highest development dynamics. Moreover, one has to agree with the majority of scientists who indicate in studies that it did not deteriorate at the time of the outbreak of the Covid-19 pandemic (Wang, Huang, 2021; Comporek et al., 2022; Clemente-Suárez et al., 2022); this is because emissions of harmful substances into the atmosphere have significantly decreased due to temporary restrictions on conducting business.

In addition, it should be emphasized that in 2019 and 2020, the sustainable development of Polish enterprises exceeded this development in France and Germany. Undoubtedly, the analyzed period shows that sustainable development takes place gradually, requires both economic and social conditions, and environmental protection regulations influence the involvement of sectors and their level. Introducing new, more restrictive environmental standards means that transport companies must implement innovative green solutions in their operations and switch to low-emission means of transport.

The research results confirm that macroeconomic conditions are important for the sustainable development of transport companies (Comporek et al., 2022). At the same time, the GDP level is crucial for the sustainable development of enterprises in the surveyed countries. The main research hypothesis is true. Thus, the analysis confirms other researchers' research results, simultaneously indicating that the direction of this influence is positive (Prus, Sikora, 2021; van Zanten, van Tulder, 2021; Bao et al., 2023).

The first sub-hypothesis of the research is also true because the environmental pillar is developing the fastest, which is a positive phenomenon proving that ecological solutions are being introduced in the sector of transport companies to reduce its emissivity.

The second sub-hypothesis is also true because the Covid-19 pandemic has not hurt sustainable development. The environmental pillar largely influenced this state of affairs, while it is noticed that the economic and social pillars slightly deteriorated.

The third sub-hypothesis is also true because the impact of macroeconomic factors on the individual pillars of sustainable development varies in terms of direction and strength of impact. At the same time, one of the essential aspects is to maintain an appropriate pace of economic growth, which affects both the economic, social and environmental dimensions of development.

The individual pillars of development, economic, social and environmental, vary depending on the analyzed macroeconomic conditions. Thus, to assess sustainable development, it is important to analyze various macroeconomic variables to respond best to the opportunities and threats related to implementing the sustainable development strategy.

The study has research limitations related to data availability at the level of sectors, the selected research period, the selection of variables, and the normalization method. Moreover, the econometric methods were selected for estimating equations.

Despite certain limitations, the study allows for formulating several theoretical and empirical implications. Theoretical implications include reviewing the literature on the subject and formulating a definition of sustainable development and research methodology. The empirical implications include that the research results can help those in power (formulation of specific legal regulations and conditions for sustainable development of enterprises). Furthermore, those managing enterprises should focus not only on the company's internal situation but also on analyzing macroeconomic factors continuously.

6. Conclusions

Sustainable development, including simultaneous development in three economic, social and environmental areas, is crucial for the stable development of current and future generations. The study shows that its dynamics are positive, and it recorded the greatest progress in Poland.

Macroeconomic conditions have a statistically significant impact on the sustainable development and its pillars. At the same time, economic growth, which increases the level of green investments, is of pivotal importance.

Further scientific research will be devoted to assessing the impact of geopolitical conditions related to the war in Ukraine and related social and economic turmoil and problems on the sustainable development of enterprises in selected sectors of the economies of Central and Eastern Europe.

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THE IMPACT OF VALUES ON THE PROCESS OF SHAPING THE INTENTIONS OF SUSTAINABLE ENTREPRENEURSHIP

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Purpose: The growing need to achieve the goals of sustainable development has extended the role of entrepreneurs to "eco or green-entrepreneurs" who, through commercial entrepreneurial activities, strive to solve social and environmental problems. In this context, it is important to define the intentions of entrepreneurs that influence the creation of new ventures that take into account the principles of sustainable development. The article aims to fill the gap in the impact of four values such as: social altruism, environmental altruism, egoism, and hedonism on the process of shaping intentions in the field of sustainable entrepreneurship among young people.
Design/methodology/approach: In this study, in addition to the analysis of the literature on the subject, the results of surveys conducted in the period from March to May 2023, among 156 secondary school students, were used. The test of impartiality $\chi 2$ and T Czuprow's convergence coefficient were used in the study, with a significance level of $\alpha = 0.05$.
Findings: This study identifies the values influencing future green business creation. From a practical point of view, the results suggest that in the process of shaping entrepreneurial intentions, values that go beyond the individual are of the greatest importance.
Research limitations/implications: The research carried out is an implication for further research, including new values that affect the process of entrepreneurial intentions in the field of sustainable development. This will allow us to define the future attitudes of sustainable entrepreneurship.
Originality/value: Previous research on the impact of values on pro-environmental entrepreneurial intentions concerned mainly the study of students, not including young people aged 15 to 19. Thus, this research is the basis for shaping curricula related to sustainable entrepreneurship.

Keywords: entrepreneurial intentions, entrepreneurship, sustainable entrepreneur, values, sustainable development, VBN theory.

Category of the paper: Research paper.

1. Introduction

Entrepreneurship plays a key role in every economy, and with it the person of the entrepreneur. This is because as a result of entrepreneurial activities, innovations are generated (Valliere, Peterson, 2009; Baron, Tang; 2011), new jobs are created (Morris et al., 2015; Moses et al., 2016; Ivanovi-Djuki et al., 2018), the potential of human capital is developed (Van Praag, Versloot, 2007; Blumberg, Pfann, 2016), and risk is taken (Vereshchagina, Hopenhayn, 2009; Ha et al., 2021), resulting in an increase in exports, progress technological, productivity, competitiveness and economic growth of the country (Coulibaly et al., 2018; Abdesselam et al., 2018; Nakara et al., 2020).

According to E. Herman (2019, p. 319), entrepreneurship is considered an important mechanism generating sustainable and socially inclusive development. In this context, the role of the entrepreneur changes. This is because entrepreneurs are increasingly recognized as responsible for solving current social and environmental problems (Hockerts, Wüstenhagen, 2010; Evans et al., 2017). Recognition of entrepreneurship as a solution, and not as a cause, of environmental degradation and social inequalities shifted the field to identify a new type of entrepreneurial activity, namely sustainable entrepreneurship (Muñoz, Cohen, 2018, p. 300). Sustainable entrepreneurship refers to the discovery, creation and exploitation of entrepreneurial opportunities that contribute to sustainable development by generating social and environmental benefits for other members of society (Groot, Pinkse, 2015, p. 634). In this approach, sustainable entrepreneurship is mentioned as a link between business and the concept of sustainable development. Compared to ordinary entrepreneurs, it is believed that sustainable entrepreneurs face special challenges when setting up a business. These challenges may stem from the mismatch between private value creation and social value creation (Dean, McMullen, 2007; Shepherd et al., 2011; Shepherd, Patzelt; 2011; Hoogendoorn et al., 2019; Terán-Yépez et al., 2020). According to the definition of sustainable development, sustainable entrepreneurs must take into account the needs of future generations, while pursuing economic, social and environmental goals (Zahra et al., 2009; Hall et al., 2010; Ruiz-Ruano, Puga, 2016; Belz, Binder; 2017; Le et al., 2021). In other words, sustainable entrepreneurship is focused on economic prosperity, social equality and environmental protection. Based on these three concepts, sustainable entrepreneurship should be contracted in terms of a long-term economic process whose goals have been taxonomically ordered towards making profits through an enterprise exploiting market opportunities from a social and environmental perspective (Mohan, 2022).

The condition for the implementation of entrepreneurial activities, including sustainable entrepreneurship, is the development of entrepreneurial intention. The aim of the article is to determine, in accordance with the VBN theory, the impact of four values, such as: social altruism, environmental altruism, egoism, and hedonism, on the entrepreneurial intentions of

secondary school students in the field of sustainable development. These values were divided into two main groups: going beyond the individual (altruistic and environmental values) and enriching the individual (egoistic and hedonistic values).

2. Page setup, formatting, notes – first level numbering

As Zamrudi & Yulianti (2020) rightly notes, however, entrepreneurial activity does not appear overnight. It is a process spread over time, which consists of a number of various activities. Researchers of the problem agree that entrepreneurial activities (leading to the establishment of an enterprise) are a manifestation of planned, purposeful behavior. Increasingly, the key word to understand the mechanisms of these behaviors are the so-called entrepreneurial intentions (Najafabadi et al., 2016; Ridha, Wahyu, 2017; Tsai et al., 2016; Vamvaka et al., 2020).

According to McSweeney et al. (2022) entrepreneurial intentions are considered one of the strongest predictors of entrepreneurial behavior, defined as a commitment to create a new venture (Obschonka et al., 2017). On the other hand, Thompson (2009, p. 676) is of the opinion that entrepreneurial intentions are a conviction about the intention to create a business venture and conscious planning to create this process in the future. Linan and Chen (2009) believe that an individual's entrepreneurial intentions are an expression of his or her approach to entrepreneurial behavior and therefore depend on the perception of reality. In view of the above, they can be called cognitive variables, which in turn gives the opportunity to delve into the complex processes of entrepreneurship. In a word, entrepreneurial intention is a psychological state that directs an individual's attention to specific business goals in order to achieve entrepreneurial results (Santos et al., 2016; Byrne, Fayolle, 2016). Entrepreneurial intentions result mainly from having certain characteristics of entrepreneurs, such as the need for achievement, motivation to act, self-efficacy, openness, risk tolerance (Garrido-Yserte et al., 2020; Borsi, Dőry, 2020; López-Núñez et al., 2020). Mohan (2022) believes that intentions result from the influence of the external environment. In turn, Palmer et al. (2019) believe that attitudes towards entrepreneurship, subjective norms, self-esteem, internal locus of control, and perceived behavioral control are important antecedents of entrepreneurial intentions. Liñán and Chen (2009), Chattopadhyay and Ghosh (2008) recognize that intentions are the result of a cognitive process, needs, beliefs, expectations or values that influence the way entrepreneurs think and shape their approach to business. Considering sustainable entrepreneurship, entrepreneurial intentions should translate into attitudes or behaviors that have an impact on society.

Compared to conventional entrepreneurship, sustainable entrepreneurship is a "value-laden" concept, and sustainable entrepreneurs rely on certain values as guiding principles. These values not only influence the way entrepreneurs think, but above all shape their approach to business (Muñoz, Dimov, 2015; Muñoz, 2018). Steg and De Groot (2008) claim that values have a significant impact on behavior, including intentions, and even guide them. In the context of setting up a sustainable enterprise, values imply the mindset of the entrepreneur, which is consistent with the VBN (value-belief-norm theory) (Stern, 2000). According to the VBN theory, pro-environmental behavior is more likely to occur when there is a causal chain (i.e. values, beliefs and personal norms) (Jansson et al., 2011; Sahin, 2013; Lind et al., 2015).

The VBN theory in its essence revealed that three values influence the shaping of sustainable attitudes: egoistic (care for one's own good), altruistic (care for the good of others) and biosphere (care for non-human aspects of life, i.e. the environment) (Stern et al., 1999; Steg, De Groot, 2008; 2010; Steg et al., 2014; Kiatkawsin, Han, 2017). Steg et al. (2014) showed that in order to understand the beliefs, preferences and actions important for the environment, in addition to the above values, hednonistic values that affect the way of making decisions are important. It should be remembered that values are deeply rooted and established at an early stage of an individual's life. They influence beliefs in the field of sustainable development, which in turn lead to specific actions of the individual. As a consequence of being aware of the potential impact of an individual's activity on the environment, they have a sense of responsibility attributed to them (Ciocirlan et al., 2020). Previous studies (Pradhananga et al., 2017; Riper et al., 2020; Thelken, de Jong, 2020) have shown that these values, on the one hand, go beyond the individual, and on the other, enrich it. Of course, the way in which values shape pro-environmental behavior often differs from person to person. Values beyond the individual (altruistic and biospheric) are assumed to pursue general well-being, while egoistic and hedonic values (values that enrich the individual) emphasize private gain and personal well-being. This makes it possible to determine the positive and negative impact on the formation of entrepreneurial intentions. Therefore, the following hypotheses were put forward:

H1: Values beyond the individual: altruistic (a) and biospheric (b) shape sustainable entrepreneurship among youth.

H2: Values enriching the individual - selfish (a) and hedonistic (b) have no impact on shaping sustainable entrepreneurship among youth.

3. Research methodology and research sample

In order to examine the impact of values on the process of shaping the intentions of sustainable entrepreneurship, a questionnaire containing a 16-item value measure proposed by Steg et al. (2014) (table 1).

All variables were measured on a seven-point Likert scale, where 1 defined the least significant value, and 7 - the guiding principle of creating a sustainable enterprise.

The purposeful sampling method was used to collect data by means of a survey questionnaire, referring to the purposeful selection of participants due to specific characteristics. (Etikan, 2016; Li, Chen, 2023). According to Ghazali et al. (2019) this technique does not require basic theories or a specific number of participants. The main criterion of the target sample was the desire to start own business. The second criterion was the willingness to rationally use natural resources, which is in line with the essence of sustainable development.

Table 1.
Variables to be analyzed

Variables	explanation of variables	
Going beyond the individual	Altruism	equality
		social justice
		the world in peace
		work for the benefit of others
	Biospheric	respect for the land
		unity with nature
		preventing pollution
		environmental protection
Enriching the individual	Egoism	wealth
		Influencing people
		power
		diligence
		dominance
	Hedonism	satisfying desires
		joy of life
		satisfaction, self-realization

Source: own elaboration based on: Steg et al., 2014; Thelken, de Jong, 2020.

And so, 156 secondary school students took part in the study, who voluntarily filled in a prepared questionnaire. Data collection took place from March to May 2023. The characteristics of the study environment showed that mainly young women took part in the study - 91 people - 58.3%, 41.6% were men. People aged 15 to 19 took part in the study, the average age was 17,3.

The obtained data were subjected to statistical analysis, in which a choice was made between two contradictory hypotheses:

H^0: value not affecting the development of sustainable entrepreneurship,

H^1: value influencing the development of sustainable entrepreneurship.

For the estimation of H0 and H1, arithmetic means, the $\chi 2$ test of fairness and the Czuprow T convergence coefficient were used, at the significance level.

4. Results and discussions

The study referred to the impact of values on entrepreneurial intentions in the field of sustainable entrepreneurship. Taking into account the average ratings (Table 2), it can be seen that the shaping of pro-ecological attitudes is influenced primarily by altruistic values (average 4.6), biospheric values (average 4.5) and hedonistic values (average 4.2). As can be seen, egoistic values have the least impact on these attitudes (average 3.4). In turn, taking into account the individual variables characterizing the given values, the most important in the process of entrepreneurial intentions are equal opportunities for all (average 5.5) and environmental protection (average 5.1).

Table 2.
Average values of individual values

variables		explanation of variables	average ratings of individual variables	total grade average
Going beyond the individual	Altruism	equality	5,5	4,6
		Social justice	4,2	
		The world in peace	4,8	
		work for the benefit of others	3,9	
	Biospheric	respect for the land	4	4,5
		unity with nature	4,3	
		preventing pollution	4,6	
		environmental protection	5,1	
Enriching the individual	Egoism	wealth	3,6	3,4
		influencing people	3,2	
		power	3	
		diligence	4,4	
		dominance	2,7	
	Hedonism	satisfying desires	3,7	4,2
		joy of life	4,4	
		satisfaction, self-realization	4,5	

Source: own analysis.

As Paztelt and Shepherd (2011) point out, altruism, treated as a motivation to improve the quality of life of another person, is not in itself a sufficient explanation of sustainable entrepreneurial intentions, but it should be distinguished by concern for the environment. The results of this study showed that for H1a and H1b (Table 3) the null hypothesis should be rejected in favor of the alternative hypothesis. In view of the above, it can be concluded that values such as altruism ($\chi 2$ = 33.32; T-Czuprow 0.14) and biospheric values ($\chi 2$ = 34.54; T-Czuprow 0.13) are consistent and largely affect the establishment of a sustainable enterprise.

Table 3.
Relationships between values that go beyond the individual and shaping sustainable entrepreneurship

Variables	Stat value	Gauge value	The value that determines the rejection area	Accepted hypothesis
Altruism	33,32	0,14	31,41	H^1
Biospheric	34,54	0,13		H^1

Source: own analysis.

Considering H2 (Table 4), it should be noted that in the case of values enriching an individual, sustainable entrepreneurship is influenced by hedonic values ($\chi 2$ = 32.45; T-Czuprowa 0.13). Thus, previous studies (Stek et al., 2015; Thelkena, de Jong, 2020) confirm that in the case of young people, selfish values have a negative impact on entrepreneurial intentions.

Table 4.
The relationship between the values that enrich the individual and the development of sustainable entrepreneurship

Variables	Stat value	Gauge value	The value that determines the rejection area	Accepted hypothesis
Egosim	14,95	0,08	31,41	H0
Hedonism	32,45	0,13		H1

Source: own analysis.

The results show that all hypotheses were approved except for one, i.e. H2b, where selfish values focus mainly on the interests of the entrepreneur, ignoring the needs of other stakeholders, such as employees, customers, local community or the natural environment. In practice, this means taking actions that maximize profits and benefits for the entrepreneur or enterprise, even if it is at the expense of others. It was also found that other values in the context of sustainable entrepreneurship positively shape intentions in this regard. And so, altruism can refer to taking actions that benefit other people and society, even if they do not bring immediate profit to the entrepreneur. In turn, care for the environment means taking actions aimed at minimizing the negative impact of business activity on the natural environment and promoting sustainable development practices. In the context of sustainable development, hedonism can be positive if it is integrated with altuism and taking into account the principles of sustainable development.

5. Conclusions

Katz-Gerro et al. (2017) argue that values are formed at an early stage of life, therefore they play a significant role in shaping attitudes and environmental behavior. It should also be remembered that entrepreneurship now appears as a value in itself, expressed in various forms

of entrepreneurial activities. The study confirmed that the values that go beyond the individual (Romero-Colmenares, Reyes-Rodríguez, 2022), as well as those that enrich the individual in the form of hedonic values (Stek et al., 2014) have a significant impact on shaping the intentions of sustainable entrepreneurship. Previous research on the impact of values on pro-environmental entrepreneurial intentions concerned mainly the study of students, not including young people aged 15 to 19. Thus, this research is the basis for shaping curricula related to sustainable entrepreneurship. Strengthening the intentions of young people in the field of sustainable entrepreneurship already at the school stage is the basis for shaping values as well as the basis for pursuing your career as future entrepreneurs. Appropriate education in sustainable entrepreneurship influences entrepreneurial intentions and creates the ability to be flexible, willing to conceptualize thinking, imagination, creativity and seeing change as an opportunity, combined with care for the natural, social and economic environment.

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ANALYSIS OF URBAN TRANSPORT IN THE PERIOD BEFORE AND DURING THE COVID-19 PANDEMIC – A CASE STUDY

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Purpose: The purpose of this article is to analyze and evaluate public transportation before and during the COVID-19 pandemic.
Design/methodology/approach: The research problem is to what extent the operations of a public transportation company changed during the COVID-19 pandemic. Main hypothesis: actions taken by the urban transportation company caused positive changes in transportation operations during the COVID-19 pandemic. The method used in the article is a case study, analysis of internal company data and method of a document examination.
Findings: At Miejski Zaklad Transportu Sp. z o.o. (MZK) Koszalin (MTC) during the COVID-19 pandemic, current liabilities increased to 9,392.51 thousand PLN in 2019 and decreased by 26.49 percent in 2020 during the pandemic, and operating expenses decreased by 4.91 percent, including material and energy consumption by 18.49 percent. The level of inventories remained constant. Due to increased losses of 67.97 percent
Research limitations/implications: Difficult access to data/extension of the research period.
Practical implications: The company took measures for passenger's safety like purchasing ticket machines. It is necessary to continuously modify existing lines and launch four new lines to three neighboring municipalities.
Social implications: Increasing safety and accessibility for passengers, improving the quality of life of residents.
Originality/value: The article shows the phenomenon and scale of public transport in the era of a pandemic. Similar situations may occur with other social, economic or geopolitical threats (crises).

Keywords: urban transport; pandemic COVID-19; protection of passengers.

Category of the paper: Case study.

1. Introduction

The proper functioning and development of public transport enterprises depends, among others, on economic stability, market opportunities and business potential. The changing expectations of society, often e.g. resulting from the improvement of the quality of life, force carriers to constantly develop (improve), by modifying the rolling stock, changing and creating new lines, attractive ticket prices, service delivery time, etc. Not all enterprises are prepared for such external factors, especially for sudden crisis situations, i.e. a pandemic or an economic (energy) crisis. The risk and effects of crisis situations are increasing, forcing managers of companies to act more quickly and flexibly. It is also an important research area for science, because certainty such phenomena can be analyzed in many ways.

During the COVID-19 pandemic, many enterprises changed their activities, commercial companies entered the e-commerce market, and most manufacturing enterprises in-creased their stocks on the supply side. There is no information on what actions have been taken in the field of a public transport. The Polish and foreign subject on the effects of the COVID-19 pandemic is illustrated by many publications on aspects of transport, in particular a public transport. The authors of these publications analyzed, among others, the relationship between the impact of the pandemic and changes in a transport behavior and expectations, working conditions, a social activity, a transport policy or a transport system efficiency. The analysis of these phenomena was to provide guidance on how to manage the organization of public transport (e.g. Miejski Zaklad Transportu Sp. z o.o. (MZK) Koszalin (MTC)) in order to maintain transport balance and provide a guarantee of epidemiological safety for customers and an economic safety in the era of the pandemic crisis. Actions aimed at a specific goal become important, which improves the socioeconomic image, despite unprofitable services provided in this period. Therefore, in the case of public transport, sources of financing activities and a development are important.

However, the study of the most important databases (Web of Science, Scopus) showed that there are few publications focusing on assessing the correlation of the impact of the pandemic on the economic and planning sphere of a transport entity. It can there-fore be concluded that the issues raised in the article in general assessment are rarely studied, and the literature is limited. Therefore, with this publication, the authors want to fill the research gap.

The purpose of this publication is to analyze and evaluate the public transportation before and during the COVID-19 pandemic. The research problem is to what extent the operations of a public transportation company changed during the COVID-19 pandemic.

In addition, the main hypothesis was formulated: the actions taken by the urban transportation company caused positive changes in transportation operations during the COVID-19 pandemic.

Particular hypotheses were formulated:

- [H1] The COVID-19 pandemic positive caused an increase in costs at the MTC enterprise.
- [H2] The COVID-19 pandemic affected the development of the enterprise by raised investment.
- [H3] During the COVID-19 pandemic, the increased the safety of passengers and employees from negative effects such as illnesses and layoffs.

The considerations presented in the study, supported by the results, can be used as a way to gain an adequate knowledge about the functioning of market mechanisms in public transport in crisis situations, e.g. the COVID-19 pandemic; an energy crisis, a geopolitical situation. Increasing the amount of information supported by data in a given field (practice, experience of others) can speed up the process of making planning decisions (strategic, tactical and operational) aimed at increasing the guarantee of proper functioning and ensuring the development of the organization while reducing the level of customer satisfaction. This publication has the following structure: it begins with an analysis of the subject, followed by an original approach to research. Then, as part of the research presentation, a case study is presented. The authors have tried to present the relationship between the COVID-19 pandemic and its aspects and the direction of changes in individual factors determining the provision of services. In this part of the work, a comparative analysis was used. After presenting the research results, the authors show how the organization adapted to the pandemic situation, implemented restrictions and government support, and other restrictive changes necessary to apply during the pandemic. The publication ends with the authors' conclusions and limitations in the research process.

2. Literature review

The effects of the COVID-19 pandemic were visible throughout the global economy. All economic sectors, including transport, have passed an important test of their ability to adapt to sudden crisis situations. Epidemiological restrictions have affected the conduct of business activities, forcing actions to guarantee safety (Camargo, 2021; Anderson, 2020) or a sense of security in the functioning of the entity and the work of its employees, as well as potential customers (Khan, Upadhayaya, 2020; Olkiewicz, Wolniak, 2018).

Transport organizations faced new challenges, which had to adapt their functioning during the pandemic to the restrictions implemented by governments and WHO, as the literature and practice indicated the transmission and development of the virus by air (WHO, 2020; Pawar et al., 2020; Muley et al., 2020; Germann et al., 2006). This was particularly evident in the case of public transport, both in the area of planning and meeting customer needs after the

introduction of the social distancing, the obligation to wear masks or partial lockdown in some sectors (Anderson et al., 2020; Lewnard, Lo, 2020; Musselwhite et al., 2020; Moreno et al., 2021).

The sense of security has become a determinant of customer behavior, regardless of age, gender, profession or lifestyle when choosing a means of transport, as the probability of infection may be higher in it. However, it should be remembered that public transport is the best alternative to ensure effective and safe mobility of the society (Chen et al., 2022; Gutiérrez et al., 2020). It can be said that mobility has acquired a new dimension and meaning. Fear, fear of infection, and in the worst case, death caused by the SARS-CoV- infection, or other factors may reduce the willingness to use public transport in favor of bicycles, electric scooters, own means of transport or walking. (Edwards, 2020; Circella, 2020; Mohammadian et al., 2020; Askitas et al., 2020; Yap et al., 2010; Kraemer et al., 2020; Abdullah et al., 2020; Parady et al., 2020)

Such actions indicate a high level of individual and a collective awareness and a social responsibility (Wolniak et. al., 2021; Wyszomirski, Olkiewicz, 2020).

Although many serious measures have been implemented by the public transport authorities and operators since the outbreak of the pandemic (Naletina, 2021):

- Adapting the transport supply;
- Improving cleaning and disinfection procedures;
- Supplying protective equipment to their staff and passengers;
- Ensuring staff and passengers comply with health regulations;
- Increasing the level of natural ventilation and air renewal;
- Accelerating the digitalization and the deployment of IT tools to better monitor their operations;
- Anticipating the number of travelers and occupancy in vehicles to provide re-al-time information to avoid crowds;
- Arranging contactless payment facilities; and
- Providing their staff and customers with regular transparent communications, the demand was decreasing.

Research shows that in public transport during the COVID-19 pandemic, there was a decrease in the number of passengers over 80% in large cities in Iran, China or the USA, as much as 70% for some operators in the UK. Passenger reductions range from 60% and 67% in Philadelphia and Detroit, respectively, 80% for Singapore's mass transit, and 85% to 95% for Toronto, New York subway Budapest, Netherlands, Lyon and Nice, San Francisco and Washington (Gkiotsalitisa, Cats, 2021; Carrington, 2020; Atchison et al., 2020; Bucsky, 2020; Teixeira, Lopes, 2020). Figure 1 shows the decrease in daily mobility (time from 5.00 to 23.00) visible in the study area of this study in the period from September 3 – October 15, 2020 (Google LLC, 2020), which had a direct impact on increasing security.

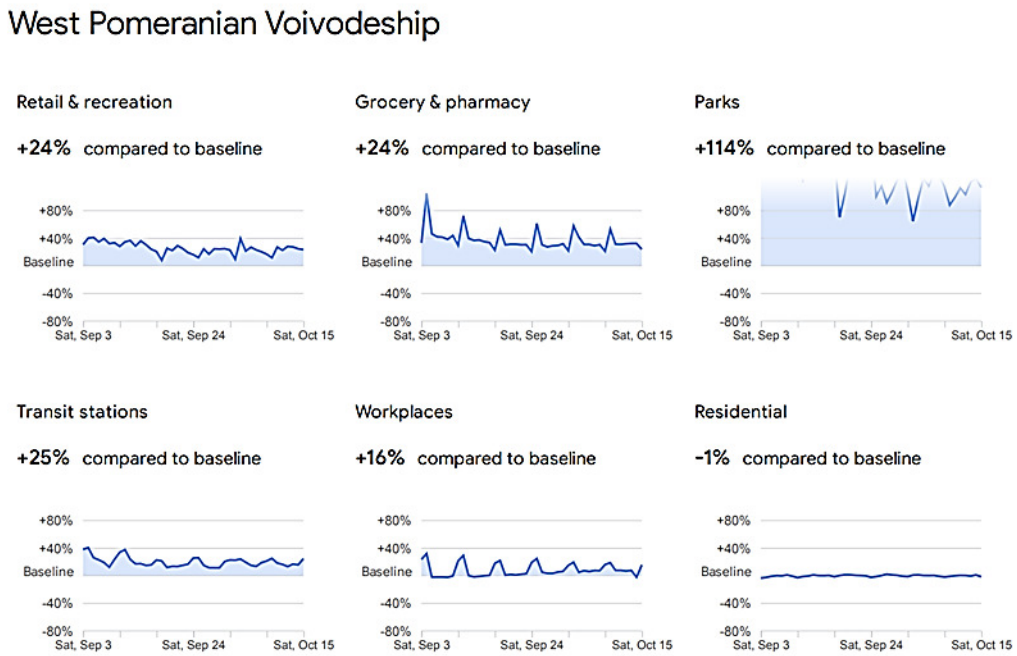

Figure 1. Daily mobility trend (September 3 – October 15, 2020).
Source: Google LLC, 2020.

The development of the pandemic and its long duration result in a change in the habits of using public transport. Such a phenomenon may adversely affect the financial condition of enterprises, resulting in low or no profitability and solvency. Especially that public transport is a type of a public service that is directly supervised by a local government unit, where the price of services correlates with financing (Cascajo et al., 2018; De Oña et al., 2021; Basagaña et al., 2018; Delgado et al., 2019; Romero, Monzon, 2018). This means that despite the unprofitability of the provision by the operator, they must provide the service, and the costs are covered from public funds (Holmgren, 2013). It should be noted, however, that entities providing public transport services strive to maximize profits as part of their strategic plans, including investment plans. Naletina (2021) points out that the main issue with organizing public transport in pandemic times is the reduction of the capacity. Practices that have been proven successful for overcoming this challenge are:

1. Increase transportation capacity.
2. Limit occupancy to enable physical distancing.
3. Shift travel demand away from peak hours.
4. Help passengers make choices that alleviate crowding.
5. Enact safety measures for public transport users.
6. Restore confidence through communication and public relations (Naletina, 2021).

All activities undertaken by the entities indicated an increased need for financing (Beck et al., 2021), as a decrease in demand may lead to the canceling of connections (lines) (UITP, 2020).

In the characteristics of the journey, all three aspects of implementation (i.e. economic, social and environmental) should be involved in the planning of the system in order to mitigate the effects on the transport system (Shokouhyar et al., 2021). Evidence has been obtained that some travellers have moved to private cars in addition to public transport, which will change their habits in the future (de Haas et al., 2021). Changes in traveler behavior over time further support the opportunity to promote sustainable modes of transport and social responsibility (Dyczkowska, 2015; Reshetnikova et al., 2021). However, other means of transport in cities should be analysed (Mouratidis, Papagiannakis, 2021). Even though scientific studies that have analysed changes in the transport system during different phases of operation (Sträuli et al., 2021; Mouratidis, 2021; Freudendal-Pedersen, Kesselring, 2021), it is very difficult to fully analyse the impact of COVID-19 on the further development of public transport. In this situation, decision-makers are thinking about adapting earlier transport planning strategies and their type in the context of exhaust emissions (De Borge, Proost, 2022; Jin et al., 2023). Due to the uncertainty of the situation, some studies have recommended a new procedure in public transport that takes into account COVID-19 (Zhang, 2020; Simic et al., 2022). In cooperation between services and interested parties (e.g. city authorities, public transport companies), I am asking you to translate knowledge into practice in the strategy of action and start transport tasks. Public transportation carries out tasks in coordination with local governments, and often the authorities of the cities concerned are on the board of city enterprises. Decisions made must be in accordance with the needs of residents and agreed with the authorities of the city in the question. As well as means of transport that require assistance in making multi-criteria decisions. Changes in behavioral behavior have already been recognized by urban researchers as an inherent influence on the urban transport experience (Wilson, 2011; Koefoed et al., 2017) and incorporated into planning and design strategies for public spaces. For example, a person whom someone meets and observes in different places and times but never interacts with (Zhou et al., 2020) is considered the basis of another in the neighbourhood or commute. Many people from smaller towns and cities commute to larger cities for work, school or to run errands in offices or to see a doctor.

The sustainability of the transport system should be supported through the prism of social, economic and economic development. It is important in the assessment to help transport planners select the most effective measures and to verify the priority that would be recommended to study for new, special, auxiliary, which can serve to support financial programs. For joint travel and urban transport, Combs and Pardo (Combs, Pardo, 2021; Kamargianni et al., 2022) analysed data on participation activities during COVID-19, proposing an in-depth case study to identify activities that could remain implemented even without COVID-19, they also argue for a commitment actions because of the adherents' goals of equality and security.

3. Materials and methods

A case study method was used to conduct this analysis. The research was conducted for a public transport company in northwestern Poland - Miejski Zaklad Transportu Sp. z o.o. (MZK) Koszalin (MTC). The research used financial statements and internal docu-ments of the company regarding changes from 2016 to 2020, with a special description of 2020, as the year of the COVID-19 pandemic. The collected reports and internal documents were analyzed in terms of the years studied and the implemented changes regarding passenger safety. Analyzing the activities of MTC, it can be determined that the company made decisions in accordance with the literature review. Despite the drop in demand, it operated all the time during the COVID-19 pandemic. Earlier studies in the literature have looked at purchasing behavior or declining emissions, public transportation companies in these cities were not included in the analyses. This section presents an analysis of financial data in the period before the pandemic (2014-2019) and during the COVID-19 pandemic (2020), the data collection process and the characteristics of the company participating in the study.

Koszalin is a city with county rights in north-western Poland, in Zachodniopomorskie Voivodeship (Western Pomerania). According to data from the Central Statistical Office (CSO) as of 30 June 2021, Koszalin had a population of 150,801 and was the second most populous city (after Szczecin) in the West Pomeranian Voivodeship and the 37th most populous city in Poland. The Koszalin's area is 98.3 km² with an average population density of 1067.7 persons/km². Koszalin's public transport in today's dimension was created when the city was being organized anew after the Second World War. It should be mentioned that trams ran in the city for 25 years from the beginning of the 20th century, and in 1935 the first bus line was opened. Further significant changes took place after the political transformation. WPKM was transformed at the beginning of the 1990s into Municipal Transport Company (MTC in Poland -MZK), which was initially a budgetary unit and since 1997 a municipal company, which allowed it to operate in a different financial reality. Danish DABs assembled at the Koszalin depot appeared on the streets of Koszalin and were later joined by the then state-of-the-art MANs, Neoplanes and Mercedes. The MTC headquarters were extensively renovated. The bus routes were reorganized and, although this improved logistics, unfortunately some suburban lines were closed. In the following years, MTC slowly and methodically transformed itself into a modern company, successively increasing its fleet and investing in new solutions. MTC has spent more than PLN 32 million on investment over the past three years (PLN 21 million comes from the Regional Operational Program). The most important of these are the purchase of 21 modern buses (including five Volvo hybrids) and the construction of a transfer center on North of Koszalin. From 2015 to 2019, as planned, the number of vehicle kilometers performed increased from 2,800 to almost 3,200, the number of buses in service increased from 48 to 57, the number of courses increased from 305,305 to 370,302, as did the number of passengers carried.

4. Results

In The analyzed period from before the COVID-19 pandemic is 2014-2019 compared to 2020 as a time of the urban transport exclusion and a high number of infections. Table 1 presents an analysis of the values of non-current assets and equity in the period 2014-2020 in PLN thousand on a selected public transport company within the city of Koszalin.

Table 1.
Analysis of the values of non-current assets and equity in the period 2014-2020 in thou-sand PLN

Period of analysis	Non-current assets	Equity capital
2014	35.686	30.814
2015	34.857	30.784
2016	34.359	31.024
2017	38.998	29.486
2018	43.001	28.786
2019	53.445	28.696
2020	52.274	27.369

Equity is the difference between the assets and liabilities of a company. The book value of the company is determined on the basis of equity. Bearing in mind that the value of assets may not reflect their market value, Equity should not be equated with the market value of the company. The ratio measures the share of equity in the total sources of financing operations, thus it allows to assess the degree of financial independence of the enterprise.

The analysis of fixed assets and equity over the period 2014-2019 presents a steady increase. Specifically, 2019 is the year of the best economic situation, which the company has not taken advantage of, as reflected in the analysis of long-term and short-term commitments. 2020 will see a slight decrease in fixed assets and equity.

Table 2 shows an analysis of the values of long-term liabilities and short-term commitments for the period 2014-2020.

Table 2.
Analysis the values of non-current of long-term commitments and short-term commitments in the period 2014-2020 in thousands of PLN

Period of analysis	Long-term commitments	Short-term commitments
2014	96,74	3.993,82
2015	47,56	4.509,88
2016	64,52	4.788,36
2017	101,72	5.534,87
2018	50,04	7.642,64
2019	2.975,02	9.392,51
2020	1.744,55	6.904,32

Long-term commitments have risen steadily in the period 2014-2018. In 2019, the company has invested in an interchange center and a ship to transport passengers be-tween the city of Koszalin and the city of Mielno by the Sea due to the economic climate. Short-term commitments increased steadily up to 2017, purchases resulted in an increase in the following years. In 2020, long-term commitments fell by 41.36% and short-term commitments by 26.49% due to COVID-19. MTC in Koszalin has purchased seven second-hand 12-metre buses in a tender for leasing. The leasing period is set at 36 months with the possibility of buying the vehicles back. The offer amounted to PLN 5.035 million gross. The lease period was set at 36 months 2019-2022, with an option to buy back the vehicles. MTC managed to acquire seven 12-metre, low-floor Scania buses with Euro 6 standard in 2018, bought with support from EU funds under the West Pomeranian Voivodeship ROP. Koszalin received a support of over PLN 4 million. MTC paid PLN 1.14 million for one bus. Table 3 presents the value of stocks and expenditures for the company in the period before and during the COVID-19 pandemic.

Table 3.
Value analysis of the public transport company's expenditure and stocks in the period 2014-2020 in thousands of PLN

Period of analysis	Company expenditure	Company stocks
2014	1.721,36	1.263,27
2015	1.505,04	1.077,40
2016	2.210,46	1.204,21
2017	1.396,56	1.176,30
2018	1.330,49	1.087,02
2019	2.871,14	1.173,99
2020	4.582,86	1.108,30

The company's business inventories were unchanged in the period before and during the COVID-19 pandemic. For expenditure despite the pandemic, there was an increase of 37.35 per cent in 2020 compared to 2019 despite a reduction in public transport be-tween March and May 2020 of 67 per cent. The company was incurring fixed costs, not eliminating expenses. The company was incurring costs for employees, insurance, and loan and lease repayments. The company committed to a short repayment period of 36 months, which, with a decrease in revenue, resulted in an increase in the company's expenses and commitments. Table 4 presents the surveyed company's operating costs for the period 2014-2020, including a material and energy consumption.

Table 3.
Value analysis of the public transport company's expenditure and stocks in the period 2014-2020 in thousands of PLN

Period of analysis	Operating costs	Consumption of materials and energy
2014	36.390,76	5.849,48
2015	38.317,35	5.313,47
2016	39.846,00	5.258,24
2017	42.356,80	5.639,31
2018	43.867,97	5.989,51
2019	47.615,75	6.331,85
2020	45.275,18	5.163,89

The activity of every company is inherently related to incurring costs. Consumption of materials and energy are the costs of consumption of basic materials, auxiliary materials, office materials, packaging, energy, fuels in connection with the basic operating activity of the economic entity. Valuation of consumption of materials purchased externally is made at purchase prices or purchase prices. And materials produced in-house, at the cost of their production. In this case, operating costs remained constant except for 2020. The analysis shows that operating costs rose steadily and 2020 saw a decline of 4.91 percent. For material and energy costs, there was a decrease of 18.45 percent. Figure 2 shows the size of materials and energy in operating costs over the 2014-2020 period.

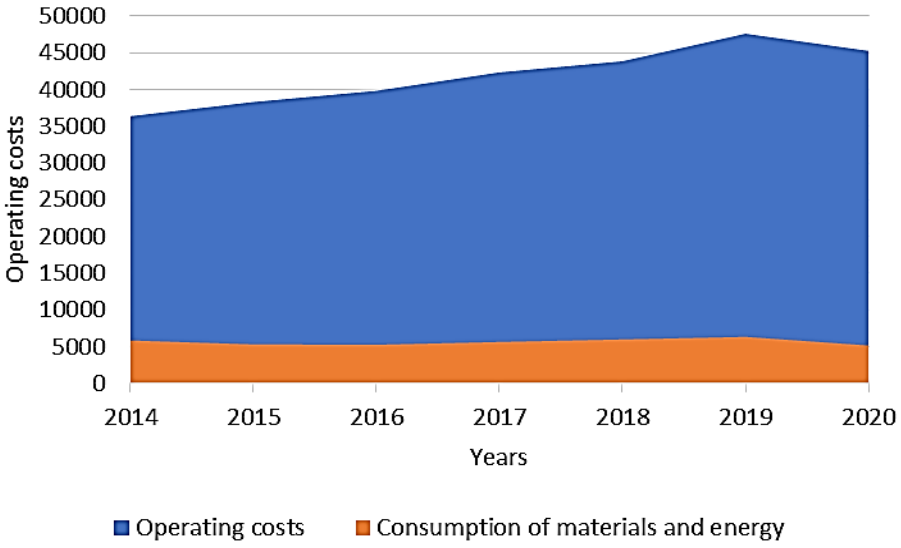

Figure 2. Analysis of materials and energy in operating expenses in the period 2014-2020.

An analysis of materials and energy in operating costs in the period 2014-2020 shows that costs are steadily increasing, and in the case of 2020, where the company practically in the period March 21-May 15 has reduced its operating activities, the value of materials and energy used fell, but not proportionally to the reduction in the number of bus routes, which fell by more than half. If one additionally compares material and energy consumption as a percentage of fuel prices, the analysis shows no correlation of this raw material in MTC despite the fact that it is the most important cost carrier. The year 2014 was taken as the basis -100 percent (Figure 3).

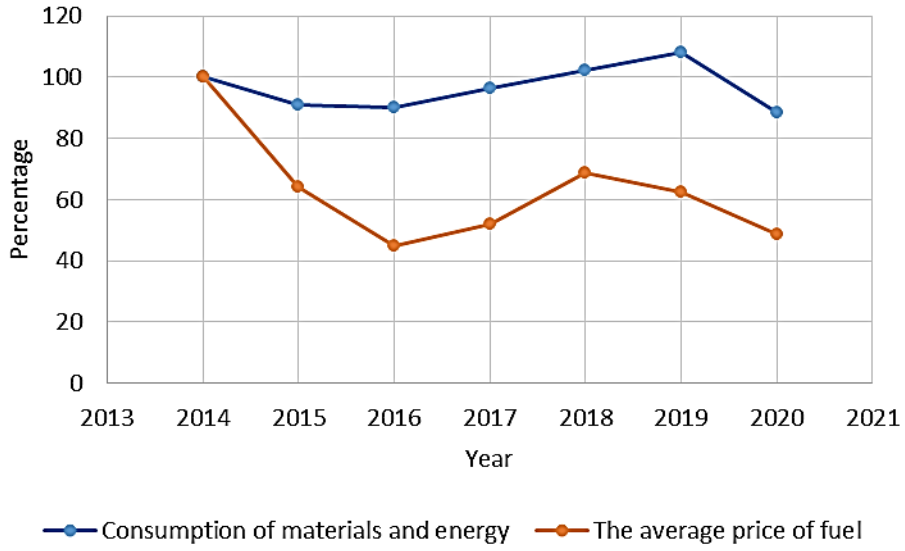

Figure 3. Percentage analysis of average fuel prices in relation to material and energy consumption for the period 2014-2020.

The analysis took 2014 as 100 percent of the average price of fuel and consumption of materials and energy, then for fuel it was the year with the highest price of diesel. The de-crease in fuel as the primary cost of transportation did not translate into volumes in the company in the 2015-2019 period, only for 2020 there was a decrease in material consumption of 19.97 percent, and for fuel prices of 13.89 percent compared to the previous period.

A similar trend over time to costs in a company's operations can be seen in net income (Figure 4).

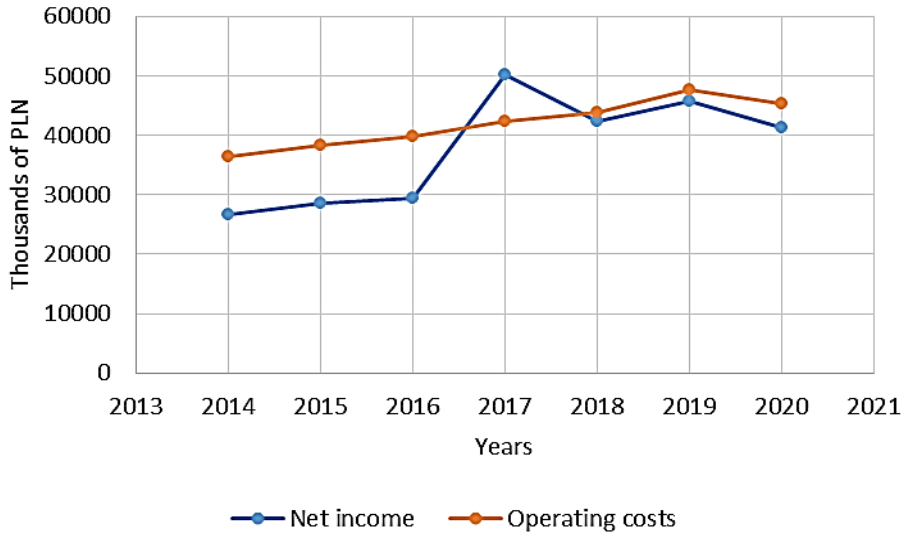

Figure 4. Net income and operating cost for the period 2014-2020 in thousands of PLN.

With the exception of 2017, operating expenses exceeded net income; in 2020, they were 9.36 percent higher. The company, due to COVID-19, had to invest in modern ticket machines. MTC has changed its way of operating, according to the analysis of the literature, despite the loss and reduced demand, MTC maintained its previous lines, invested in ecological means of transport, and decided to install ticket machines.

The best economic and social effects are provided by fees for promoting regular users of public transport - buying network seasonal tickets - the price of which should be the equivalent of 25-30 single tickets, which we will not buy in tickets, but via an application on the Internet. In Koszalin, the price of a 30-day city network ticket was calculated as 30 times the price of a single ticket. In the tariff suburban tariff, the price of a 30-day ticket is equivalent to the price of 25 single tickets. During the COVID-19 pandemic, there was a real threat that passengers would not buy seasonal tickets, and there was a problem with the purchase of single tickets.

During the 2014-2020 period, the company recorded losses. The largest in 2017 in the amount of PLN 1,864, 41 thousand, but the COVID-19 year of 2020 brought a loss of as much as PLN 1,326.6 thousand (Figure 5).

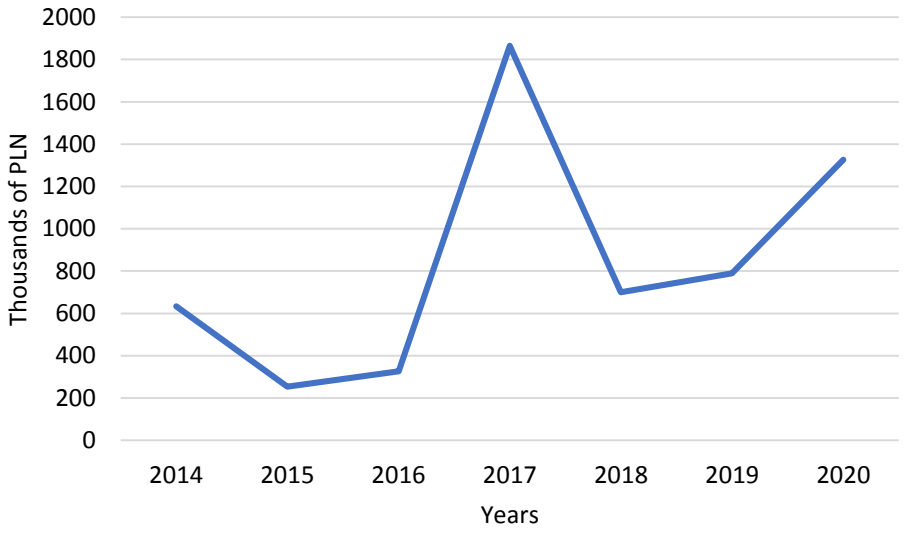

Figure 5. Losses of the company for the period 2014-2020 in thousands of PLN.

The company paid employees during COVID-19, but due to government restrictions did not fully utilize the rolling stock. The recommendations stated that every second seat on a bus must be free.

5. Discussion

The company, according to the authors, with low oil prices, should increase inventories (Fig. 3). The company made decisions regarding the launch of four new lines to three neighboring municipalities, which raised already high losses in the first analyzed period of 2020 (Fig. 5). MTC decided to introduce a line modification in Koszalin and three suburban lines to neighboring municipalities (Manowo, Sianow, Swieszyno). The analysis of the volume of demand for transportation services on non-urban sections of suburban lines Koszalin public transport begins with the determination of its level in the section of a weekday school, Saturday and Sunday. Swieszyno municipality has 7848 in-habitants, covers an area of 132.6 km²,

with an average population density of 53 per-sons/km². Manowo municipality has 6885 inhabitants, covers an area of 188.3 km², with an average population density of 37 persons/km². Sianow municipality has 13785 residents, occupies an area of 226.8 km², with an average population density of 61 persons/km². These municipalities are the place of residence for the workplaces of Koszalin, and to sum it up to 15 percent in relation to the number of residents of Koszalin are a commuting group.

Demand estimation and any further analysis is for the above-mentioned non-urban sections of the individual lines studied (Figure 6):

- for line 3 - the neighbouring municipality of Swieszyno (Nieklonice) – in figure 6 marked in dark green,
- for line 8 - neighbouring Manowo municipality – in the figure 6 marked in gray,
- for line 19 - neighbouring Swieszyno municipality (Kretomino, taken over to Koszalin city in 2022) – in figure 6 marked in light brown,
- for line 33 - neighbouring Sianow municipality – in figure 6 marked in light orange, but not visible to the village of Sianow itself.

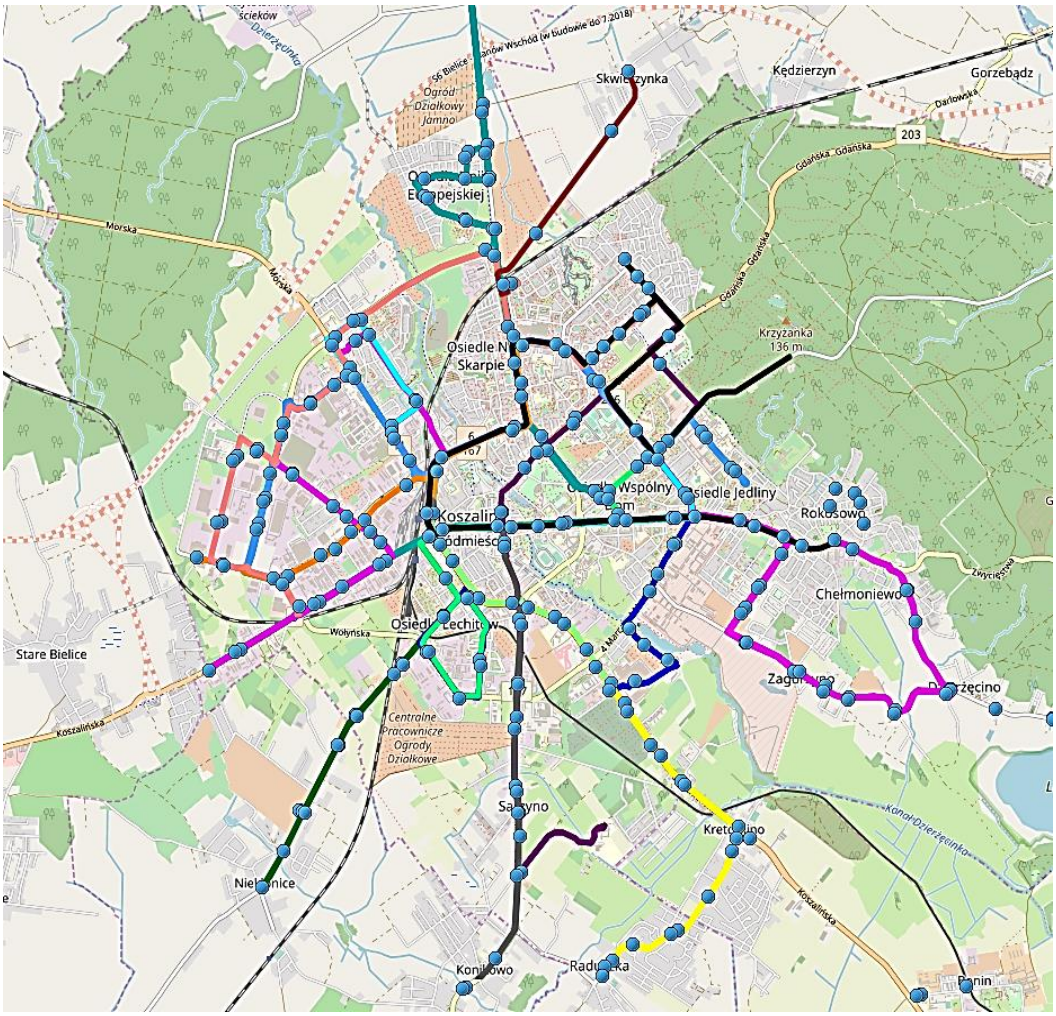

Figure 6. Bus lines in Koszalin.

Source: www.mzk.koszalin.pl, 2023.

Despite the losses and the decrease in demand, the company fulfilled the mission of transporting passengers, the development strategy by launching new lines. MTC Koszalin maintains:

- thirteen municipal lines (2, 4, 6, 8, 10, 11, 12, 14, 15, 16, 17, 18, and 20) - with routes entirely within the administrative boundaries of the city of Koszalin,
- four suburban lines (3, 8, 19 and 33) - with routes connecting the city of Koszalin with six towns in the neighboring communes: Manowo, Sianow and Swieszyno.

The volume of demand on the non-urban sections indicated above, as well as the number of passengers per vehicle kilometer, presented for individual suburban lines in relation to for a weekday, Saturday and Sunday.

The COVID-19 period forced MTC to change its area of operation. The total of passengers on the individual suburban sections of Line 19 does not correspond to the total of passengers on the line, as passengers traveling on the Konikowo-Swieszyno section overwhelmingly - except for a few people - travelled from Koszalin and were also included in the previous section of the Seminary-Konikowo section. An analogous situation occurred in the opposite direction. For this reason, the number of passengers per kilometer is uncountable for the constituent sections on line 19 - the value of this indicator would not reflect reality. At the scale of individual lines, on a weekday in the segment of suburban connections, in the studied non-urban area, the highest traffic was recorded on line 3, whose services outside Koszalin were used by 470 people. Slightly lower demand was recorded on line 19, on which out-of-town or out-of-town services carried 444 passengers. The smallest number of weekday passengers in the suburban line segment was recorded on lines 33 and 8, which carried 73 and 75 passengers, respectively, on the surveyed out-of-town sections. On a weekday scale, the total demand for MTC's suburban line services in Koszalin in the neighboring municipalities was at the level of 1,062 passengers. The two best-used suburban lines (3 and 19) on non-urban sections on a weekdays were used by 914 passengers, or as many as 86% of the total number of passengers traveling outside Koszalin or on Koszalin public transportation. In the segment of surveyed suburban connections, the best used on a weekday were the following Line 3 buses, carrying an average of 6.9 passengers per kilometer outside the city, which is 68.3% more than the average value for all lines. At a lower level - 4.3 passengers per kilometer outside the city - were used by vehicles serving line 8. Next in order were lines 19 and 33 - with results in the range of 3.3 and 1.9 passengers per kilometer performed outside Koszalin, respectively. As already mentioned, commuter courses were taken into account when calculating the number of passengers per vehicle kilometer.

On the scale of the entire studied network of non-urban sections of MTC commuter lines in Koszalin, the average daily number of passengers per kilometer on a weekday was 4.1. This is an attractive result, although it should be emphasized that this indicator refers only to the studied sections of the routes of individual lines, and not to their entire length.

Based on information from 2017, it can be noted that the majority of new standard transportation vehicles purchased in MTC meet the emission limits that exist in European countries (EURO5/6). However, hybrid buses meet such standards. The company will consider the purchase of more natural gas-powered buses, rather than enter electric buses as in most Polish cities. Such actions were indicated in a literature review (De Borge, Proost, 2022; Jin et al., 2023).

Given the challenges faced by public transportation companies in many cities during the 2020/2021 lockdowns, as well as the shortcomings of emergency scenario planning, it is recommended that emergency planning scenarios be incorporated into the company's business plan. The nature of the COVID-19 pandemic emergency is urgent, and acting urgently involves risks due to lack of time for proper planning. Emergencies will occur, as will threats of various kinds. Ad hoc planning ignores planning implications relevant to the long term.

And this is where emergency planning as part of strategic planning is important, and the option of hazard planning especially in public transportation should be taken up.

6. Conclusions

The outbreak of the COVID-19 pandemic significantly changed the activities of the public transportation companies analysed. The case study analysis on the example of MTC Koszalin presents the activities carried out during the COVID-19 pandemic and to what extent the pandemic changed the financial situation of MTC. Although the lasting impact of the COVID-19 pandemic on urban mobility and resilient cities is still unknown, lessons can be learned for future planning policies. MTC Koszalin correctly reacted to the problems arising from the COVID-19 pandemic, in line with the previously presented literature.

Firstly, based on the results of the MTC Koszalin company, in which the analysis of financial statements is defined as fundamental to its activity. Decisions of the company's authorities should not be based on the expectations and behavior of passengers, but on financial considerations. In recent decades, urban transport planning has focused on generating a modal shift from private motorized vehicles to active forms of mobility as well as public transport, measuring the quality of the latter by efficiency, speed and networking rather than range and performance. The financial analyses of the MTC Koszalin company present the impact of the COVID-19 pandemic on the financial situation of the company and the actions it takes before and during the pandemic.

Secondly, however, not using an additional funding and introducing changes to the lines that help passengers who rely on it to move around Koszalin. In this way, changes in the use of MTC by some benefits may be perceived as an expression of concern and solidarity with neighbouring municipalities. Thus, the approach to disclosing the conflicting effects of

an alternative to MTC when developed as an adaptation to amplify an external effect that the company had no control over. On the one hand, many passengers used MTC transport throughout the pandemic, on the other hand, forcing an alternative that provided additional space between passengers and safety for those in need of public transport.

Third, our study targeted whether changes in public transportation operations during the COVID-19 period had specific financial effects, as well as in the perspective of analyses of new lines launched and experiences. The analysis presents that the number of passengers of the three lines has been steadily increasing, and the city of Koszalin in 2021 has applied to incorporate part of the area into it, as residents of neighboring municipalities work in Koszalin. In this way, we combine a horizontal approach with an examination of various MTC practices during the COVID-19 audit. We take into account the importance of behavioral, basic and structural elements of experience in policy-making for the future of urban transportation, but with an eye on potential risks. As part of its social responsibility, MTC has not decided to lay off employees and has maintained the same level of wages. However, our research shows that the benefits of the changes introduced during COVID-19 affect the functioning and perception of MTC after the pandemic.

The main hypothesis was positively verified, as the actions taken by the urban transportation company caused positive changes in transportation operations during the COVID-19 pandemic. Hypotheses H1-H3 were also positively verified, among others, by demonstrating actions, i.e.: new suburban lines were launched, ticket vending machines were installed to ensure the safety of passengers, and the number of seats was limited (every second seat was free). In addition, the increase in investments affected passenger safety, but the company had higher short-term and long-term liabilities in the period 2019-2020. Investments during the COVID-19 pandemic function well after the lifting of restrictions. Also, retaining employees during the COVID-19 pandemic increased trust in the employer.

As a result, the solutions that the systems are supported and financed have important policy implications for the MTC enterprise. In response to emerging public transport challenges, they must be used to use devices with attached features and activities to support social distancing and test forms of service delivery or funding, such as call-on-demand transport in Koszalin.

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MANAGEMENT OF SUSTAINABILITY KNOWLEDGE OF THE GENERATION Z ON SOCIAL MEDIA

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Purpose: The aim of the article is to present a model approach to knowledge management in the field of sustainability in social media and to discover whether social media properly fulfill their role in the key processes of this management in the case of generation Z. They include the acquisition, collection and development of knowledge, as well as its dissemination and use.
Design/methodology/approach: The qualitative method was used in the research. Focus studies were conducted using the method of partially defined, focus group interviews. The authors adopted the principle of a posteriori research in close correlation with theoretical thinking, while recognizing the studied socio-cultural reality as a system of interrelated elements. The actual research was preceded by a critical analysis of domestic and foreign literature on the subject.
Findings: The study found that, in terms of sustainability, young people are more likely to encounter content on social media about environmental issues and less likely to encounter content about social issues. Social media contribute to the growth of their interest in sustainability issues. The young generation requires that the content on sustainability posted on social media be understandable, easily digestible and not overloaded with facts. The authenticity of the presented content, a title that arouses curiosity and interesting graphics are important.
Research limitations/implications: The study focused on young people. Another proposed line of research is therefore to include other age groups, such as the elderly and middle-aged people.
Practical implications: The conclusions and solutions contained in the article may contribute to a better use of social media in managing the knowledge of the young generation in the field of sustainability.
Social implications: This will positively influence the shaping of pro-environmental and pro-social attitudes and behaviours of the young generation and increase their activity in the area of sustainability.
Originality/value: The model approach to the management of sustainability knowledge on social media presented in this article organises this area and identifies opportunities to better exploit its potential.

Keywords: Knowledge management, sustainability, social media, generation Z.

Category of the paper: Research paper.

1. Introduction

Progress in the area of sustainability requires knowledge, as well as pro-environmental and pro-social actions. Accelerating knowledge-based sustainable development is particularly important today, in an era of increasing environmental and social threats. Many producers and consumers continue to ignore these threats, failing to see their negative impact on the state of the Earth and its potential. Research shows that corporate involvement in sustainable development goals is still limited. The involvement is largely symbolic and intentional, rather than substantive (e.g. van der Waal, Thijssens, 2020). D. Fogel emphasises that the modern industrial society can collapse if resources are mismanaged and abused (Fogel, 2016). Modern societies have to solve not only environmental problems but also social ones. They include: poverty, exploitation, unemployment, crime, drug addiction, alcoholism, social diseases, and epidemics. The deteriorating state of our planet and social problems threaten the existence of future generations.

Further progress in the area of sustainability depends on young people of generation Z. Young people will soon begin to take over the reins of organisations and determine the directions of their development. In their various roles in their societies, young people will either accelerate sustainable development by making determined attempts to eliminate environmental and social threats or they will hinder it. An important factor influencing the pro-environmental and pro-social behaviour of the younger generation is sustainability knowledge. Such knowledge allows better understanding of the nature and extent of environmental and social threats as well as provides information on how to eliminate them. In addition, it shapes pro-environmental and pro-social attitudes and inspires young people to undertake pro-environmental and pro-social actions, as well as to search for new, effective solutions in this sphere.

The Internet, including social media, plays a special role in the lives of the young generation. In January 2022, of the 7.91 billion people living on Earth, as many as 4.95 billion (69.5%) used the Internet. The number of social media users has reached 4.62 billion people, representing almost 94% of all internet users worldwide. The largest number of social media users is young people aged 20-29 (32.2%) (Polewko, 2022). Also in Poland, the number of social media users is very high at 27 million people. The share of people aged 18-34 in this group is 48.8% (Pietraszek, 2022). Social media "allow customers to be served and educated" (Gamoń, 2021) and “provide an opportunity to develop relationships and deepen them, starting from casual acquaintances, ending with the status of a friend. Social media are tools that significantly increase the effectiveness of communication activities" (Andrzejczyk, 2022). The smartphone through which young people most often access social media "has become a personal medium that allows the user to be always available and connected both to other people and to businesses" (Kotler, Stigliano, 2022). However, the advantages and potential of

social media are still have not been fully exploited. "Unfortunately, due to the lack of the necessary practice of using social media, many organisations still approach their presence in this channel in an unplanned manner and without a broader vision of how to use the opportunities it offers" (Kaznowski, 2021). This incomplete use of social media also applies to the dissemination of sustainability knowledge among the young generation.

Social media are very popular among young people and should therefore be used to a high degree to communicate sustainability knowledge to them. Is this the case in reality? This question prompted the authors of this article to formulate the following research problem: what is the role of social media in the acquisition, development, use and dissemination of sustainability knowledge by the young generation? These activities are categorised as key knowledge management processes. Such a broad approach to this problem has not been reflected in the research literature.

The article contributes to research and practice. It enriches the achievements in sustainable research and sustainable management. It additionally shows the state of management of sustainability knowledge of the young generation by revealing its flaws and shortcomings. Finally, it indicates actions that should be taken to improve this management. Therefore, it can contribute to greater utilisation of the potential of social media in managing the young generation's sustainability knowledge, which will certainly contribute to balancing intergenerational needs.

2. Literature review

The authors of this article carried out an extensive review of the literature, looking for publications and research results on the topic, i.e. the role of social media in the knowledge management of the generation Z in the field of sustainability. The literature review has shown that to date, no research has been conducted in such a broad perspective linking all four components simultaneously: knowledge – the young generation – social media – sustainability. Instead, research has been done on the relationship between some of the components of this 4-element system. In the following section, we present the most important research achievements in this area.

Some researchers have focused on finding links between the younger generation, social media and sustainability. Researchers appreciate the role of social media in sustainability. "In recent years, social media technologies have gained increased attention for their potential to amplify environmental concerns and encourage sustainable behaviours among people". These authors carried out a study that aimed to determine the role of social media in the consumer purchasing behaviour for wine between the millennial and non-millennial generations. The results of their study show the power of social media in raising the awareness

of sustainable development, and therefore influencing the consumer purchasing behaviour for wine (the higher price segment). From a marketing perspective, companies should improve their capacity to share and communicate their environmental activities through social media (Sogari et al., 2017).

The characteristics of meaning-making in young people's conversations about environmental and sustainability issues on social media (in an online community) (Andersson, Ohman, 2017) were investigated. Other researchers considered the relationship between students' social media exposure and their valuation of sustainability in entrepreneurship and of environmental and social care as drivers of new venture creation. They showed that a higher frequency of reading such content is related to a higher perceived relevance of environmental sustainability, social welfare, and fair trade (Verdugo, Villarroel, 2021).

The scientific literature also includes work on the relationship between:

a. social media, sustainability and knowledge,
b. sustainability and knowledge as seen through the lens of education,
c. knowledge and social media.

A social experiment was carried out through social media accounts to increase the level, effectiveness, skills and actions of people for life. The results of the experiment show that 49% of the followers learned more about sustainable living and 25% developed at least one sustainable habit in two months (Al.-Mulla et al., 2022). A holistic approach to education for proper development was also examined, with an emphasis on identity, motivation and higher order dispositions (Podger et al., 2010) and higher order dispositions, and sought to determine how internal or external social media technologies are used for knowledge sharing at work or for professional development. Among other things, these researchers came to the following conclusion: the members of Generation Y (younger generation) or employees with lower level positions are less likely to use social media technologies in the workplace. We would postulate that this is because social media tools are more common among young people but they use them for private purposes, while using these tools for work (mainly for knowledge sharing or professional development) is more typical for G eneration X and Baby Boomers (older generations) (Gaal et al., 2015).

The use of social media in the sphere of sustainability has received slightly more attention in academic literature. Scientific results show that listening on social networks can be used more effectively than other more traditional activities. The researchers analysed the different contexts and areas of knowledge where the concept of sustainable development is used in society by using social listening on Twitter, one of the most popular social networks today. In addition, they mapped the social network of users who generated or spread content regarding sustainability on Twitter (Ballestar et al., 2020). The results showed how 16 global corporations from different industry sectors use social media platforms and corporate social responsibility reports to communicate about sustainability. These researchers concluded that communication varies across firms and industries regarding the types of sustainability initiatives reported,

metrics employed, and communication media utilised. In addition, green firms are more active than non-green firms both in addressing sustainability and in general social media activity (Reilly, Hynan, 2014).

Searching tweets (micrologues) to explore trends and retrieve ideas for various purposes such as product development, technology and sustainability oriented issues showed that the social media data mining process can be used as a decision making tool to detect innovative ideas or solutions for product or service (Ozcan et al., 2021). Researchers who have focused on the B2B sector argue, that Big data and social media analytics can facilitate business to business sustainability. Web analytics can support the social, environmental and economic agendas of business to business sustainability (Sivarajah et al., 2020).

The young generation mentioned in the first part of the Literature Review is being researched more extensively in two areas related to the subject of this article: 1. the young generation - social media 2. the young generation - sustainability. Malin Sveningsson studied how young people using social media are interested in civic and political issues. He concluded that the participants appreciated the immediateness of social media news, and felt that it could provide insights into new perspectives and make news stories feel more relevant. However, this was also seen as one-sided, fragmented and subjective, giving a biased, or even false, image of what happens in society (Sveningsson, 2015).

Social media "influence the life style of youth so that brands and companies can exploit the space of social networking sites to create loyalty among youth". For example, if social media sites promote a healthy lifestyle through their posts, videos, and messages, that will help to develop a healthy young generation (Kulandairaj, 2014). There is evidence of young people's engagement with social media and the influences they report on their health-related behaviours (Goodyear et al., 2019).

The question arises of how to best teach environmental sustainability in order to reach diverse student mindsets. This is a important topic because, "environmental sustainability represents a polarising topic with some students dismissing its importance and legitimacy" (Swaim et al., 2013). Student attitude represents the strongest influence on environmental sustainability intention. It is important to open up spaces for deliberation and channels for youth engagement in order to embed sustainability in global cities. It identified "young people's relatively low prioritization of most environmental issues – due to an overwhelming sense of economic precarity and a lack of opportunity to reflect upon the relevance of environmental issues for their everyday lives" (Sloam, 2020). Therefore, there should be a scholarly discussion about the roles children and young people might take as agents of change in sustainable community development and what forms of learning are needed to achieve this goal (Percy-Smith, Burns, 2013).

The extensive literature review carried out by the authors of this article demonstrates that there is a research gap regarding the topic, namely the role of social media in the management of the young generation's sustainability knowledge. No publications on this topic were found that took into account knowledge management processes such as its acquisition from social media by the generation Z, its collection, development, use and dissemination. It has been shown above that researchers have only focused their research inquiries on fragments of the subject matter reflected in the title of this article. Its authors set out to fill this gap.

3. A model approach to management of sustainability knowledge on social media

The model approach the management of sustainability knowledge on social media presented in this section was developed by the authors of this article and is their own concept. The two key terms of this concept are 'sustainability knowledge' and 'management of this knowledge on social media'.

Let us first address the subject of management, i.e. sustainability knowledge. This is a young, emerging area of knowledge, not yet fully formed. It covers many different types of issues. The content of sustainability publications mainly focuses on:

- general sustainability issues (e.g. Brinkmann, 2016; Thiele, 2016; Holden et al., 2018),
- sustainability action strategies (e.g. Fogel, 2016; Avlonas, Nassos, 2014),
- sustainable business (Jeanrenaud et al., 2017; Lenox, Chatterji, 2018; Carbo et al., 2018),
- sustainable management (e.g. Cohen, 2011; Haugan, 2014; Bossink, 2012),
- sustainable marketing (e.g. Belz, Peattie, 2010; Emery, 2012),
- sustainable projects, production and labour (e.g. Brzozowska et al., 2021; Stark et al., 2017; Epstein, Rejc-Buhovac, 2014),
- and other issues, such as sustainability education.

The authors of this article divide sustainability knowledge into three main areas, which are reflected in the publications listed in a-g above:

- sustainability knowledge on the state and development of environmental and social threats,
- sustainability knowledge about the impact of environmental and social threats on the Earth and its inhabitants,
- sustainability knowledge showing how to counteract environmental and social threats.

The first important area (a) is the knowledge on the state and severity of environmental threats (the depletion of non-renewable natural resources, pollution of the atmosphere, soil and water, the decline of biodiversity and others) and social threats (social diseases, exploitation, poverty and deprivation, unemployment, excessive consumerism and others). These threats worsen the state of the Earth, reduce its potential and adversely affect the societies that inhabit it.

The issue of the negative impact of these threats on the environment and humans falls under the second knowledge area (b). Here are some examples of such impacts. According to research, the reserves of elements such as iron, lead, copper and gold will only last for a dozen to several decades. Oil reserves, which are easily accessible and inexpensive to exploit, will run out in about 20-30 years. The upper layers of the atmosphere are polluted by chlorofluorocarbons, which contributes to the formation of the ozone hole and increases the penetration of harmful ultraviolet rays (Steffen et al., 2015).

The manifestation of soil pollution is the acidification or alkalinisation of soils, as well as the accumulation of pesticides, nitrites and organophosphorus compounds. More than three-quarters of the Earth's entire land surface has already been degraded, and this figure could rise to as much as 90 per cent by 2050. The supply of clean drinking water is dwindling in many parts of the world. By 2025, it is predicted that up to two-thirds of people will live in areas experiencing severe water shortages. From 1970 to 2014, the world's vertebrate population declined by an average of 60% and the population size of freshwater species decreased by 83% (Brzozowska et al., 2021). Hundreds of millions of people worldwide suffer from social diseases. An example is diabetes. Already today, around 422 million people worldwide have diabetes. It is estimated that this number will more than double in the next 20 years. (Koprowska, 2019). There are 21 million victims of forced labour worldwide resulting from human trafficking, slavery, bonded labour and prostitution. They generate 150 billion USD in illegal profits (Jeanrenaud et al, 2017).

In order to eliminate or reduce the negative human impact on the environment and to solve social problems, knowledge indicating how to do so concretely is necessary (c). This includes shaping people's pro-environmental and pro-social attitudes, using sustainable products and services, doing work and other activities in a sustainable way (Brzozowska et al., 2021).

Let us move on to the model approach to the management of sustainability knowledge on social media. The essence of our approach to this problem is reflected in Figure 1. Its starting point is the knowledge we discussed above. The first step in managing the sustainability knowledge thus defined is to create carriers of this knowledge for the needs of social media. These carriers mainly take the form of texts, photos and videos. They should be introduced to all types of social media listed in Figure 1. This will ensure that sustainability knowledge reaches a large audience.

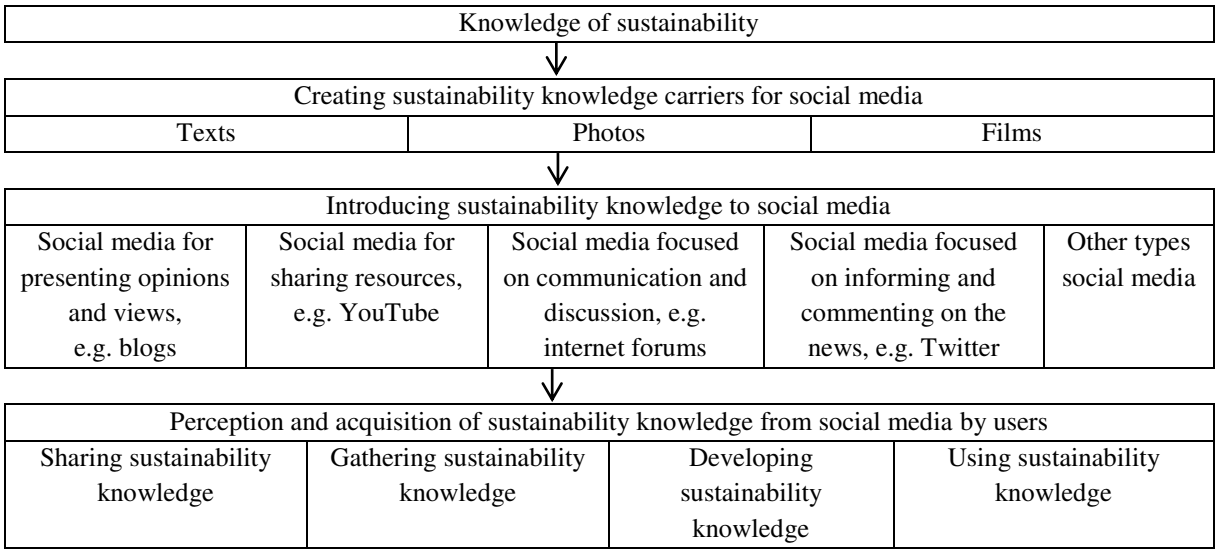

Figure 1. Management of sustainability knowledge on social media - a model approach.
Source: authors' own elaboration.

The sustainability knowledge posted on social media will reach the users of these media, including young people. The perception and acquisition of this knowledge can range from a very superficial approach to a deep approach consisting in penetrating its details. This is determined by the ability of messages about sustainability posted on social media to capture the attention of the recipient. Such messages should interest the viewer with their content and appearance. An interesting and attractive message is bound to elicit positive reactions: it will prompt the recipient to spread the knowledge among his or her friends, and may also encourage him or her to expand this knowledge. If a social media user is particularly interested in some content on sustainability or needs it to achieve a specific goal (e.g. write a paper, prepare a presentation), he or she will start to collect such content (save it in folders, copy it to notes). There is another very important aspect of the impact of sustainability knowledge posted on social media on the audience: such knowledge should encourage the recipient to apply it practically in everyday life. It should inspire the recipient to take pro-environmental and pro-social actions. Only knowledge combined with concrete actions can accelerate sustainable development.

In order to delve deeper into the problem regarding the young generation's response to sustainability knowledge gained from social media, the authors of this article carried out a qualitative study, the description and results of which are presented in the following sections of this article. It explains to what extent social media are useful in managing the sustainability knowledge of the young generation and how it can be improved.

4. Research method

The aim of the study was to determine the role of social media in the acquisition, development, use and dissemination of sustainability knowledge by the young generation. In order to achieve the objective formulated in this way, a research plan was prepared, the study was carried out according to this plan, the collected information was analysed and conclusions were drawn.

The study used the focus group method. This method involves the creation of focus groups of 4-12 people, who conduct a focused discussion on a specific topic under the guidance of a moderator. The focus method was chosen by the authors of this article because it has a very important advantage: it allows access to information that is inaccessible by other research methods. Focus groups reveal not only what research participants think, but also why people think a certain way (Barbour, 2011).

In order to conduct the focus study, a scenario was drawn up. The scenario included the following: the subject and purpose of the interview, participants of the meeting, conduct of the meeting. The 'Conduct of the meeting' section of the script lists the five stages described below.

Stage 1 Introduction.
Stage 2 Discussing the rules of the meeting by the moderator.
Stage 3 Proper discussion.
Stage 4 Summary of the proper discussion.
Stage 5 Conclusion.

Stage 1 consisted of the following activities: welcoming the participants of the meeting, introducing the moderator, informing them that an attendance list had been drawn up, outlining the objectives of the meeting, presenting the stages of the meeting, explaining the concept of 'sustainability knowledge' and the concept of 'social media'. In stage 2, the moderator set out the rules for the discussion and explained how the information collected from the participants would be used. In the part of the scenario identified as Stage 3, 15 open-ended questions were listed, which properly guided the discussion and enabled the research objectives to be achieved. Stage 4 was the moderator's summary of the discussion. Stage 5 was the conclusion of the meeting, which included thanking the participants for their participation in the study.

The study covered four focus groups, consisting of students from the Z generation.

5. Results

The initial part of the study discovered how the participants of the conducted focus studies use social media. The study found that all the informants use social media. They use the following media: Facebook, Instagram, YouTube, TikTok, Snapchat, WhatsApp, Messenger, Twitter, and Twitch. The most popular among them are: Instagram, Facebook, and YouTube. TikTok is becoming increasingly popular.

All the informants access social media via mobile phones, mainly smartphones. This is because, as they claim, *the smartphone is at hand and always with you. Even when I'm on the move, I look at it somewhere along the way*; *first of all, it's convenient and we're used to it because we use the phone every day and go on social media every day. We don't often have a computer with us, so we instinctively pick up the phone* Another informant adds: *even if I have my computer on and I am doing something on it, when it comes to social media I only use my phone.* Some of the people surveyed also identified other devices that they utilise when using social media, but they only do so while at their place of residence. These devices are: laptop, tablet, desktop computer, and TV with internet connection. Outside the home, they all only use mobile phones, mainly smartphones.

The majority of the informants stated that their maximum use of social media per day is between 5 and 6 hours per day. Few indicate less activity of 2 to 3 hours per day.

The informants revealed that their social media use increases at weekends, while it decreases on holidays and during family celebrations. They justified it as follows: at *weekends it's definitely longer because there's no work, there aren't as many responsibilities as during the week*. In addition, *at the weekend it happens that you catch up on the use of media that appeared during the week, so this time at weekends extends to three to four hours*. During holidays and family celebrations, the social media activity of the informants is definitely lower because, as they say, *holidays are for family, not for media.* At weekends, they use media until 8 pm because, as they add, *later you spend time with friends and your phone is in your pocket, you don't spend time on your phone*.

The next main part of the study revealed if and how the young generation obtains, develops, collects, uses and disseminates sustainability knowledge using social media.

All the respondents unanimously answered that they encounter content on environmental protection, social issues and sustainable development on social media at least once a week. Nevertheless, the frequency that this content appears is determined by their type of online activity and personal interests. Encountering content related to sustainability depends on what the respondents are interested in (what or who they follow on social media). According to one informant, *I come across such content almost every time I visit Instagram or Facebook. Either it's pages I've liked or some featured ads, based on what I like.* Contact with content regarding sustainability largely depends on whether a young person is interested in sustainability.

One survey participant put it this way: *I'm rarely get these things because I'm interested in other things on social media.* Thus, the development of sustainability knowledge gained from social media depends on the young person's interests. If they are interested in the issue, they will seek further information on it.

According to the statements of the respondents, the content related to sustainability posted on social media is mainly of a pro-environmental nature, while that dealing with social issues is less frequent. Here is an example of an informant's statement: *There's this boom on social media for environmental content, then it disappears and in a while we get it again because some people focus on protecting the natural environment and making other followers aware. It comes back again and it's all over the place.* In support of their words, the informants indicate the content they encountered on social media in the last week preceding the focus study. Their statements are quoted below.

- *Such posts are often shared on Instagram, for example, the model Joanna Krupa does it.*
- *On Instagram, I very often come across posts of the actress Julia Wieniawa. Now she has opened her own clothing company called LEMISS. They are sports clothes for yoga and are actually made of recycled materials. The shipping and packaging are also very environmentally friendly because you can put a few of these clothes in one such small package. Also on TikTok, I very often see things promoting freeganism, i.e. collecting things that are fit for use from the bin or from the rubbish and that it is better to buy second-hand clothes, e.g. in second-hands rather than the Shein chain.*
- *I even came across something like that this morning. I found out that because of the pro-environmental actions of countries like China and India, the Earth is greener than it was 20 years ago, in other words, things are moving in a fairly good direction, positively.*

Few informants use specialised social media dedicated solely to environmental protection, social problems and sustainable development issues. One informant said: *This is where WWF Poland comes to mind. I follow them on Instagram and on Facebook, so that's such a source that is dedicated to this topic. Sometimes, when they have an interesting article from which only an excerpt is given, I go to their website where the content is more extensive. I also happen to watch [National]Geographic Channel.* Other informants are aware that specialist social networking sites focusing on sustainable development issues exist, but they do not access them, justifying this by their lack of English language skills. Here is an example of a statement: *I don't use it because it's mostly some English-language content, and my English is average, so I rather listen to Poles who talk about it.*

The informants also indicated important elements that must be present in the message to arouse their interest and encourage them to read. It is primarily the title that arouses curiosity and interesting graphics. The informant emphasises that *if something is pleasing to the eye, we automatically click on it, and if it is unsightly, we skip it and don't read it.* The authenticity

of the presented content is also important, e.g. photos should be real and not altered by processing in computer programmes.

The respondents claim that a very important element of the message regarding sustainability is who it comes from. According to one informant: *If it is, for example, a video on YouTube, I have my specific creators and I know by the name whether I want to watch it. As an example, Jordan Peterson's lectures give me a much bigger view and a deeper understanding, so I can shape my views better.* Equally important is the credibility and professionalism of the source because, in the words of one informant, *when I'm going to read, I also look at who the author of it is, in the sense that it's not some Onet, or Interia (popular Polish portals), or some gossip, but the point is that the website should be clear and transparent, credible and competent.*

The majority of the people surveyed admit that even if they read content related to sustainability, they do not comment on it on the Internet. According to an informant, *there must be a very provocative post to comment on it*. Another informant complements the statement of the predecessor of the discussion as follows: *I definitely get acquainted with environmental content, but I shy away from commenting, I tend to be a passive listener, and I am mainly encouraged to watch such content by the name of the creator and the presented content.* The respondents do not collect information in the field of sustainability that they encounter on social media.

Almost all the people surveyed feel the need to share the content obtained on social media with other people, family, and friends. They do this mainly through social media. An informant explains: *When I come across an interesting post, I forward it on to my friends so that they can take a look at it.* Her colleague adds: *If I share, it's through Messenger or I forward it on Instagram.* Some informants share knowledge gained from social media while being in direct contact with their interlocutors (*face to face*). This is especially the case when the interlocutors are elderly people who do not have IT devices, do not know how to use them or do not have access to the Internet.

Nearly all the informants emphasised that it was the content found on social media that made them more interested in the issues of sustainability, considering this content important and necessary. Social media inspired most of the respondents to take various pro-environmental and pro-social actions to implement the principles of sustainability in their daily life practices. Examples of the informants' statements are presented below.

- *I've generally been trying to avoid eating meat for five years now, mainly for environmental reasons, precisely thanks to the content I've found on the internet, or for example, I buy clothes from second-hands, sources that don't support consumerism.*
- *Posts remind us to act according to the principles of sustainability. If, for example, we see that there is a water shortage in Africa, it makes us aware that we should respect water and, let's say, we brush our teeth - we don't leave the tap turned on all the time - but we try to take care not to waste water. The same goes for segregating rubbish or feeding animals in zoos, we try to act according to these principles.*

- *I, thanks to the fact that I started reading such content in the media, have stopped using plastic shopping bags, I just take reusable bags with me. It's the same with plastic straws. Turtles were in the news. When I saw the material, it was about turtles, that turtles suffer a lot. I watched such horrible footage of these straws being pulled out of these turtles' nostrils, so I haven't used them since.*
- *I personally try to save water because of the fact that water prices are rising, the water supply is decreasing and I have read a lot on the internet about water shortages and not somewhere far away in Africa, but already here, e.g. in the Lodz area there is a problem with water and it will be the biggest problem in the future.*
- *I, for example, use reusable cups, I have such a thermal cup here for tea and I also have one made of such thick plastic for various cold drinks; when I go somewhere, I take this cup with me rather than buying disposable ones.*
- *I have been inspired in my daily life not to throw food away but to leave it for the next day or make something else out of it. I make sure that when I brush my teeth I pour water into a cup and not run the water all the time.*
- *I recently came across a profile on Instagram of my technical school friends and they came up with this method of using old bedding, old sheets to sew new clothes, which they later sell. So it's using old materials that could be thrown away to be transformed into something completely new.*

Some of the young people taking part in the survey believe that despite their knowledge of environmental and social threats gained through the media, they do not have the opportunity to use this knowledge to take action on a large scale. In their view, as individuals they have little influence and too little power to bring about positive pro-environmental and pro-social changes in their environment. They believe that adequate capital and appropriate prestige and social status are needed to bring about such changes.

When asked what actions should be taken to make social media more useful in spreading knowledge on environmental protection, social problems, and sustainable development, all the informants unanimously point to the need to disseminate this content in the family and at school in the process of educating the young generation: *Parents and teachers should make young people aware in face to face manner, so that later these people can find this content for themselves on the Internet. To sow the seed so that young people want to continue down this path and keep looking for this content on social media.* In their opinion, it is also important to use local authorities and celebrities to promote sustainability knowledge and to make sure that the media have a clear and attractive message.

I think maybe it would be a good idea to encourage the most popular creators, mainly from the entertainment area, because entertainment is the most searched for and received form of communication on social media, to encourage creators to promote this content so that more people can access it and maybe arouse interest in them.

To make some kind of challenge on social media, like the website Reddit for example. I mean that celebrities who exist on Facebook, media, TikTok create such a challenge that promotes sustainable development.

Celebrities have a big impact in the media, it is a ripple effect, it reaches everyone, if they start talking about it more loudly, different portals start writing about it, because it is known that it's a hot topic and then such a snowball effect will dominate, it will spread and the algorithm will want to distribute as much of this content as possible to more people.

It is also important, according to the informants, that the content posted on social media is easily digestible, accessible, understandable, not overloaded with facts and served in an aesthetically pleasing way. This is because, as they say, *young people often watch videos because they are easy to understand, you don't have to concentrate very much, and I believe these videos should show situations that really happen in polluted areas, where, for example, an animal is entangled in nets or nets left behind, and younger people will care about something like that because they like animals and don't want them to get hurt, and it might inspire them not to produce waste.*

The informants also emphasise that *there should also be prepared content, pictures for children who use technology and look for games, for example, because if there is a lot of text, it is bad, because children are not interested in reading five-page long texts, but a graphic version. Some themed competitions with prizes, such as eco bags, are also a good thing.*

The conducted research uncovered important facts about the role of social media in managing the sustainability knowledge of the young generation.

6. Discussion

In the discussion, we refer to some of the conclusions and opinions of the researchers listed in the Literature Review of this article, and we also present our own opinions.

We agree with Giovanni Sogari, Tommaso Pucci, Barbara Aquilani, Lorenzo Zannl that social media is playing an increasingly important role in the sphere of sustainability. Relating their research to the wine sector, they found that social media increases awareness of sustainability and influences consumer purchasing behaviour. Our study confirms these findings, although it is much broader and not focused on the wine sector. We take into account all the pro-environmental and pro-social activities that young people can carry out under the influence of social media. The consumer behaviour of purchasing sustainable products and services is just one type of this.

Social media, according to A. Jesu Kulandairaj, influence the lifestyle of the youth. We believe that this lifestyle can be divided into two types: a sustainable lifestyle and an unsustainable lifestyle. Thus, social media also have an impact on shaping a sustainable lifestyle for young people.

The research by Maria Teresa Ballestar, Miguel Cuerdo-Mir, Maria Teresa Freire-Rublo shows that obtaining information on sustainable development from social media through listening is very important. In our opinion, this listening will be even more effective if it is complemented by content that also interacts with the visual sense. This is why we believe that verbal messages should be supplemented in social media, where possible, with photos, videos and graphics. They will certainly reinforce the message and make the recipient remember it longer. The authors mentioned above focused their research on Twitter. We consider the acquisition of knowledge about sustainability in the broad context of multiple social media.

Referring to the findings of James A. Swaim, Michael J. Maloni, Stuart A. Napshin, Amy B. Henley, we believe that the traditional teaching of sustainability must be complemented by the transfer of knowledge to the young generation via social media. Young people use social media extensively. Sustainability knowledge conveyed through social media should be an important complement to traditional education. It will contribute to the formation of pro-environmental and pro-social attitudes and inspire youth to take actions in the sphere of sustainability.

A continuation of the study, the results of which are presented in this article, is desirable. We suggest that each of the key processes of managing the young generation's sustainability knowledge gained from social media should be explored more broadly and in more detail. Separate extensive studies could be conducted on issues such as the acquisition, collection and development of such knowledge, as well as its dissemination and use.

7. Conclusions

Social media are very popular among the young generation. Young people use different channels of social media. They devote a great deal of time to media every day, usually several hours. The most frequently used include: Facebook, Instagram, YouTube, Snapchat, WhatsApp, Messenger, Twitter, Twitch, and TikTok. Social media have become a part of young people's lives and using them has become a habit. Social media distract them from books, newspapers and magazines. The dissemination of sustainability knowledge via social media is therefore fully justified. This type of content should be posted on social networking sites.

Social media activity among Gen Z youth increases on weekends and decreases during annual holidays and family celebrations. From this, it follows that the most content in the field of sustainability should be posted on normal work and study days and at weekends. During the

holidays, less new sustainability content can be introduced as young people spend time in real life with their families then.

Young people are more likely to encounter content on social media relating to environmental issues, but are less likely to encounter content relating to social issues. They rarely use specialised sites dealing exclusively with sustainability issues.

As the study has shown, it is the information contained in social media that prompts young people to take an interest in the issue of sustainability and causes them to consider it important and necessary. The growing interest in sustainability issues makes young people start to deepen their knowledge in this area.

In order to arouse greater interest in sustainability issues among young people, the attractiveness and design of this type of social media content needs to be improved. The young generation requires content that is easy to understand, digestible and not overloaded with facts. The authenticity of the presented content, a title that arouses curiosity and interesting graphics are important. The impact of sustainability messages grows significantly if they are conveyed by well-known actors, artists, filmmakers and celebrities. All of this has an impact on a young person's willingness to share sustainability knowledge with their family, colleagues and friends.

Special campaigns on sustainability attract the attention of the young generation. An example of this is the Trashtag initiative. Its aim is to motivate Internet users from all over the world to protect the environment and the landscape and to publish 'before' and 'after' photos. For example, one photo shows a littered area and another shows the same place that has been cleaned up. There should be more such campaigns on social media to mobilise young people to take up pro-environmental and pro-social activities. As the study showed, young people do not always put sustainability knowledge into practice in their everyday lives. For many of them, the inspiration for such actions comes from extraordinary situations publicised on social media, e.g. a tragedy resulting from an anti-environmental or anti-social activities.

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ASSESMENT OF FLOATING GARDEN STRATEGY IN CREATING THE PLACE BRAND OF SZCZECIN

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Purpose: The aim of the study is to identify and evaluate the image of the Szczecin brand associated with the Floating Garden strategy among residents of the city and residents of other Polish cities who are potential tourists on the basis of a long-term brand management strategy.
Design/methodology/approach: To achieve the objective, the method of comparative analysis was used. Selected identifiers of the Floating Garden strategy, collected in 6 groups of activities undertaken to create the image of Szczecin, were subjected to empirical verification in 2 target groups: residents of Szczecin and residents of other cities (potential tourists). The data was collected using the Internet survey method (CAWI) and the results were interpreted using the Anholt-gmi city brand hexagon model. On their basis, several sets of hexagons were developed according to the criterion of gender and age. Two hypotheses were adopted in the study. The first presumes that inhabitants identify the most important assumptions of the Floating Garden strategy. In contrast, the second one presumes that potential tourists do not know the assumptions of the discussed strategy. The hypotheses were defined based on a need to build the Floating Gardens strategy towards residents and tourists, articulated by the creators of the strategy.
Findings: Assessment of the image for the local community, based on the implementation of the Floating Garden strategy, is characterised by a high intensity of associations between the given factors included in the assumptions of the discussed strategy. Residents know and understand the assumptions of the strategy and notice the positive changes taking place in the city and in their everyday lives. Building an image of the Szczecin brand is positively received. Despite great commitment to the promotion of the city's image in Poland and abroad, potential tourists do not yet fully identify the Szczecin brand as Floating Garden.
Research limitations/implications: In the study of potential tourists who are residents of metropolitan areas, they were treated as a homogeneous group, thus it is possible, by adopting more extensive criteria, to deepen the results of the conducted research. In addition, models other than Anholt's hexagon can be used to interpret the results, e.g. models using the theory of planned behaviour or semantic profiles for comparing promotional messages.
Practical implications: The article contains implications for city leaders who can use Anholt's hexagon in 6 dimensions, both to evaluate an umbrella brand, such as Floating Garden, and to assess an individual brand.

Originality/value: In the study, the content of questions concerned not only identifiers associated with the city, grouped into 6 brand dimensions according to the Anholt-gmi city brand hexagon model, but also enquiries about associations and the visual side used in creating the Szczecin brand logotype. Research on the perception of logotypes and their compliance with the strategy of the place brand is also a rarity in literature on the subject.

Keywords: place branding, the Anholt-gmi city brand hexagon, Szczecin Floating Garden strategy.

Category of the paper: Research paper.

1. Introduction

There is a great number of publications on city image in literature on the subject (Kotler, Haider, Rein, 1993; Papadopoulos, 2004; Anholt, 2006; Szromnik et al., 2007; Daszkiewicz, 2009; Florek, Glińska, Kowalewska, 2009; Florek, 2013; Zenker, 2014; Rozhkov, Khomutskii, Romanowski, Muniz-Martinez, 2020, and others).

Often, the conducted research is limited to analysis of homogeneous respondent groups, most frequently - tourists, remaining in the sphere of interest of both the city authorities and researchers (Chan et al., 2021). It is much less common to come across the results of surveys among residents who can be a reference group for analyses of other target groups (Manyiwa, Priporas, Wang, 2018; Ciechomski, Romanowski, 2013; Romanowski, 2019).

The Anholt - GMI City Brand Index (Anholt, 2006) predominates among image assessment methods, but other models, such as the hierarchy of effects (Wijaya, 2012, p. 77) or AIDA (Ghirvu, 2013, p. 94), are also used. To ensure comparability of the results, the author of the article decided to use The Anholt - GMI City Brand Index (Anholt, 2006) method to assess the image of Szczecin. As for the content of the questions on the basis of which the image is assessed, statements assume a rather individualised form in each city, as they refer to the unique identifiers or landmarks of a given place. Research on the perception of logotypes and their compliance with the strategy of the place brand is also a rarity in the literature.

Many studies have been carried out among the inhabitants of Szczecin to assess and recognise the image of the city, but most of them are already out of date. There is also not enough information on the opinions of potential tourists regarding how they perceive the Szczecin brand. Therefore, the choice of topic is related to filling a gap in research and updating data on recognition of the Szczecin brand.

The aim of the study is to identify and evaluate the image of the Szczecin brand associated with the Floating Garden strategy among residents of the city and residents of other Polish cities who are potential tourists on the basis of a long-term brand management strategy. To achieve this objective, the Anholt - GMI City Brand Index (Anholt, 2006) was used. The perception of the Floating Garden strategy's logotype was also analysed.

2. Literature review

Image is one of the key and basic concepts in place marketing, as well as in place branding. The interest of scientists in the subject of a city image appeared in the 1960s, and the first researchers were Boulding (1956) and Martineau (1958). In their works, they recognised that "images can have greater impact on human behaviour than objective information about perceived objects or surroundings". However, the increase in interest concerning the issue of image began only after the publication of the work by J.D. Hunt from 1971 (Grzegorczyk, Kochaniec, 2011, pp. 43-44).

Referring to the interdisciplinary nature of research on a place image, one can come across many definitions of this concept. Most often, the author refers to the definitions created by P. Kotler and H. Barich (1991) and J.L. Crompton (1979). According to them, an image is the sum of the ideas, beliefs and pictures that a person has about a given place. F. Lawson and M. Bond-Bovy (1977) think similarly, according to whom the image includes knowledge about the place, emotional attitude towards it, the picture of it and prejudices. However, some researchers limit research on the image of a place and analyse only the opinions and imaginations of people who do not stay in a given place (Grzegorczyk, Kochaniec, 2011, p. 44). Therefore, they define image as "a mental reflection of the environment in the minds of people who have never visited a given place" (Kangas, 1998, cited in: Grzegorczyk, Kochaniec, 2011, p. 44). According to P. Grzyś (2017, p. 7), the image of a place is a fixed added value of an entity that determines its position on the market, for example cities or other territorial units. He adds that the process of shaping this image is often modified and supported by authorities, and this shaping of this image most frequently occurs through the creation of the city's brand and promotion, which is set in strategic documents.

Umer Zaman and Murat Aktan (2021, pp. 394-395), on the other hand, point out that a place image has been operationalised in the literature in 3 dimensions: cognitive, affective and conative, referring to the model of hierarchy of effects. The cognitive dimension is connected with the features and attributes of a place and refers to the beliefs and knowledge of people about the physical properties of a given place, which helps them shape its mental image. These include climate, landscape as well as cultural and tourist attractions. The affective, or emotional dimension of a place image, concerns subjective emotions, feelings and even fears or prejudices related to the attributes and characteristics of a given place and its surroundings. In turn, the conative dimension, sometimes also called the behavioural one, is an element of taking action towards a given place, such as the intention to visit or arrive.

Most of the defined definitions of a place image in literature can be summarised in such a way that the image of a place is a mental structure (visual or non-visual), integrating elements, values and impressions that a person has in relation to it. This structure is based on the knowledge that a person has about a specific place, as well as on perception of a more emotional

nature (Glińska, 2010, p. 129). The image will therefore be the sum of attitudes declared towards a city.

Such an approach to the concept of image requires the use of a method that will allow to map the ideas of potential target groups about a given place. This type of method is the Anholt - GMI City Brand Index (Anholt, 2006).

3. Research methodology

The model proposed by Simon Anholt consists of 6 dimensions, which can be represented in the form of a hexagon (Figure 1).

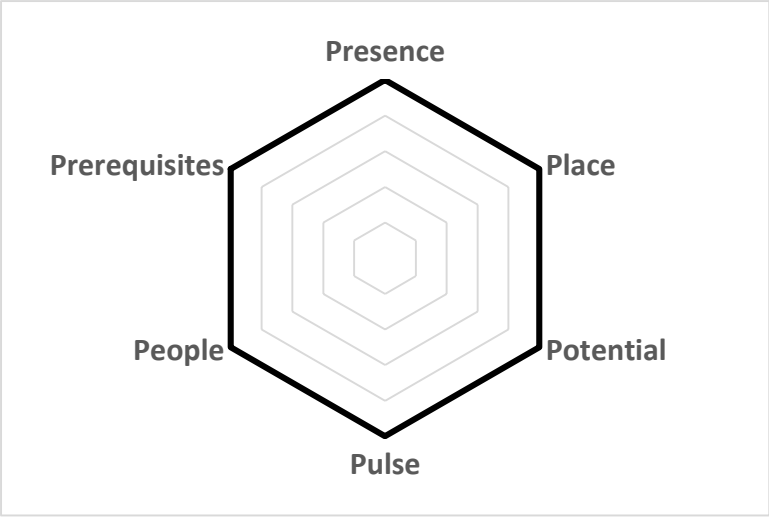

Figure 1. The Anholt - GMI City Brand Index.

Source: Own elaboration based on Fasli, Kalantarzadeh, 2018, p. 85.

The index is estimated using of the average of dimensions that comprise the model. The first dimension is 'Presence', which refers to the international status and position of the city. The second is attractiveness or physical appearance of the city ('Place'), which is related to a favourable climate for living, the purity of natural environment or the attractiveness of buildings and public places. The third component is called 'Prerequisites', which defines what features determine the choice of a city, such as: price attractiveness, standard of public facilities (e.g. hospitals or schools), public transport or sports facilities in the city. The 'People' dimension refers to the characteristics and behaviour of local society. This aspect also relates to a sense of security in the city. 'Pulse' defines the possibility of filling free time with various types of additional activities. The indicated dimension also specifies the degree of excitement of the city in relation to new places to discover. 'Potential' measures educational and economic benefits in the city, the possibility of finding a job in line with expectations, the degree of ease for running a business (Anholt, 2007).

When creating the Szczecin brand strategy, it was stated that it cannot be created based on the historical past of the city, which is why the assumption was made to shape the brand of Szczecin on the basis of what the city may look like in the future (Kordek, Worobjow, 2015, p. 141).

The Szczecin brand strategy primarily refers to the richness of nature around the city and is based on the assumption that the development of Szczecin must be based on its assets, i.e. the use of numerous rivers, canals and backwaters, as Szczecin has a chance to become the "New Green Venice of the North". Therefore, the strategy assumes, among others, a return of the city to the water and the development of numerous islands of Śródodrze, so that they become the new heart of Szczecin (Mosir, 2022).

Another assumption of the strategy is readiness and openness to new things, which are deeply embedded in the identity of the city. Therefore, the strategy assumes making visionary decisions, taking advantage of Szczecin's unique location, such as its cross-border location, and undertaking extraordinary projects without being afraid of bold architectural solutions. Therefore, one of the assumptions and key elements of the brand manifesto is a need to create an architectural object that will attract the attention of Europe as a whole, due to its class and innovation (UMS, 2022a). The Philharmonic of Szczecin, rated very well in the survey, was one such facility.

The aim of such an approach is to move away from the image of Szczecin as a port and industrial city and to eliminate the barriers that hinder the development of the city (UMS, 2022b). In addition, the strategy also assumes that Szczecin will become an open city, which is why an important element included in this strategy is to facilitate access to the city by people from outside Szczecin due to road investments and reconstruction of its main thoroughfares (UMS, 2022a). Therefore, a document entitled "Revitalisation of the centre of Szczecin - directions of activities 2019-2050" was created (Wacinkiewicz, 2019, pp. 3-19). According to the Floating Garden 2050 strategy, the city should invent and "build itself" from the beginning.

An expression of turning towards water and openness to new things was to create a new logotype for Szczecin Floating Garden 2050 (Figure 2). The colours of logotype refer to the above-mentioned natural values (blue – water, green – city greenery, white – space). This colour code also illustrates the goals of the Floating Garden strategy, related to respect for nature, building the perception of the city through the prism of water and greenery (UMS, 2022c). The graphic symbol in the lower part of the logo refers to the pools intertwined with greenery, creating a space unprecedented on such a scale in the middle of one of the largest Polish cities.

Figure 2. Promotional logo of Floating Garden 2050.
Source: UMS 2022c.

The name inspired by the phonetic notation symbolizes the openness of the city and its inhabitants, regardless of nationality. It is also open to creative behaviour in the city, even in terms of presenting its name. The next part, i.e. the inscription "Floating Garden" in translation, meaning a floating garden, is the slogan of the city and, at the same time, its vision. It was created from the English language, because the city wants to communicate its brand not only in Poland, but also abroad. Moreover, the city authorities want Szczecin to be perceived through the prism of its cross-border location. The last part of the logo is "Project 2050", which shows a systemic approach to implementation. The date and the word "project" emphasize Szczecin's task-oriented approach to its own development. It is also a long-term goal with the time horizon of 2050. Such a long period of time embeds the vision into reality. The given promotional logo of the city is used, among others, to coherently mark all activities that fit into the postulates of the strategy, which are implemented by authorities, residents and organisational units (UMS, 2022a).

In order to examine the image of Szczecin's brand on the example of the Floating Garden strategy, an anonymous online survey was conducted via the Google form, distributed on the Facebook platform. The author assumed that a representative sample was to be made up of 2 research groups: residents of Szczecin and residents of cities with more than 500,000 inhabitants, i.e.: Warsaw, Kraków, Łódź, Wrocław, Poznań and the Tri-City. Due to the fact that it was not possible to obtain representative groups from individual cities with more than 500,000 inhabitants, it was necessary to aggregate a group of respondents from outside of Szczecin. The problem in collecting the second representative research sample resulted from the unfavourable rules and regulations of Facebook groups. It mostly prevented the insertion of links redirecting to other pages, self-promotion and insertion of items unrelated to the subject of the group, which is why the administrators often did not accept the post with the author's study or the posts were deleted. Therefore, in the analysis of the study, the first group consists of residents of Szczecin, while the second group includes residents of other Polish cities with over 500,000 residents. In order to obtain answers from respondents coming from other cities,

a study was made available on various city and travel groups on the Facebook social networking site. The questionnaire was created and made available in June 2022.

In the first question, the respondents were to determine the strength of associations regarding the above-mentioned factors with the statement: "Szczecin reminds me of...", using a unipolar scale from 0 to 5, where 0 meant "I have no associations" and 5 – "I strongly associate it with". All 25 factors were assigned to the 6 dimensions of the Anholt hexagon shown in Table 1. The city hexagon is a general model for studying the image of a territorial unit. In his study, the author assigned the factors that fit into the brand strategy of Szczecin to individual dimensions, guided via the criterion chosen by them.

The 'Presence' dimension was defined by factors from the strategies that determine the city's position on the national and international arena and that testify to the city's reputation and express what the city is famous for, such as, being a seaside, cross-border and metropolitan city. In addition, factors that influence people's familiarity with the city, such as the City's Visual Order and what the city wants to be strongly associated with - the Floating Garden, were also assigned to 'Presence'. The last of the included factors – an industrial city – is not the part of the city's strategy. On the contrary, Szczecin no longer wants to be associated with industry. The factor was included to check the strength of respondents' association with the pre-strategy image of city.

Table 1.
Dimensions of the city hexagon with assigned factors of the Szczecin brand strategy

PRESENCE	PLACE	POTENTIAL	PULSE	PEOPLE	PREREQUISITES
• seaside town • cross-border city • Urban Visual Order • Floating Garden • metropolitan city • industrial city	• greenery • water • eco-city • space • nature-friendly city	• port town • shipping route to the sea • innovation • entrepreneurship • modern city	• Regatta, the Tall Ship Races, • parks and squares • boulevards as places for meetings, recreation and relaxation • Days of the Sea	• sense of security • multiculturalism	• modernised road infrastructure • high-quality sports facilities • world-class, innovative architectural facilities

Source: own elaboration.

The 'Place' dimension was matched with the factors from the strategy related to the physical aspects of the city and which are attractive in terms of living in it, such as natural values, spatiality of the city and care for nature.

The 'Potential' dimension contains factors influencing the development of Szczecin and proving its economic potential. These factors include employment opportunities for residents and those offered by the market for potential investors and companies, such as a shipping route to the sea and the status of a port city (possibility of developing maritime tourism), attracting investors and other stakeholders related to shipping.

It was assumed that the ‘Pulse’ dimension will include factors concerning attractive events and activities, interesting forms of spending time and those that make the city teeming with life. These include the largest events organised in Szczecin, such as the Tall Ship Races and Days of the Sea, as well as places visited daily by many residents, tourists and those bustling with life all-year-round, such as boulevards, parks and squares.

The next dimension, ‘People’, includes the characteristics of residents and their attitude towards tourists, which is why the sense of security and multiculturalism, which are part of the strategy of Szczecin brand, are assigned to this dimension.

The final dimension, ‘Prerequisites’, defines public facilities, basic infrastructure that serves residents and tourists, and public services offered by the city. Therefore, modernised road infrastructure as well as world-class, innovative architectural and sports facilities have been assigned here.

In the questionnaire, a inquiry related to the compatibility of 3 colours associated with Szczecin in the city's brand strategy was made. The author wanted to find out whether the respondents see the city as the authorities want it to be seen, i.e. as a green city (green), surrounded by water (blue) with large, open space (white).

In the last of the analysed questions, the respondents were asked to define associations with the Szczecin Floating Garden 2050 project logo. The purpose of this question was to find out how the respondents identify the given symbols and whether their associations are in accordance with the assumptions made for the Floating Garden strategy.

The study and its analysis allowed to determine the perception of the Szczecin brand strategy as Floating Garden in the opinions of Szczecin’s residents and residents of other Polish cities (potential tourists).

A population of 253 respondents took part in the study, including 86 men (34%) and 167 women (66%). The largest research group (71%) was represented by people between the ages of 18 and 29, and the smallest by people below 18 (1 person) and above 60 (4 people). Therefore, in the subsequent analysis, the age groups were combined as follows: 18-29, 30-39 and 40+, of which a person under the age of 18 from Szczecin was assigned to the first group.

In further analysis, 2 groups of respondents were examined, i.e. 108 (43%) residents of Szczecin and 145 (57%) residents of other cities who can be treated as potential tourists.

4. Findings

At first, an analysis for a group of Szczecin residents was performed, of which 71 were women and 37 men. Considering the division into 3 age groups, the largest comprised individuals aged 18 to 29 (69%), the smaller – people aged 40+ (17%), and the smallest – aged from 30 to 39 (14%). Based on the respondents' answers, a city brand hexagon covering 6 dimensions, was created (Figure 3). It consisted of matched factors included in the Floating Garden strategy. A hexagon was created on the basis of drawn averages from each dimension.

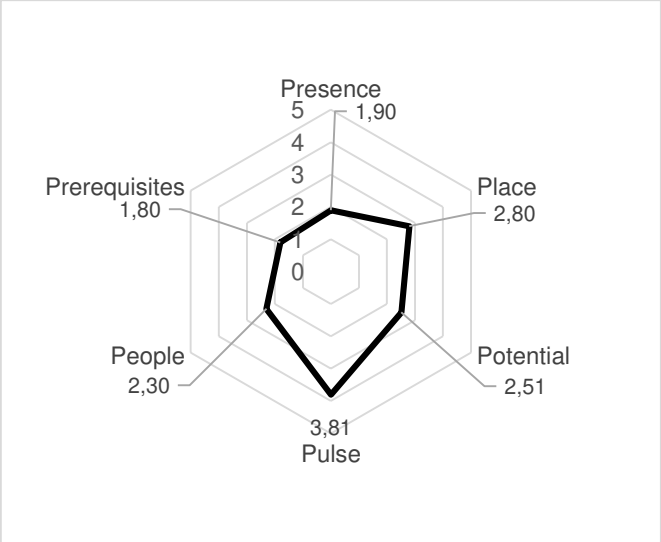

Figure 3. Hexagon for the image of the Szczecin brand – residents.

Source: Own elaboration.

In the case of Szczecin inhabitants, the strongest dimension is ‘Pulse’, which stands out significantly. Such a situation may prove that Szczecin residents associate their city with cyclical events organised in its area and with places where they can spend their free time and get away from everyday duties. This also shows that residents are most impressed by large events and places for recreation and socialising, rather than small investments.

On the other hand, the ‘Prerequisites; dimension was rated the lowest, which indicates that residents do not associate the city with world-renowned architectural buildings or high-quality sports facilities that provide cultural and sports services. It is probable that residents do not pay enough attention to them. The same applies to road infrastructure, still being modernised. Therefore, the lack of associations could be influenced by the fact that the process has not yet been completed and that numerous repairs of road infrastructure are a frequent cause of irritation for residents due to constant traffic jams and closed roads.

It is also surprising that the weakest dimension, apart from 'Prerequisites', is 'Presence'. It primarily represents the resources for which the city is famous and with which it wants to be associated. Moreover, in a given dimension, the industrial city was rated the highest, which contradicts the assumptions of the Floating Garden strategy, according to which the city wants to move away from such an association. This proves that the inhabitants do not fully identify the new vision of the city. This could probably be dictated by the functioning of the Shipyard of Szczecin in the old days, which has taken root in the minds of inhabitants.

The 'Place' dimension was assessed by the residents as the second strongest. This means that the factors greatly emphasized in the strategy's assumptions and being the main part of the Floating Garden strategy (greenery, water, space) were positively perceived by the residents. In this dimension, the highest and lowest grades for individual factors were pointed out, because the highest rated association among the inhabitants of Szczecin were the cyclically organised Days of the Sea (4.06) and Boulevards as a place of meetings, recreation and relaxation (4.02). On the other hand, the lowest grade were given to associations with seaside character of Szczecin and Floating Garden. This means a very low rating for the basic slogan used in the city's identification system.

Analysing the hexagon from a gender perspective (Figure 4), it should be noted that men assessed each dimension better than women. In addition, the average hexagon size ratings for men are more evenly distributed than for women. Both men and women associate Szczecin most with 'Pulse', where the average is 3.81 and 3.87, respectively. However, women rated 'Prerequisites' the worst – 1.80. For men, 'Presence' was ranked the worse – 231.

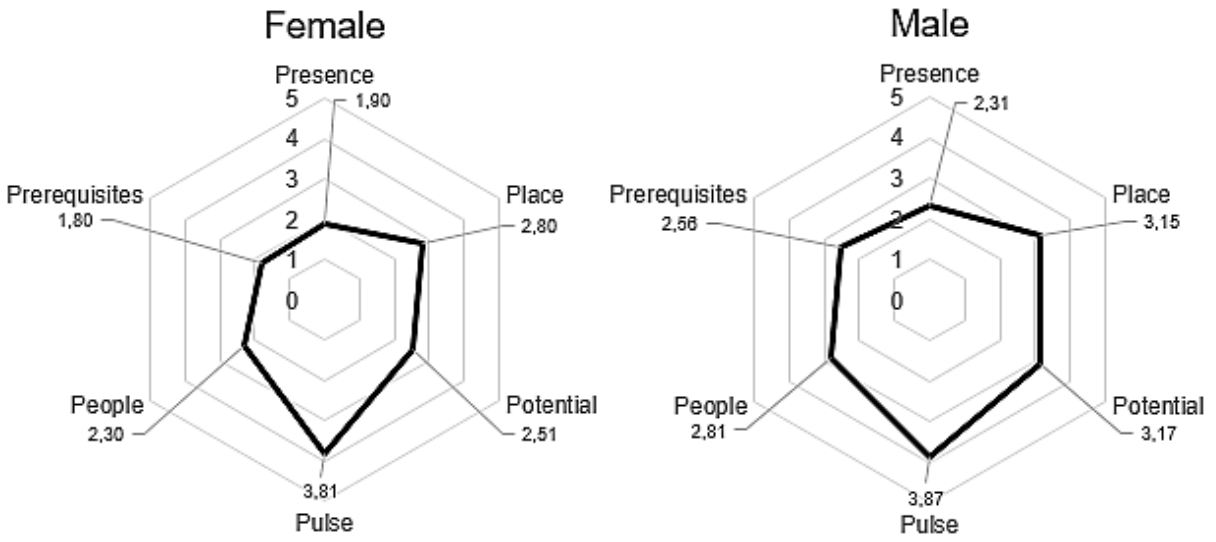

Figure 4. Hexagons for the image of the Szczecin brand seen through the eyes of the residents – female and male.

Source: own elaboration.

The hexagons for the Szczecin brand image should also be considered through the prism of age (Figure 5).

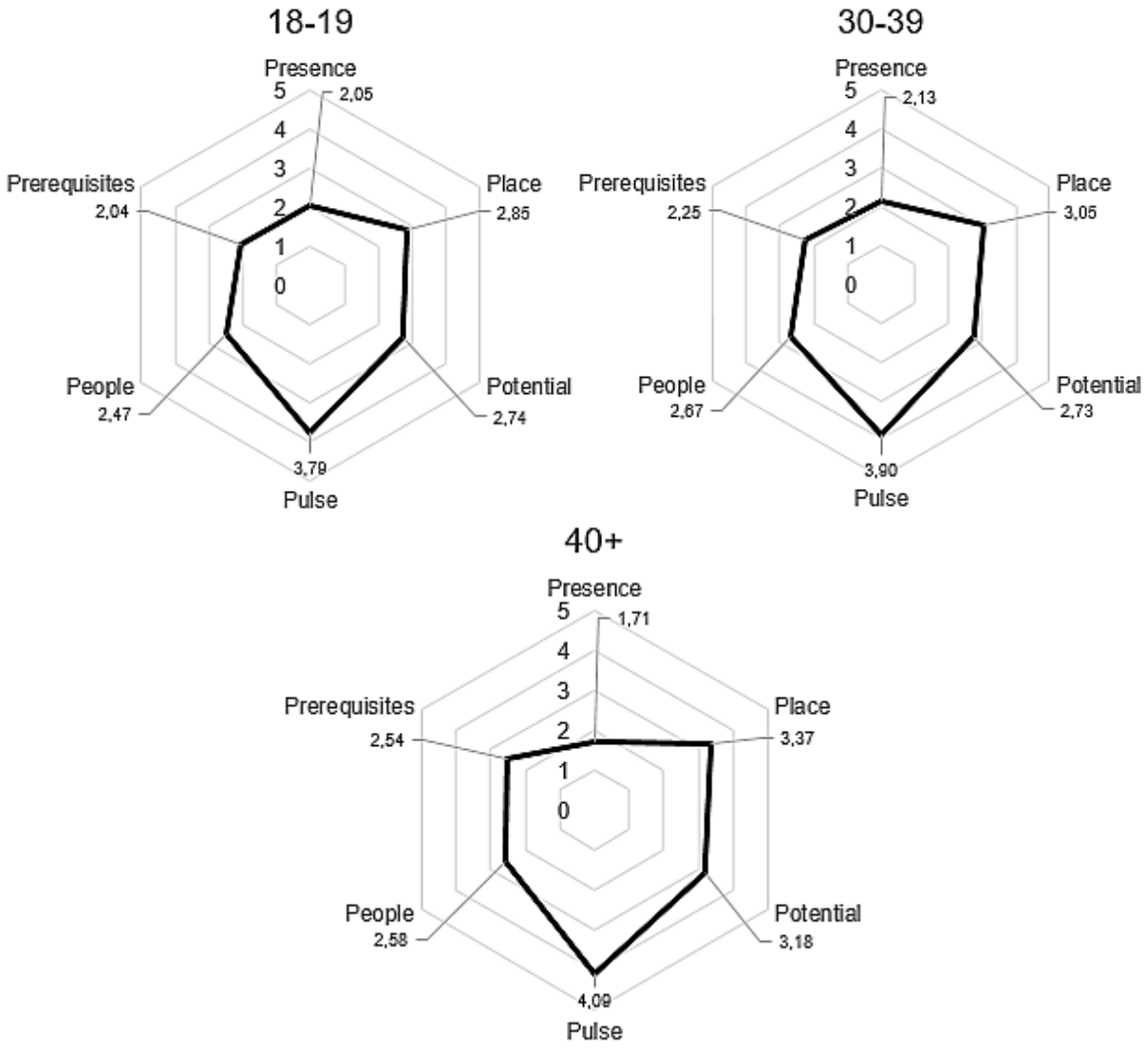

Figure 5. Hexagons for the image of the Szczecin brand in the opinion of residents– age ranges.
Source: Own elaboration.

In this case, the answers of three age groups were analysed: 18-29, 30-39 and 40+. The hexagon for the first and the second age groups is almost identical, which indicates that the respondents from these groups gave very similar answers and assessed their associations with the factors that fit into the city's brand strategy at a similar level. It is different in the third age group, 40+, where the hexagon is slightly different. In all ranges, the 'Pulse; dimension was rated the highest, the average of which clearly differs from the rest. In addition, the author's attention was drawn to the fact that the highest average in the 'Pulse' dimension was in the oldest age group (4.09), and not, as might be expected, in the youngest, where it was the lowest (3.79). These data indicate that the older the age group, the more Szczecin is associated with organised events and places adapted for recreation, rest and socialising. Interestingly, in the 50-60 age group, as many as 2 factors, such as Days of the Sea and the Tall Ship Races Regatta, achieved an average of 5.0. In each case, the 'Place' was also rated very high. In the 30-39 and 40+ age groups, 'Presence' was given the lowest rates, and in the youngest

age group – 'Prerequisites' and 'Presence' were graded the worst. What is more, all dimensions of the hexagon were rated the best by the oldest age group, and as the worst – by the youngest.

When it comes to the associations of Szczecin inhabitants with the Floating Garden strategy, 55 out of 108 has some associations with it. Asked about colours, they agree with the assumptions of the Floating Garden strategy together with the logotype. The most frequently chosen colours by all Szczecin inhabitants were: blue (85%), green (83%) and white (55%). Considering that the question was multiple-choice and each respondent could choose different colour sequences, a positive fact for the city is that the sequence: blue, green, white was chosen as many as 45 times. Thus, it may be concluded that it was a conscious choice for the residents, dictated by the accuracy of the Floating Garden strategy in the city's assets and good communication between the brand and residents, and not a random choice. Residents, asked about specific associations with the Floating Garden strategy, pointed out greenery and water areas, ecological aspects of the city together with pro-ecological investments. There were also respondents who were able to professionally define what the brand strategy shown in the Floating Garden was. However, the analysis also showed that there are inhabitants of Szczecin who have not heard anything about the strategy (33%) or heard little or did not delve into the subject.

The residents of other Polish cities constituted a group of 145 respondents in the study, of which 96 (66%) were women and 49 (34%) were men. Also in this case, the largest age group were young people aged 18-29 (105.72%), a slightly smaller group – people aged 40+ (21.15%), and the smallest – people aged 30-39 (19.13%). At first glance, it can be stated that the created hexagon is more even than for Szczecin inhabitants and has no significant deviations (Figure 6).

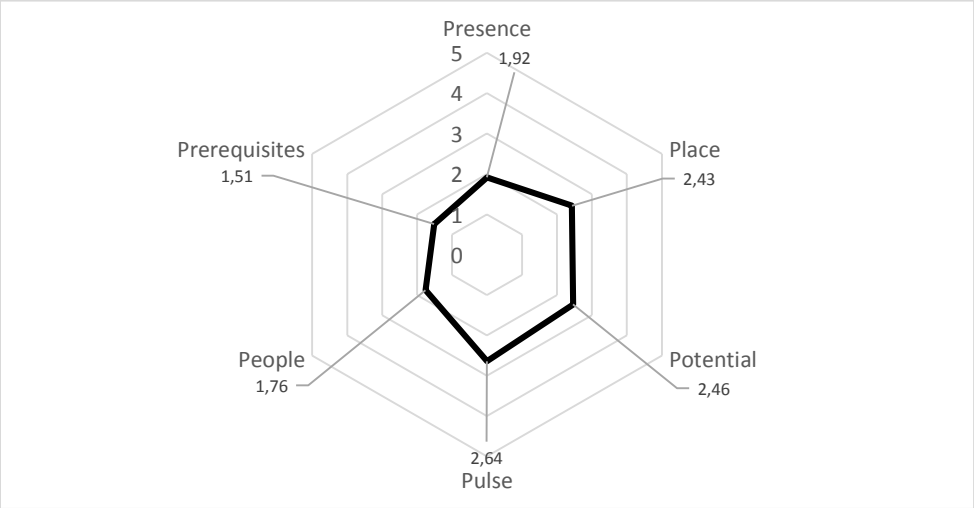

Figure 6. Hexagon for the image of the Szczecin brand – residents from other Polish cities.
Source: Own elaboration

However, it can be noticed that, as in that case, the ‘Pulse’ dimension has the greatest impact, with an average of 2.64. This is not as a big deviation as for the hexagon from Szczecin inhabitants. Nevertheless, such an observation shows how important it is to organise cyclical events in cities that match the city's identity, which later shape its image and are strongly associated with a given territory. Furthermore, they are a strong argument for the arrival of tourists. In addition, the second strongest dimension is ‘Potential’, with an average of 2.46. This situation shows that residents of other cities view Szczecin as a city with great potential, thanks to the fact that it is a port city and has a shipping route to the sea. What is more, it also proves that they perceive Szczecin as a modern, innovative and entrepreneurial city. Such features seen through the eyes of people from outside the city may make them want to move here, for example, for earning purposes, or investors wanting to commence an investment. The ‘Place’ dimension (2.43) is almost as strong as ’Potential’, which proves that residents of other cities also see greenery, water and space as the greatest assets of Szczecin. On the other hand, the smallest strength of associations was observed within the ‘Prerequisites’ dimension, where the average was 1.51. Then come ‘People’ (1.76) and ‘Presence’ (1.92).

It is worth noting that men also rated each dimension more strongly than women (Figure 7), similarly to the hexagon for Szczecin inhabitants. In both cases, the highest rated dimension was ‘Pulse’, where the average grade for women was 2.58 and for men, 2.76, as well as the least rated dimension – ‘Prerequisites’, where this totalled 1.47 for women and 1.61 for men. The ‘People’ dimension was also rated very poorly (women: 1.70, men: 1.88), which means that people out of Szczecin do not associate the city with a sense of security and multiculturalism. It should also be noted that no dimension exceeded the average of 3.0, which means that each element of the Floating Garden strategy was rated quite poorly in respondents' associations.

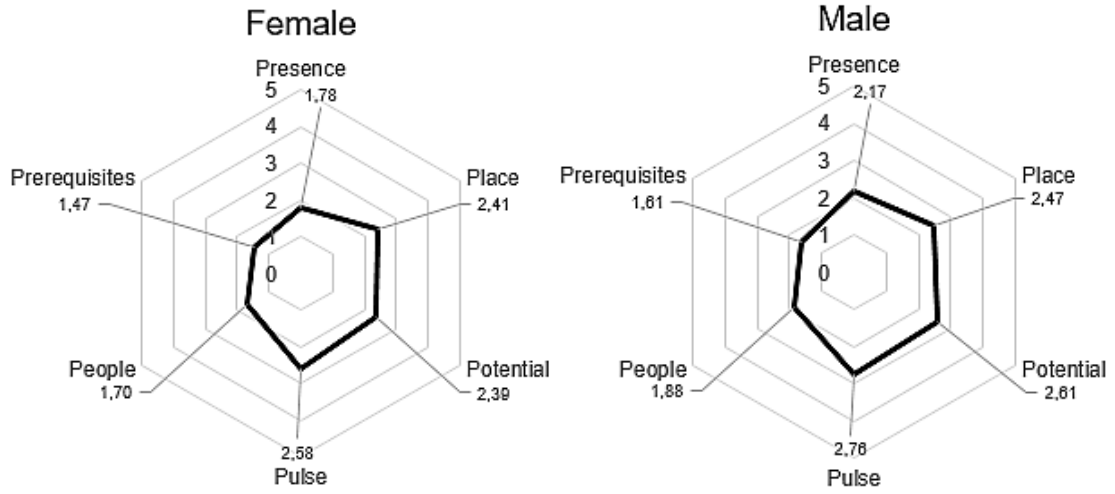

Figure 7. Hexagons for the image of the Szczecin brand in the opinion of residents from other cities – female and male.

Source: Own elaboration.

An analysis of hexagons was also performed for residents of other cities coming from 3 age groups (Figure 8). Looking at the presented hexagons, it can be seen that there is a similar situation as in the case of Szczecin inhabitants, namely people aged 40+ assessed individual dimensions the strongest. In the case of the 18-29 and 40+ age groups, the strongest dimension was 'Pulse', with the average being: 2.64 and 3.25, respectively, and for respondents aged 30-39, this was 'Potential' (2.77). This means that for the given group, potential in the city may later be converted into a desire to settle or work in Szczecin. The lowest rated dimensions for respondents aged 18-29 and 30-39 were 'Prerequisites', with an average of 1.50 and 1.42, respectively, while the oldest age group rated the 'People' dimension the lowest. Moreover, looking at a more detailed analysis, the strongest association with Szczecin for the youngest age group is a port city, for the intermediate group it is also a port city, and for the oldest, it is water. On the other hand, the association with the Floating Garden was rated the lowest for all age groups.

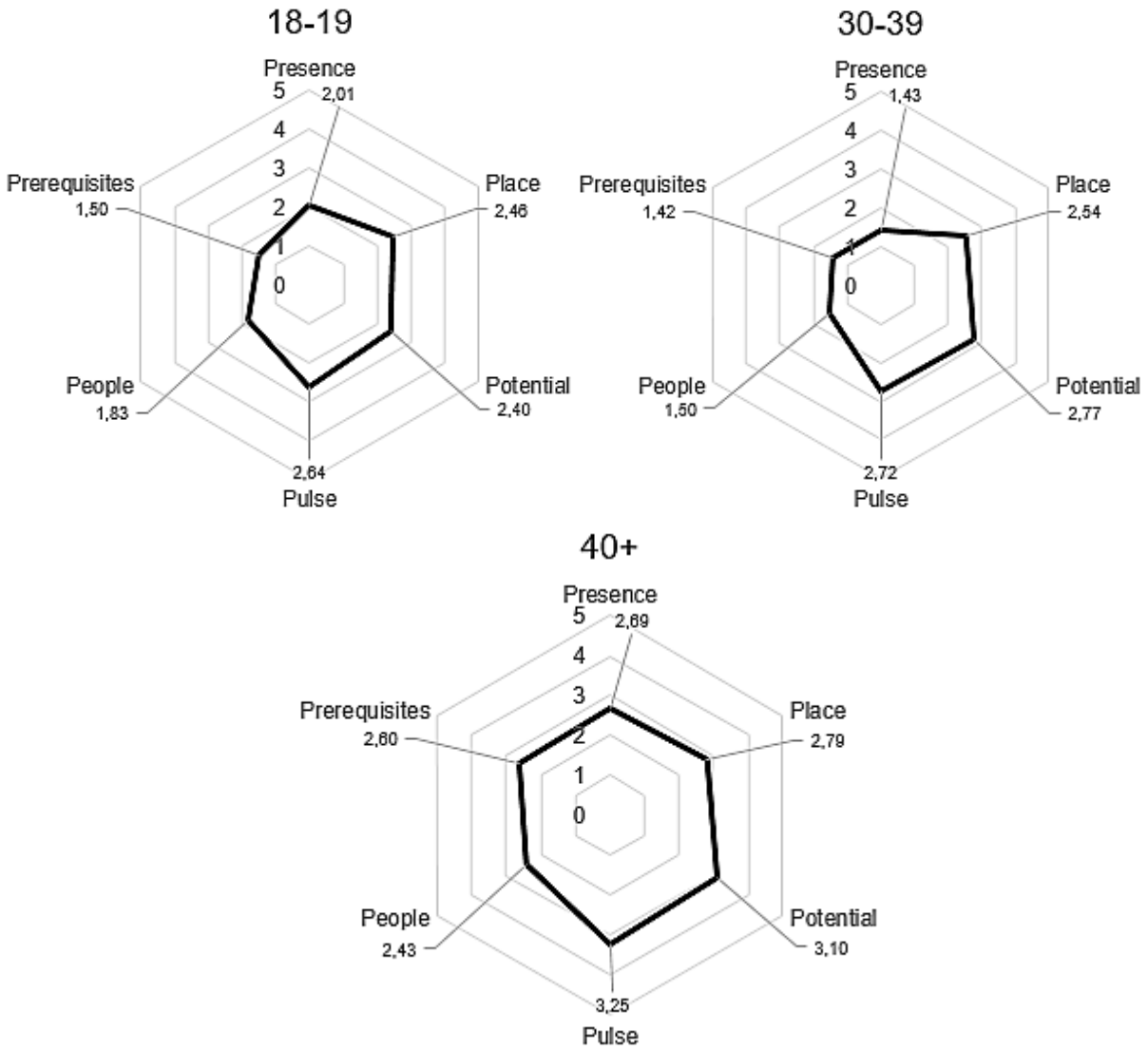

Figure 8. Hexagons for the image of the Szczecin brand in the opinion of residents from other cities – age ranges.

Source: Own elaboration.

When it comes to colour associations with Szczecin, the most chosen colours were: blue (78%), green (58%) and white (44%), which means that residents of other cities associate Szczecin with the colours adopted from the Floating Garden strategy identification system (UMS, 2022c). In addition, these 3 colours were the most frequently chosen sequence. The blue colour was chosen the most times, which proves that the inhabitants of Poland know that Szczecin is surrounded by water. Also, many of them think that Szczecin is located by the sea or is very close to the sea. What us more, 33% of respondents believe that they associate Szczecin with greyness, which has a slightly negative connotation.

The question about associations with the Floating Garden strategy was answered by 129 people from outside of Szczecin, which made it possible to determine which residents of other Polish cities had heard about the City's brand strategy. As many as 73% of respondents from outside of Szczecin have not heard anything about the Floating Garden strategy, and only a few respondents associate the logo with the name. However, there were respondents who were able to define what Szczecin brand strategy is and what its assumptions are. The respondents pointed out that the given strategy includes ecological activities, investments respecting greenery and nature, as well as investments and development of infrastructure in the waterfront parts of the city. In addition, some of the respondents know that Szczecin wants to become a modern, innovative, multicultural and liveable city through the strategy. Moreover, several of them know that the City's Vision is to become a floating garden. Only 27% of respondents were able to say anything about the brand strategy of the city, which once again, confirms the belief that the Floating Garden strategy is not sufficiently promoted beyond Szczecin.

The associations of respondents from outside of Szczecin with the Floating Garden logo can be considered as interesting. The question was answered by 128 respondents, of which, 7 people had no associations. Recurring associations included: water, greenery, nature and sea. In addition, there were also such associations as: islands, pools, gardens, the Oder river, future, innovation, modernity. All these associations can be attributed to the assumptions of the Floating Garden strategy.

The most interesting associations concerned the phonetic notation as part of the logotype. The phonetic spelling of "Szczecin", which was supposed to symbolise the openness of inhabitants and the city to others regardless of nationality, is associated by the respondents with integrals, mathematics, strange stamps, but also with the script and language of Arabic, Hebrew, Georgian, Islam, Judaism, Germany and Aztec pictograms. In addition, some respondents stated that the logo is unclear, illegible, incomprehensible, chaotic and overcomplicated for them. Two respondents also commented on the logo's gradient, which they found to be “dicey” and “cheap”.

5. Discussion

The study was carried out on a research sample divided into 2 groups: residents of Szczecin and residents of other Polish cities with a number of inhabitants above 500,000. Looking at all the created hexagons, in both cases, the ‘Pulse’ dimension was most often chosen as the strongest and the ‘Prerequisites’ as the weakest. This proves that large, cyclically organised events in Szczecin have been strongly inscribed in the image of the city. Therefore, one should not resign from organising large events in the city, because they can have the greatest influence on the city promotion, attracting tourists and influence shaping of the city image. In addition, highly rated parks, squares and boulevards in the ‘Pulse’ dimension show that respondents associate the city as vibrant with life, where a lot is happening and where one can spend his/her free time pleasantly. The so poorly assessed ‘Prerequisites’ dimension should be a signal for the authorities that appropriate steps should be taken in such a direction that factors from a given dimension have a greater impact on the city's image.

In the analysis of the study, it is also puzzling that the ‘People; dimension was not strongly rated, which indicates that neither the inhabitants of Szczecin nor of other Polish cities associate Szczecin with a sense of security or multiculturalism, although due to its cross-border location, the city is inhabited by many foreigners, for example, Germans. Therefore, the city authorities should focus on developing and promoting factors that are among the least rated, and consider developing the promotion of those factors that were of average strength in relation to others.

Additionally, Szczecin inhabitants better perceived the image of the Szczecin brand as a Floating Garden when considering the assessment of individual strategy elements. For inhabitants of other Polish cities, the Szczecin brand is less widely promoted, as evidenced by poor knowledge of the Szczecin brand strategy by 73% of them. It is true that the assumptions of the strategy were supposed to be introduced to Szczecin inhabitants and that they would first get to know the idea of the vision. However, the city authorities should focus on more effective promotion of the Floating Garden strategy in other parts of Poland, bearing in mind the period during which the strategy is being implemented.

It is also of significance that the city not resign from organising the largest events, such as Sea Days and the Regatta, which shape the city's identity and attract hundreds of tourists from other cities, as well as new investments that have been successively implemented so far. In addition, 3 huge investments were completed in 2022 and 2023 – Aquapark Fabryka Wody, the Maritime Science Centre and the New Stadium of Szczecin, creating a powerful opportunity for the city, which must be properly and thoughtfully utilised for promotional purposes shaping the city's image.

6. Conclusions

The aim of the article was to identify and evaluate the image of the Szczecin brand associated with the Floating Garden among inhabitants of the city and residents of other Polish cities who are potential tourists on the basis of a long-term brand management strategy. In addition, 2 hypotheses were adopted in the article. The first assuming that the inhabitants identify the most important assumptions of the Floating Garden strategy. On the other hand, the second one assumed that potential tourists do not know the assumptions of the discussed strategy. The proposal of these hypotheses resulted from the need to build the Floating Garden strategy for residents and tourists, articulated by the creators of the strategy.

Residents positively identified the assumptions of the Floating Garden strategy, and the factors included in the strategy of the Szczecin brand had an acceptable intensity regarding association strength, which was at an average level. The research results presented in the form of hexagons showed that none of the dimensions exceeded the value of 4.0 (on a scale of 0-5). The exception was in the group of people above the age of 40, who assessed the 'Pulse' dimension higher than this level. The analysis of individual dimensions indicated that 'Pulse' was the best assessed dimension of Szczecin's image, and 'Prerequisites' – the worst one.

Analysis of the research results proved that the inhabitants know and understand the assumptions of the strategy and notice the beneficial changes taking place in the city and in their everyday lives. This allowed to confirm the first hypothesis. It has been proven due to analysing the associations of Szczecin residents regarding the logotype used in the Floating Garden strategy, colours they associate with Szczecin and the description of associations concerning the brand strategy.

The second hypothesis assumes that potential tourists do not identify the Szczecin brand as Floating Garden. In this case, analysis of the research results also did not allow to confirm the hypothesis. Residents of other cities do not yet fully consider Szczecin as a floating garden, and as much as 73% of respondents in this group declared lack of knowledge and were unable to determine the details of the Szczecin strategy. On the other hand, respondents from outside of Szczecin were aware of the strengths and values of the city communicated by the authorities of Szczecin, but they were not able to fully adjust them to the brand strategy.

In addition, deciphering the logo, including the phonetic inscription, causes them a lot of problems. The comforting fact is that they identified the main factors that are part of the brand's assumptions, i.e. greenery, water, ecology, nature, modernity and innovation. In this group, the 'Pulse' dimension was rated the best, which proves that the biggest events organised in Szczecin are best encoded in the minds of potential tourists.

Recommendations that can be made certainly concern larger and broader activities related to the promotion of the Floating Garden strategy outside the city. This would also help change the stereotype of an industrial city and increase its attractiveness by communicating the greener

character of a port city. Furthermore, an important recommended action is to focus on factors from the least rated hexagonal dimensions, i.e. mainly 'Prerequisites', 'Presence' and 'People'.

As far as the limitations of research are concerned, in the study on potential tourists living in metropolitan areas, they were treated as a homogeneous group, so it is possible, by adopting more extensive criteria, to deepen the analysis. In addition, models other than Anholt's hexagon can be used to interpret the results, e.g. models using the theory of planned behaviour or semantic profiles for comparing promotional messages. Moreover, research could be conducted on both umbrella brands, such as the Floating Garden, and individual place brands that require in-depth analysis.

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PRO-ENVIRONMENTAL COMMUNICATION ACTIVITIES OF PAPER AND PLASTIC PACKAGING PRODUCERS. EVIDENCE FROM POLAND

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Purpose: The aim of this research is to analyze level of pro-environmental communication activities including the aspect of the circular economy concept in non-financial reports of packaging producers required to report environmental issues (group 1) and compare them to packaging producers which do not have to presents environmental aspects (group 2).
Design/methodology/approach: This research uses the text analysis method. Quantitative and qualitative analysis was carried out. The information source in this aspect are non-financial report of paper and plastics producers (30 organizations). All reports were obtained from the National Court Register and cover the years 2019-2021. Statistical analyzes were also performed using the Shapiro – Wilk and U Mann Whitney tests to examine the distribution of variables and the significance of differences between the studied groups.
Findings: The quantitative analysis of reports showed that the most of organizations in first group communicated environmental aspects in their reports. Despite the fact that second group do not have obligation to do it there were still some organizations which include these aspects in reports. Statistical analysis did not show any significant differences between the surveyed groups. Qualitative analysis showed that despite the fact that environmental aspects are taken into account in the reports, are treated superficially, and the level of communication in both groups was low and mostly concerned general statements or individual actions. Specified actions or their effects were rarely shown. Descriptive analysis showed that these organizations particularly do not communicate their commitment to circular economy concept.
Research limitations/implications: Some limitations were identified in this study, i.e., lack of uniform reporting requirements or problems with reports content verification. Producers were presenting environmental aspects in general way. The law requires a minimum scope of data reporting and what elements will be included depends only on the organization.
Originality/value: The article presents the packaging industry in terms of non-financial disclosures communication. No other studies in this field have been identified on such a research group. Also, there no studies have been found include organizations with no obligation to report. Article concentrate on aspects connected with environment but also relatively new circular economy concept.

Keywords: non-financial reporting, quality, environment, circular economy, packaging production.

Category of the paper: research paper.

1. Introduction

Nowadays environmental aspects are becoming one of the most important issues. Humans' activity connected with e.g., overconsumption of products, excessive consumption of resources or production of too much waste is the reasons for environmental degradation. The area of production is one of the greatest threats to environment. All types of business use natural resources. They are a key element of functioning of organizations, because are components of natural circuit of matter using in production and available in the form of products and waste to the natural and social environment (Godlewska, Sidorczuk-Pietraszko, 2015). In order to reduce the negative impact of the organization's activities on the environment, there is a possibility to take some initiatives. One of the most recent solutions for problems in field of environment is the circular economy concept. It concerns on among others energy recovery, closing the loops, increase efficiency, reducing of use natural resources (Morseletto, 2020). However, in addition to taking actions for the environment, it is also, important to inform about it. One of the best ways to presents information about environmental aspects are reports or statements of organizations. This is important because such reports are a form of dialogue with stakeholders and the organization's surrounding. This is confirmed by studies, e.g., which showed that disclosing non-financial information positively affects the organization's relations with its surrounding (Chojnacka, Jadanowska, 2020).

Non-financial reporting is one of communication tool between organization and their stakeholders. Those type of statements that used to be voluntary are becoming mandatory for some organizations (Krawczyk, 2021). Communicating with various groups of stakeholders in terms of social or environmental issues is important because lack of such communication may result in the perception of these activities by stakeholders being negligible or even negative (Pérez, 2015).

In Poland only big organizations (it means employ over 500 employees and achieve over PLN 170 million net turnover exceeding or PLN 85 million balance sheet total) are obligated to prepare non-financial statements (Act of 15 December 2016…, 2016). In this group of organizations can be e.g., banks, insurance companies or organizations listed on The Stock Market. According to Sierra-Garcia et al. (2018) an increasing number of organizations which choose to disclose information about the impact of their activity on aspects of corporate governance, society, environment and human rights. Therefore, it is necessary to conduct the research in terms of non-financial data reporting not only by organizations like banks, insurance companies etc. but also in other groups of organizations that are and are not required to conduct such reports.

One of the key sectors, which is of great importance both for the functioning of other sector and for the environment, is the production of packaging. Packaging is one of the most important items in the life of every human being. They are also one of the sources of threat to the life of

society and the natural environment. Plastic packaging are the final element of the plastics market and at the same time they are the main source of plastic waste (Allison et al., 2021). According to Geueke et al. (2018) in 2014 the amount of packaging waste from European households together with production industry sectors, was around of 82 million metric tons.

The aim of this research is to analyze level of pro-environmental communication activities including the aspect of the circular economy concept in non-financial reports of packaging producers required to report environmental issues (group 1) and compare them to packaging producers which do not have to presents environmental aspects (group 2). This article is divided into two parts. First part includes literature review connected with non-financial reporting in case of communication and impact of packaging industry on the environment. Second part is empirical and is divided into two parts. In first stage reports were analyzed in case of number of reports communicate environmental aspects. Second stage is connected with qualitative analysis of environmental communication.

2. Literature review

2.1. Non-financial reporting as communication tool

Communication is a process in which groups, institutions and individuals engage in a kind of dialogue. The aim of this process is to exchange ideas, thoughts and to share information or knowledge. It can be operated on different levels by using communication channels (Siemieniak, 2017). In the case of organizations, communication may refer to various aspects of its functioning i.e., dialogue with stakeholders, presenting information about social or environmental activities. In recent years communication of environmental aspects became important issue in organizations functioning. The reason for the increased practices in this area are e.g., social pressure and government actions focused on environmental protection. Environmental aspects communication refers to sharing the information about environmental activities and its effects undertaken by organizations with stakeholders. This allows to create a trust, credibility and partnership (Szkiel, 2018). Communication in the aspect of reporting can take various form depending on individual criteria e.g., communication area, addresses, communication nature or the scope of information provided. Due to the last criteria communication can be divided into mandatory and extended information (Mazurowska, Płoska, 2022). Communication, as was mentioned, is a dialogue. Therefore, in communication process there must be at least two subjects: sender and receiver. In communication model should be included also: announcement, code, channel, noises, feedback, reference frame and information gap (Potocki et al., 2011). In conducting dialogue, extremely important is the way of conveying the announcement – channel. There are a lot of different types of communication channels with

stakeholders including financial, management, non-financial reports, social media, advertisements, packaging, labels, web sides etc. (Mazurowska, Płoska, 2022).

Non-financial reporting was treated as supplementary information to the financial reports. Due to increased demand of information by stakeholders they were became separate part but also separate document as report (Ogrodnik, 2019). According to EU directive 2014/95/UE non-financial information are connected with social, labor, environmental, human rights and corruption issues (Directive 2014/95/EU…, 2014). In Poland non-financial reporting is regulated by Account Act. In 2017 act was changed to implicate new EU directive from 2014. Accounting act include two the most important elements connected with non-financial reporting: reporting obligation criteria and the minimum scope of information disclosed. Organizations should inform about (Act of 15 December 2016…, 2016):

- the description of business model of organization,
- key non-financial indicators of effectiveness,
- a description of the policies applied by the organizations regarding the social, labor, environmental, respect for human rights and counteracting corruption issues,
- a description of the due diligence procedures,
- risk description.

Non-financial reporting can be presented in different types of reports e.g., sustainability reports, CSR reports, environmental reports, integrated reports. Sustainability and CSR aspects can be presented also in form of ESG reports. It refers to discourse the aims of organization in case of sustainability development. This type of reports includes information about environmental, social and government goals and progress in checking these goals. Many countries in Europe reacquires ESG reporting. Another possibility is to presents integrated reports. These reports present the organization's impact on the environment and social issues. GRI requirements are a common presentation of non-financial data in these reports (Bukowski, 2020). In Poland non-financial reporting can be included also in management statements (Act of 15 December 2016…, 2016).

In polish law the obligation connected with non-financial reporting is a relatively new issue. Before 2017 organizations in Poland may voluntarily disclose or not disclose non-financial data. It was not regulated from the legal point of view (Wójcik-Jurkiewicz, 2020). Despite the fact that it is new issue, interest in this topic among researchers is high, as indicated by a number of studies, e.g. Rubik (2018), Wójcik-Jurkiewicz & Sadowska (2018). In researches, concentrated on non-financial, CSR or sustainability reports analysis, there are published more and more researches connected with aspects of information communication and its usefulness and quality (Ciechan-Kujawa, 2013; Fijałkowska, 2013; Laskowska, Lingo, 2018; Smuła, 2018). In the cited studies the assessment of non-financial reports and the information contained therein is measured using various methods. Some of the researchers evaluated reports in relation to the requirements or principles of reporting standards e.g., GRI, SIN (Bek-Gaik, Surowiec, 2019; Błażyńska, 2019; Garcia- Torea et al., 2020; Skoczylas, 2019; Smuła, 2018). In Poland

there is no obligation to prepare reports using any of these reporting standards. In addition to communication aspect there are researches which are based on the Account Act obligations (Krzysztofek, 2018), but also on the type of report (Michalczuk, Konarzewska, 2018). Some of these researches concentrate on communication but more in a qualitative way e.g., Smuła (2018), Munzarowa et al. (2022). Laskowska and Lingo (2018) propose measurement depending on what is communicated i.e., whether the actions themselves or also their effects. There are also studies using Likert scales to assess what information is presented in reports, e.g., Matuszak and Różańska (2017a). Another possibility to measure environmental communication can be number of indicators according to reporting standards. This method is used by e.g., Skoczylas (2019), Piłacik (2017) to present providing environmental information by GRI standard.

In Poland, researches connected with non-financial reporting mostly concentrate on large public trust entitles. In previous years researches has been conducted on different groups of organizations like banks (Wójcik-Jurkiewicz, 2020), insurance companies (Lament, 2017) or food producers (Kafel, Nowicki, 2021), energy companies (Bartoszewicz, Szczepankiewicz, 2022; Woźniak, 2018) or mining (Bogacz, Migza, 2016). There are also some researches that include different sectors e.g., fuels, banks, clothing, IT (Czaja-Cieszyńska, 2022). According to research conducted by Krawczyk (2019) there are three leading sectors, which publicized the largest number of CSR reports from 2005 to 2018: energy sector, banks and food sector. Among the aforementioned studies related to the reporting of non-financial data, organizations that clearly have a reporting obligation, because they are large public interest entities, dominate. However, organizations not always include all aspects which should be presented in reports. According to Manes-Rossi et al. (2018) 94% of researched organizations include environmental aspects, 78% include key performance indicators and only 54% of organizations include due diligence procedures.

As can be seen, only some groups of organizations are research subjects in case of non-financial reports. There are still unexplored sectors in case of non-financial reporting analysis. Due to the fact that organizations with an obligation to report do not always communicate environmental aspects, maybe organizations that do not have such an obligation can inform about environmental aspects. This article focuses on the analysis of reports from organizations in the packaging industry which are and are not obligated to presents environmental aspects.

2.2. Impact of packaging industry on the environment

Currently, the world is facing with problems which are the effects of people and civilization development, including waste, pollution, greenhouse gas emission etc. Those problems are the result of e.g., mass production which was started by The First Industrial Revolution. Nowadays, the world still feels these effects. One of the biggest problems to the environment is packaging waste. According to Ncube et al. (2020) the packaging industry uses the largest number of plastics which is produced all over the world. This is also main source of waste plastics which

are delivered to the environment. The development of packaging materials has become the reason for the emergence of a problem related to the management of packaging waste. The production of packaging is associated with a significant impact on the natural environment through soil, air or water contamination. Therefore, it becomes important to monitor the impact of packaging materials on the environment. Moreover, packaging has become an indispensable part of people's lives and it is impossible to remove them (Varun et al., 2016). Microplastics have also been a significant problem in recent years. Polar waters, marginal and coastal seas are already contaminated with microplastics. It is predicted that by 2060 the amount of microplastic particles in water will increase fourfold. Even stopping the production of plastic will not contribute to reducing the amount of microplastics due to their presence in the environment (Kafel et al., 2021). Packaging industry is main user of raw materials due to the fact that they require appropriate quality materials. Packaging industry in Europe, uses 40% of plastics and 50% of paper to producing packaging (Coelho et al., 2020). Unfortunately, paper is material with low strength, heat sealability and poor barrier properties that is why it is not enough to use in some group of products e.g., food. For such products, paper packaging requires lamination or impregnation. Additives, aluminum or plastics are used for this purpose, which improve the usable properties of the packaging (Deshwal et al., 2019). For this reason, paper packaging is often not recyclable.

Packaging plays an important role in human life because it protects products during their distribution, storage, sale or use. However, the excessive amount of packaging waste continues to deteriorate environment. It is therefore necessary to design, produce and use packaging in a sustainable way (Zhu et al., 2022). This makes it possibly by applying the circular economy concept. According to Hobson (2016) circular economy is an industrial system. Circular economy has been defined as an industrial system with a regenerative character that displaces the concept of end-of-life in favor of renovation, the use of renewable energy sources, the rejection of harmful substances, and its goal is to eliminate waste as a result of appropriate design, products, material systems and business models. According to Ghisellini et al., (2016) circular economy concept can be realized by actions connected with 3R principles: reduce, reuse and recycle. Reduce principle is connected with minimalization of material, energy use but also with minimalization of waste generation by increasing efficiency of production and consumption. Second principle is connected with using again products and its components. Finally, recycle refers to any activity including reprocessing of products, material or substances (Ranta et al., 2018).

As a circular economy is a suitable concept for elimination of environmental impact, e.g., of packaging, it was decided to check which elements of this concept are include in non-financial statements of packaging producers as well.

3. Methodology

3.1. The aim

The aim of this research is to analyze level of pro-environmental communication activities including the aspect of the circular economy concept in non-financial reports of packaging producers required to report environmental issues (group 1) and compare them to packaging producers which do not have to presents environmental aspects (group 2).

3.2. Hypothesis

In this research one hypothesis was put forward:

H_1: There are no differences in level of environmental aspects communication between organizations obligated and not obligated to inform about these aspects.

3.3. Methods and characteristics of the research sample

The conducted research included two groups of organizations that deal with production of plastic and paper packaging's. According to EMIS data base in Poland operates 1129 plastic packaging producers and 843 paper packaging producers. Based on this database, two lists were developed: one for paper packaging producers and second for plastics packaging producers. In this study non-financial reports were the subject. Due to the fact that not all organizations in Poland are required to report non-financial data, organizations in both lists were divided into organizations that did and did not meet the conditions determined by Accounting Act.

First, it was checked whether the data on revenues, total assets and the number of employees contained in the EMIS database are up to date. In the absence of data or outdated data (it was assumed that current data relate to the financial year beginning on January 1, 2021 and ending on December 31, 2021), a search for such data was undertaken in the National Court Register. After checking the data for both types of organizations, organizations for which these values could not be determined or no reports were found in the National Court Register were rejected. The remaining organizations were divided according to the requirements regarding the reporting obligation (table 1). It was checked whether organizations had revenues higher than PLN 170 million or total assets higher than PLN 85 million, and whether the number of employees was higher than 500. In addition, organizations with a different financial year, i.e., other than January 1 to December 31, 2021, were also rejected. to maintain homogeneity. The year 2021 was the reference point against which compliance with the requirements set out in the Accounting Act was checked. The analysis covered reports from 2019-2021.

Table 1.
Characteristics of analyzed groups

Group number	Characteristics
1	Organizations that in 2019-2021 had more than 500 employees and met one of the following conditions: • revenues higher than PLN 170 million, • total assets higher than PLN 85 million.
2	Organizations that in 2019-2021 had not more than 500 employees and not met one of the following conditions: • revenues higher than PLN 170 million, • total assets higher than PLN 85 million.

Source: own elaboration.

Finally, based on the collected data, it was determined that only 15 organizations were included in the first group of organizations (7 paper packaging producers and 8 plastic packaging producers). Therefore, in order to maintain the appropriate proportions, it was decided to randomly select 15 organizations from the second group (equally: 7 paper packaging producers and 8 plastics packaging producers). In all years, first group of companies complied with the requirements regarding the disclosure of non-financial data. No one organization in this group all over the years had separate report to present non-financial data. Only 4 packaging producers (2 for paper and 2 for plastics) in all years presents management statements in which was separate section called statement about non-financial information. One organization in paper packaging producers called all document as management and non-financial information statement. One organization from plastic packaging producers presented the biggest report from all organizations. The descriptions of non-financial data was extensive compared to others. The rest organizations prepared statements with mixed information. There were parts called, e.g., environmental protection. Most of the organizations in the second group, in addition to the financial report, also submitted a report of activity in all years 2019-2021 (11 organizations). Four of the randomly selected organizations did not have activity reports. In total, 78 reports were analyzed. However, in the research it was assumed that the lack of a report is associated with a lack of communication of the organization with the use of this tool.

Communication of pro-environmental activities was analyzed in quantitative and qualitative terms. As part of quantitative analysis, it was checked which organizations in both groups communicate pro-environmental activities in their reports, and then number of reports all over the years was counted. Statistical analysis was performed by subjecting the data to the analysis of the normality test. Due to small research sample, the Shapiro-Wilk test was used. Significance of differences between these two groups was also analyzed using U Mann-Whitney test.

In the case of qualitative analysis of reports, it was decided to use method used by Laskowska and Lindo (2018). However, it was decided to modify the description of individual categories:

Table 2.
Categories of communication level

Level	Points	Description	Summary of points (all over the years)
Low	1	organization declare to take actions connected with environment but did not present specific examples and effects or declare single activities	1-3
Medium	2	organization declare to take actions connected with environment and present specific examples of activities	4-6
High	3	organization declare to take actions connected with environment and presents specific examples effects of these actions	7-9
If organization did not declare any environmental activities or there were no reports 0 was entered			

Source: own elaboration.

In case of circular economy concept the analysis took on a descriptive character.

4. Results

4.1. Quantitative analysis

This part of analysis focused on environmental issues. Table 3. presents number of reports in all years which presents environmental aspects divided into two groups of organizations.

Table 3.
Amount of environmental information

Type of producer	Number of reports presented environmental information (2019-2021)	Organizations numbers
group 1	0	4, 6, 8, 14
	2	1
	3	2, 3, 5, 7, 9, 10, 11, 12, 13, 15
group 2	0	16, 18, 19, 20, 23, 26, 29
	1	17, 27
	3	21, 22, 24, 25, 28, 30

Source: own elaboration.

According to table 3. In first group almost all organizations reported environmental aspects in reports from all years (10 organizations). There were still some organizations which did not include these aspects in their reports (4 organizations). In second group there were some organizations which include in their statement's environmental aspects in all years, even though they were under no obligation to do it (6 organizations). There were organizations which presents environmental aspects in one report. The rest do not present these aspects or do not have statements. To compare the approach to communicate environmental aspects in reports in both groups statistical analysis was performed. First of all, it was checked whether the data had a normal distribution. For this purpose, due to the small research sample, the Shapiro-Wilk test was used. In table 4 there are presented results.

Table 4.
Results of Shapiro-Wilk test

Variable	N	W	p
Number of reports presented environmental information (2019-2021)	30	0,684665	0,000001

Source: own elaboration.

According to the analysis, the significance level is lower than p = 0,05. Therefore, the distribution of the variable is not similar to the normal distribution. For this reason, the non-parametric U Mann-Whitney test was used to assess differences between two groups. The analysis is presented in table 5.

Table 5.
Results of U Mann Whitney test

Variable	1 group rang sum (N = 15)	2 group rang sum (N = 15)	U	Z	p	Z corr.	p corr.
Number of reports presented environmental information (2019-2021)	263,0000	202,0000	82,00000	1,244342	0,213375	1,391604	0,164043

Source: own elaboration.

According to the analysis, at the significance level p equal to 0,05, the differences between these groups are not statistically significant. Therefore, the assumed hypothesis was confirmed.

4.2. Qualitive analysis

In this part of the research reports were analyzed in case of information connected with environment but in qualitative way. All reports were assessed on a numerical scale (0-3) in accordance with the methodical assumptions. The results are presented in tables 6 and 7.

Table 6.
Qualitative analysis of organizations from group 1

Communication of environmental aspects in group 1				
Year	Year			Sum
	2019	2020	2021	
1	1	1	1	3
2	2	2	2	6
3	2	2	2	6
4	0	0	0	0
5	1	1	1	3
6	0	0	0	0
7	2	3	3	8
8	0	0	0	0
9	1	1	1	3
10	3	3	3	9
11	1	1	1	3
12	1	1	2	4
13	1	1	1	3
14	0	0	0	0
15	2	2	2	6

Source: own elaboration.

According to table 6 nine organizations were characterized by a low level of environmental aspects communication or did not communicate them at all. Four organizations include aspects qualified as medium level of communication and only two organizations present high level. It means that only two organizations include activities and also effects of it.

Table 7.
Qualitative analysis of organizations from group 2

Communication of environmental aspects in group 2				
Year	**Year**			**Sum**
	2019	**2020**	**2021**	
16	0	0	0	0
17	0	0	1	1
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	2	2	2	6
22	1	1	1	3
23	0	0	0	0
24	2	2	2	6
25	2	2	2	6
26	0	0	0	0
27	0	0	1	1
28	1	1	1	3
29	0	0	0	0
30	1	3	2	6

Source: own elaboration.

In table 7 there are presented level of communication in second group of organizations. Most of organizations do not communicate environmental aspects (7 organizations) and four organizations presents it in low level. Four organizations qualified in medium. Despite the lack of reporting obligation, some of surveyed organizations communicate pro-environmental activities.

4.3. Circular economy concept in non-financial report

After a preliminary analysis of the reports, it was found that organizations almost did not communicate aspects connected with circular economy concept. It was therefore decided to carry out a descriptive analysis in this aspect. The concept of circular economy in reports of these organizations was mostly not presented. In the first group of organizations there was only mentioned in general that organizations are taking actions connected with sustainability development (organization number 2 and 7), prevention of pollution and recycling and minimalization of greenhouses gases emission and use of energy (organization number 3), using biodegradable solutions (organization number 11) and biodiversity support (organization number 7). Some organizations realize aspects of environmentally friendly projects, saving of water, energy, zero waste, CO2 emission reduction (organization number 12), reducing of use polystyrene materials in favor of more ecologically material (organization number 11). There was also aspect of sustainability development (organization number 9). In all of these

organizations only one organization (number 10) describe in report circular economy concept. It was presented as possibility of reducing impact of plastics on the environment. This organization also presents in numbers using of resources and materials, consumption of fossils, energy, water, CO_2 emission and waste. There where information about recycling like: limitations and increasing actions of recycling, increasing of use by organization recycled materials but also using monomaterial packaging which are fully recyclable. Also, organization showed aspects of reducing unit packaging and using renewable materials (from biodegradable resources). Organization number 15 also include aspects connected with using recyclable materials, reducing the polyethylene use, using organic materials.

Second group of organizations also presents small amount of information connected with circular economy. Some organizations mentioned about reducing of energy use (organization number 24). There is also information about minimalization of waste (organization number 22, 28 and 30). Also, aspects of optimalization are included (organization 24). As in the first group, organizations inform about acting in a sustainable and responsible manner (organization number 27 and 30). Some organizations also include information connected with using recyclable materials (organizations number 25 and 30). In this group also are references to circular economy concept by mentioning it in reports (organizations number 25 and 30). Organizations from this group also declare to taking actions which raising ecological awareness (organization number 21).

Organizations in both groups presents some aspects of circular economy concept but it is treated only in general. There were some examples of activities connected with circular economy but mostly only mentioned. Organizations did not describe in particular it. Only three organizations presented this concept in all their report. But according to types of activities mostly is concerning on recycling.

5. Discussion

Non-financial reporting is relatively new and popular aspect in the researches. Nowadays a lot of organizations prepare those type of statements as a tool for communication with stakeholders. There are a lot of possibilities to present non-financial data, e.g., ESG report, integrated report or as a part of management statements. Polish law leaves organizations free to choose the method of reporting it. Also, according to the Account Act (Act of 15 December 2016…, 2016) organizations have to report non-financial information to the extent that it is necessary to assess the development, results and position of the entity and the impact of its activities on issues connected with e.g., social, environmental, labor aspects. In this research organizations from packaging industry were analyzed. This study includes organizations which were obligated to prepare statements in all years which should include non-financial data and

organizations which were not obligated to do this in all years. Not all organizations from first group include aspects connected with environment in their reports. Interestingly, organizations which do not have such an obligation also communicate environmental aspects, but not all. According to Matuszak and Różańska (2017b) more extensive in terms of categories like environment, labor, human rights, social and anticorruption are CSR reports than the management annual reports.

In this research environmental aspects were communicated in both groups of organizations. In both groups there were organizations that did not communicate such elements at all. According to Manes-Rossi et al. (2018) research environmental aspects were also one of the most presented aspects. There were 94% organizations which included environmental aspects in their reports. Also, Guşe et al. research (2016) showed that environmental aspects are one of the most presented issues in reports. However, no significant differences in the level of communication of environmental aspects were detected between these groups. It can therefore be concluded that the level of communication is similar in both groups. Quantitative analysis showed that environmental aspects are communicated in almost all reports prepared by organizations which are obligated to reporting non-financial data. However, when performing a qualitative analysis of what elements are communicated in the reports, it turns out that this level of communication is low in this group of organizations. Such a large discrepancy can be associated with first of all freedom provided by law. This is related to an important feature of this type of reports, i.e., the lack of common guidelines regarding their form, structure or content. There are guidelines that are used by more and more organizations, such as GRI or IIIRC, however are voluntary (Matuszyk, 2018). The second problem connected with non-financial reporting is that organizations are not obligated to verify including this information. According to Bońkowski (2021) verifying reports is a good practice that depends only on the decision of the organization. The aspect of introduction the verification od reports was discussed on the amendment to the Accounting Act in 2017. Finally, it was decided that the verification of non-financial information will be voluntary. This was the reason for opposition from representatives of enterprises. In their opinion, such a verification would lead, among others, to limit the length of the reports (Krasodomska, 2017). The lack of verification of reports is somehow related to the voluntary provision of information despite such an obligation. This is evident from the conducted research. Moreover, the Polish law gives the possibility of not informing about individual elements if the organization indicates the reason for such action. On the other hand, some organizations which do not have this obligation prepared statements by using environmental aspects in it. Similar to first group of organizations, here also dominate low or medium communication level. But it is necessary to be remembered that this organizations were not obligated to presents environmental aspects in their reports. The differences in the communication of pro-enviromental activities between these groups were not statistically significant.

In this research is included also descriptive analysis of circular economy aspects. In both groups organizations refers to aspects of sustainable development which is the basis of circular economy concept. Also, some organizations declare about some initiatives that are including in this concept like: using renewable materials, saving energy or resources and minimalizing the pollution and waste, but they did not call them circular economy concept. Only three organization describe CE concept in their statements.

Based on the conducted research, several directions of research development were established:

- comparing the results of the conducted research with the analysis of parent companies' reports,
- comparing the communication of pro-environmental activities in other groups of organizations, i.e., food producers,
- aggregate comparison of communicating environmental aspects in other industries for reporting and non-reporting organizations.

An interesting aspect, not entirely related to environmental disclosures, may be an analysis of other requirements of the Accounting Act, e.g., a description of the business model or employee issues. While reading the reports of packaging producers, without the obligation to report, information about employee aspects was found. The same comparison could be prepared as in this research.

Conclusions

Packaging is an indispensable element of people' functioning. Nevertheless, both packaging and organizations which produces them have a negative impact on the environment. Organizations undertake many activities to demonstrate their environmental impact. One of the most popular ways is to disclose non-financial data in the reports of organizations. The transmission of this information is an important element of the dialogue between the organization and stakeholders. However, the degree to which organizations report non-financial data varies greatly, and therefore it is necessary to conduct research in this area.

This article concentrated on packaging producers and their non-financial statements. Researched organizations were characterized by a varied state of disclosed information all over the years. Despite the obligation to report the aspects contained in the Accounting Act, not all organizations in first group presents aspects connected with environment. What is interesting among organizations that do not have such an obligation, there are those that inform about environmental aspects. According to quantitative analysis the level of communication environmental aspects in first group was high and second low. There were no significant differences in both groups. However, qualitative analysis, based on what is

communicated in reports, showed that the level of communication in the most of organizations in both groups is low. Environmental aspects were be presented in general way by only declaration of what they are doing in these issues or presents only individual activities. In case of circular economy concept analysis showed that there are some activities which are presented but only few organizations from both groups mention circular economy concept.

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BUSINESS MODEL AS DETERMINANT OF BEHAVIORAL STRATEGY

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Purpose: The purpose of this article is to answer two research questions. The first is: what is the relationship between the business model and the behavioral strategy of companies? The second is: how does the business model determine behavioral strategy?
Methodology: The research method of the literature review involved three stages. Stage one consisted of analyzing articles retrieved from Web of Science, Scopus and Google Scholar. Key words typed into the search engine were helpful in selecting articles. The following keywords were used: creative thinking, strategic thinking, business model, business model innovation, competitive strategy, behavioral strategy, organizational intelligence, strategic intelligence, intelligent organization. Stage two involved reviewing the selected articles. Stage three involved analyzing and synthesizing the content of the previously selected publications. In the end, a total of 125 selected articles in Polish and English were analyzed, of which 42 literature items were used in the article in the form of citations and references.
Findings: The research confirmed the view that strategy and business model complement each other. Through feedback, they are interdependent on each other and coevolve. The business model is one of the determinants strongly influencing the shape of strategy.
Research limitation: The research used a reductionist approach, and therefore ignored numerous other contextual determinants of behavioral strategy. The research focused only on the business model as a determinant of behavioral strategy and on the feedbacks occurring between the studied elements of the concept.
Originality/value: The originality of the concept is reflected in its dynamic nature. The dependency analysis is set in a broader context that includes organizational intelligence and intelligent market behavior of enterprises. The concept is valuable because it takes a dynamic approach to clarifying the issue of the business model as a determinant of strategy. A cognitively interesting study could provide an answer to the question: what types of business models are the highest basis for building competitive advantage as one of the elements of strategy.

Keywords: business model, behavioral strategy, organizational intelligence, competitive advantage.

Category of the paper: conceptual paper.

1. Introduction

In the literature and practice of strategic management, the terms business model and strategy are fuzzy. *Strategy refers to the management of a company's creation of sustainable competitive advantage, is the sum of strategic choices and a mix of deliberate actions, tactical and organizational responses, and organizational learning processes* (Magretta, 2002, p. 27). A business model is a logical conception of how a company operates to satisfy the customer needs. In other words, because a business model is abstract and a simplified view of a company's strategy, it can only be used for one organization. But a company's strategy can use different business models (Teece, 2010).

The business model provides the key details of the company's value proposition for the various stakeholders and the system of activities that the company uses to create and deliver value to its customers. A business model can be defined as an abstract concept of some aspect of a company's strategy. However, unlike strategy, business models do not take into account a company's competitive position and market advantages (Osterwalder, 2004).

Business models are only the core of the logic of value creation, not its strategic implementation (Magretta, 2002; Seddon, Lewis, 2003). In many academic studies, business strategy concepts are discussed in relation to business models. At first, business models were seen as product-market strategies. In later articles, there is a growing consensus that a business model is a construct different from a strategy. (Westerveld, Field, et al., 2023).

Although the term business model has gained prominence in the last decade, the term this one has been part of business jargon for a long time, dating back to the writings of P. Drucker. There is no universally accepted definition of a business model. Magretta (2002) defines business models as logics that explain how businesses operate, and follows P. Drucker in defining a good business model as one that provides answers to the following questions: "Who is the customer and what does the customer value?" and "What is the underlying business logic that explains how to deliver value to customers at an appropriate cost? The business model refers to how an organization makes money, i.e. how it identifies and creates value for customers and how it captures some of that value as its profit (Osterwalder, Pigneur, 2010). The activity systems themselves capture the essence of business models very well.

"Business model" and "strategy" fall into the category of extremely vague terms in the field of management science. Often their conceptual scope is so broad that they seem to mean "everything," which consequently limits their practical usefulness. The lack of clear distinction between these terms means that they often - for many authors - mean almost the same thing. (Casadesus-Masanell, Ricart, 2010).

An analysis of the literature on the subject does not provide a unified view.

On the contrary, the views in the literature on the place and role of the business model in strategy and strategic management are often mutually exclude itself. The range of views on this issue is very wide, from the claim that strategy is an overriding concept vis-à-vis the business model, to the opposite extreme of views in which the business model determines strategy.

Many intermediate views can be found throughout this space. Spanning views is very high, largely due to the relatively young age of the business model concept (Wierzbinski, 2015).

The following views on the relationship between strategy and business model can be found in the literature:

1. Strategy and business model are synonymous terms.
2. The strategy is contained in the business model.
3. The business model is contained in the strategy.
4. Business model and strategy are disconnected concepts.
5. The business model and strategy have a common part.
6. The business model and strategy are complementary (Teece, 2010).

The state of knowledge presented on the subject therefore requires some synthesis.

In the literature of recent years, the approach according to the to which the strategy has a dynamic, long-term dimension, while the business model is its static expression. The strategy is oriented towards competitors and the environment while the business model focuses on the search for business opportunities. The core of the strategy is to build dynamic competencies to respond effectively to changes in the environment. The business model, in turn, is a kind of representation of the adopted strategy. The effectiveness of the company's operation is, in this view, a function of the characteristics of the implemented business model and its compatibility with the strategy. In view of the multiplicity of definitions and interpretations of the two categories discussed, it is advisable to continue the discussion of the conceptual scope of business models and strategy. However, in the context of its course so far, the possibility of reaching a consensus in the scientific community should be questioned. Regardless of the resolution of this "dilemma," it is and will be expedient to analyze individual case studies documenting the successes and failures of specific companies, regardless of whether the phraseology describing these cases will include "strategies" or "business models" (Rudny, 2014, pp. 213-224).

Whenever a new enterprise is created, it acts directly or indirectly based on a specific business model.

According to a literature review conducted by Zott and Amit (2008), there is a consensus on some of the fundamental issues of research on innovative business models. Scholars seem to agree that a business model is not only a technological and organizational facilitator, but can itself become an agent of strategic innovation, share and leverage resources such as knowledge, managerial and entrepreneurial skills, or enable the reconfiguration of the underlying value chain or value network (Drzewiecki 2016).

Other researchers say that business model innovation is a key tool for creating a competitive advantage in a competitive market (Natasha, Shahid, 2021, pp. 447-491). Innovation of a company's business concept creates internal competition of alternatives to the existing business model. This not only helps the company in the development of new products and research and development, but also in its ability to react fastly to competitor product developments and breakthrough innovations that enable product development inside or outside its own sector (Johnson, Christiansen, Kagermainn, 2008).

The process of innovation in a company's business concept is an essential tool for changing the business model to better fit, for example, the changed needs of customers. User-driven innovation plays a large role in this process. The innovative business model has a direct impact on strategy transformation, but the reverse also occurs (Holstrom, 2022, pp. 550-562; Braun et al., 2019, pp. 39-45).

Issues related to the design of an innovative business model lie at the heart of the the foundation of the fundamental question asked by business strategists: how to build a sustainable competitive advantage for above-average profits? In this case, business pioneers must excel not only in product innovation, but also in business model design, understanding business design options, as well as customer needs and technological trajectories for success. Developing a successful business model is not enough to provide a competitive advantage. Business model innovation can itself be a way to competitive advantage if the model is sufficiently different from that of competitors and difficult to replicate (Santos, Spector, Van der Heyden, 2009).

The search for profit by companies, operating in a competitive environment will lead to satisfying diverse consumer needs by constantly creating and presenting new value propositions to the consumer.

Business model change (revolutionary or evolutionary) is often forced technological innovations that create the need for market changes and better opportunities to meet customer needs. At the same time, new business models can themselves be a form of innovation that guarantees a relatively sustainable competitive advantage (Bansal, Balodi t. al., 2022).

Once a business model is implemented, its elements are often quite transparent and (in principle) easy to imitate. Technological innovation does not automatically guarantee business success. Good business model design and implementation, combined with careful strategic analysis, are essential for technological innovation to succeed not only technically, but also commercially.

Designing an innovative business model requires creativity, insight and a lots of information and data about customers, competitors and suppliers (the use of organizational intelligence). The business model is a makeshift component of the strategy and is likely to be replaced over time by an improved model that uses innovative technologies or organizational innovations.

The business model must be more than just a good, logical way to conducting business. It must be tailored to the market to meet specific customer needs. It must also be impossible for competitors to imitate in certain way.

In view of the fact that there are different views in the literature on the relationship between the business model and corporate strategy, it is worth presenting a concept that will be a different, synthesizing voice in the discussion.

The author's view is that business model and strategy are separate concepts but complementary and are dependent on each other. It will be attempt to answer the question to what extent the business model determines the strategy and how the implemented strategy (through feedback), influences the shape of the business model.

2. Reductionist concept of the relationship between business model and behavioral strategy

The starting point of the article is the concept of the business model as a determinant of the behavioral strategy in a process approach. The various elements of the concept will be discussed sequentially in the following sections of the article. The contextual relationship occurring between the business model and the behavioral strategy is presented in Fig. 1. The concept is hypothetical in nature. It is formed by a string of thought depicting the successive phases of the process taking place, together with feedbacks. The feedbacks make the analyzed concept dynamic in nature.

The starting element of the concept is organizational intelligence. Organizational intelligence like strategic intelligence applies to both the main strategists of the enterprise and the entire intelligent organization. Enterprise innovation can be understood as a set of non-standard operating rules and applies not only to the strategy and business model itself, but especially to technological, product, marketing and organizational innovations. Enterprise innovation has a direct impact on the enterprise's innovative business model and indirectly on behavioral strategy. The implementation of enterprise strategy, on the other hand, determines the organization's intelligent market behavior.

The feedback loop that exists between the strategy and the business model points to the the interdependence of these two model elements. According to a recent empirical study, the correlation between business model and strategy was as high as 87.886% (Novidia et al., 2022). In addition, organizational intelligence as shown in the presented concept has a direct impact on the business model and an indirect impact on enterprise strategy. Enterprise strategy directly affects the level of intelligent market behavior. The intelligent market behavior of an enterprise is considered in relation to current and potential competition.

Feedback occurring between intelligent market behavior enterprises and organizational intelligence points to the strengthening of the process of acquiring, recognizing and assimilating key information in the context of making optimal strategic decisions. This includes the process of organizational learning from the experience.

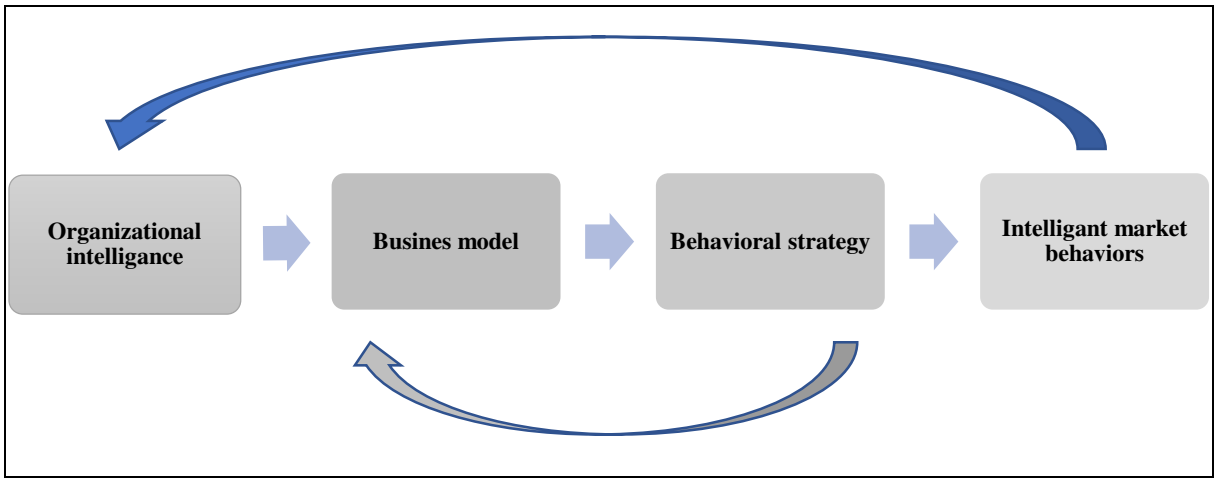

Figure 1. Concept of the relationship between business model and behavioral strategy.
Source: own study.

As the concept of the business model as a determinant of behavioral strategy presented, the intelligent market behavior of the enterprise, through feedback, directly shapes the level of organizational intelligence, through the experience gained and the process of organizational learning. An increase in the level of organizational intelligence can lead to a modification of the existing strategic thinking.

The concept presented will be useful in answering the research questions posed and will allow verification of the thesis of the interdependence of the business model and corporate strategy.

3. Organizational intelligence

Organizational intelligence (OI) was originally defined in the context of acquiring, processing and communicating information needed for decision-making. This original conception attributed the lack of success of enterprises to fossilized business logic and organizational culture. which, in place of openness, transparency, unleashing human potential and strengthening bottom up initiatives, create barriers to strategic change.

Organizational intelligence can be understood as:

1. Material for making sense of signals from the environment and making decisions based on available information.
2. Different types of expertise needed for organizational decision-making.
3. A set of processes directed at obtaining and using information throughout an organization.
4. A strategic capability that allows a company to operate effectively in a turbulent environment.

While in the traditional sense, organizational intelligence directed attention to the analysis of the information and data to make the right decisions, so later concepts questioned rational choices. The limitation of rational calculation prompted the development of organizational learning as the basis of organizational intelligence opposite management based on hard data and analysis The intelligent enterprise was also defined through the lens of managing and coordinating information to develop organizational intellect responsive to customer needs. In this perspective, the growth of a intelligent enterprise depends on: developing and using intellectual resources in place of tangible ones, focusing attention on key activities in the value chain that are knowledge-based and oriented to the needs of stakeholders, especially target users such as customers.

The term organizational intelligence is also defined as the ability to deal with complexity of the environment by capturing meaning from market signals. The level of this ability, called the organizational intelligence quotient, depends on access to knowledge and information, the ability to integrate and share information, and the ability to isolate or extract meaning from large amounts of data. Finally, organizational intelligence is the totality of problem-solving behaviors to achieve success, based not only on existing knowledge, but also creating new knowledge - due to the emergence of new problems, situations and experiences (Dyduch, 2013).

Organizational intelligence can be seen as the ability to maintain adaptive, responding to the changing business ecosystem. An intelligent organization promotes the development of tacit knowledge to revitalize creativity, uses explicit knowledge to increase efficiency, and identifies tacit knowledge that is in the background of knowledge management processes. As a result, an intelligent organization accumulates meta-knowledge, used for the creation, integration and use of intangible resources which translates into its uniqueness (Tabaczewska, 2004). Organizational intelligence corresponds to the strategic intelligence of the enterprise and the strategic thinking process.

The starting point in the concept presented is precisely organizational intelligence, which directly affects the construction of the business model. Knowledge of the environment and, in particular, of the competition and the applicability of available technologies determines decisions on possible business model options. Since the business model will be implemented as a determinant of strategy, strategic thinking in the context of the company's existing information and knowledge plays an important role alongside organizational intelligence. The feedback of organizational intelligence with intelligent market behavior strengthens the enterprise's knowledge of the strengths and weaknesses of the applied business model and strategic behavior. In this way, the enterprise gathers new experience that allows it to correct the way it delivers customer value and also to modify market behavior resulting from the application of the existing market strategy.

4. Business model and behavioral strategy

According to a relatively large group of academics, there is a view that strategy and models business complement each other. (Zott, Amit, 2008). In addition, strategy is considered as an intermediary concept between a company's business model and its environment (Mansfield, Fourie, 2004). A company with an innovative strategy coupled with an innovative business model has a good chance of success (Mansfield, Fourie, 2004; Encore, 2013).

A natural question arises regarding the relationship occurring between the business model and strategy. On scientific grounds, it is important to resolve the differences between these concepts and determine the relationship that exists between them. Resolving this problem requires, in addition to defining the business model, also defining the essence of strategy (Bilton, Cummings, 2010). Strategy undoubtedly expresses the desired position of the enterprise in the future in the competitive environment in conjunction with the achievement of satisfactory financial results. Thus, strategy has a temporal dimension, it is developed for a specific period of time. The strategy outlines the boundaries of the company's activities (geographic areas, markets, products) and defines a bundle of the most important long-term goals, the achievement of which will ensure that the company takes the desired position in the competitive environment and generates satisfactory results financial (Wierzbinski, 2015, pp. 483-499) .

If we assume that the strategy defines the desired position of the company in its environment in the foreseeable future, as well as a bundle of the most important long-term goals to achieve this position and the means to achieve them, the business model is precisely the last mentioned determinant of the strategy, the means of implementing the strategy as a system of activities (Mansfield, Fourie, 2004).

The business model is therefore the most important way to achieve the goals long-term and the desired position of the enterprise in the environment in the future. The business model is one of the most important elements of an enterprise's strategic choice in this strategy implementation. In addition, the business model is a system that binds together the type of offerings aimed at a specific customer segment, the way sales revenue is achieved, the modification of the value chain, the use of resources, relations with external partners and the way the business is financed (Baden-Fuller, Morgan, 2010; Gassmann, Frankenberger, Csik, 2017).

The business model exhausts and replaces previous approaches to determining how to implementation of strategic goals, which also focused on defining the organizational structure, activities and allocating resources to achieve them. The advantage of the business model, however, is that it expands the palette of necessary elements needed to achieve strategic goals, and applies to them a systemic and holistic approach, which involves studying and determining the interrelationships between them. In the author's view, strategy takes precedence over the

business model, and the model itself is complementary to strategy and is the object of strategic choice. In this view, the business model directly influences the shape of the strategy. The business model describes the way adopted at a given time to achieve the company's long-term goals. Long-term goals, on the other hand, have a definite time dimension - they should be achieved within a certain period of time, This does not mean, however, that the business model must be static throughout the period of implementation of the strategy. On the contrary, the business model needs to be adapted to the changing environment or fundamentally restructured in the event of a significant change that has occurred in the environment or within the company's structures (product innovations, technological innovations, new ways of doing things).

The business model must also evolve in the event of a redefinition of long-term goals. Thus, the following basic situations can be distinguished:

- strategic objectives remain unchanged, but some elements of the business model and the relationship between them must be adjusted as an expression of the need to adapt to changes in the environment,
- strategic goals remain unchanged, but the business model, including its components and the relationship between them, must undergo a fundamental reconstruction as a response to fundamental changes in the environment,
- strategic goals and business model must be fundamentally redefined in response to a break in some continuity in the business environment,
- strategic objectives and the business model must be fundamentally redefined in order to anticipate or create changes in the environment. The context outlined is essential for defining the place and role of the business model in strategy and strategic management (Wierzbinski, 2015, pp. 483-499).

Thus, the business model also evolves over time or is subject to a fundamental remodeling with changes in the company's environment and strategic goals (Amint, Zott, 2015). In many cases, the business model can anticipate or even shape certain changes in the environment. In this situation, we can talk about business model innovations, which have recently become more important for achieving competitive advantage than product innovations. Changes made to business models should be defined in such a way that it is possible to achieve corporate goals, including gaining a competitive advantage (which is crucial for strategy design) in particular markets (Amit, Zott, 2010). In some cases, a company may operate under two business models simultaneously. This type of situation occurs when a given business in a given market can be conducted both in the traditional way and in the Internet space (Wierzbinski, 2015, pp. 483-499; Bigelow, Barney, 2021),

The results of a small number of studies suggest that there is a clear relationship between the innovative business models and the company's behavioral strategy. This fact becomes even more important as innovation is the basis of competitive advantage (Evens et al., 2019). Nowadays, there is also a view that the business model is rapidly replacing strategy as a key

element in creating competitive advantage (Snihur, Eisenhardt, 2022). Generally speaking, the role of innovation in these business models is becoming increasingly important. Business management realizes that it creates long-term financial benefits and strengthens the competitive position. Companies that want to innovate in the marketplace must first understand that they are innovating through their current or future business model and strategy. Using a holistic approach to strategy, the following elements can be distinguished: corporate mission, strategic goals, functional programs of action, market domain, resource domain, sector logic, competitive advantage and business model.

As can be seen, each business model influences three elements of strategy: competitive advantage, sector logic and market domain. A company's strategy can be shaped by the evolution of the business model, including the activity system.

Now let's look at the classification of behavioral strategies in the context of the strategies used business models.

Four typical behavioral strategies can be distinguished in strategic management Which are used by companies competing in the sector. Fig. 2 shows the types of companies with different types of strategic behavior in the sector.

		Nature of sectoral changes	
		Continuous	Discontinuous
Company impact on the scope of changes	Huge	Rule makers	Rule breakers
	Little	Rule takers	Rule mistakers

Figure 2. Types of behavioral strategies in the sector.

Source: own study.

Companies that break the existing rules of the game (*Rule breakers*) use proactive strategies. A proactive strategy involves anticipating the future and reacting to events in the environment before they happen. Often companies using this strategy, based on technological or organizational innovations, designate new paths for the development of the sector or market, changing the logic of operations. Innovations introduced to the market revolutionize the sector, as they are often groundbreaking. Often the innovations introduced are new to the world. A proactive strategy forces changes in the existing way of doing things, creating an innovative business model in this activity system.

Companies that set the rules of the game use active strategies (Rule makers).

Active strategy in its nature has anticipation of the future and active response to changes in the environment. It does not assume revolutionary changes in the market, but rather relatively continuous changes that can be adapted to on the basis of incremental movements. A proactive strategy is typical of companies that have created a sector, or market, dictate the rules of the market game and are not interested in revolutionary changes in the sector, on the contrary, they try to influence the stabilization of the environment and maintain a sustainable competitive advantage in the long term. They introduce innovations that improve the existing way of doing things. The proven business models of these companies are gradually evolving at the rate at which strategy is changing. Strategy may require different business model options.

Rule takers use reactive strategies. Reactive strategies represents action under pressure or is a series of internally inconsistent actions due to environmental pressures. A reactive strategy is characterized by a delayed reaction time and/or a relatively small range of adaptive changes. The longevity of the response usually prompts one to situate a reactive strategy among crisisogenic behaviors. Companies using this type of strategy usually try to adapt to the evolutionarily changing rules of the game in the sector. They copy the business models of their competitors in an effort to maintain their existing competitive position.

Rule Mistakers use critical strategies, Critical strategy involves the rapit changes or shock therapy usually when a company is struggling to survive in the market. Managers of such enterprises become victims of cognitive dissonance and do not accept the fact of the irreversibility of changes in the environment, or have an incorrect perception of reality. Moreover, as a result of negligence in the sphere of adaptive change, a strategic gap is created that is so large that its closure can only be done radically. Otherwise, such enterprises go bankrupt. The business models of these enterprises are not aligned with strategy and are neither consistent nor flexible.

Through the feedback loop between strategy and business model, the strategy can determine various business model options, testing their effectiveness through experimentation. The described anatomy of the sector indicates the relationship between strategies and business models.

The elements of the business model should not only form a logical, coherent whole, but also be aligned with behavioral strategy (Falencikowski, 2013; Nogalski, Szpitter, Jablonski, 2016), (Rybicki, Dobrowolska, 2017). In this sense, it is possible to speak of a kind of logic of the model, which can be treated as a market test of the functioning of the enterprise at any given time. Matching in terms of the organization's environment should take into account the timeliness of a given business model from the perspective of the situation that is taking place in the sector, the changes that are taking place in it, etc. (Morris, Schindehutte, Allen, 2005, p. 732).

The business model itself can be treated as a resource for the organization. In this sense it can be analyzed from the point of view of relevant criteria from the perspective of the resource school of strategic management. Particularly valuable, therefore, will be a unique, exceptional model that does not lend itself to easy copying. While the process of strategy formulation often proceeds in a formalized, analytical manner, the business model is very often the result of spontaneous action, has a strongly incremental character. Intuition and experience resulting from the learning of the organization and its members play a fundamental role in this process. The special importance of this dominant logic for the formulation of a business model is emphasized by many authors. Consequently, the business model, as a rule, is not formalized, unlike the strategy, which, especially in medium and large organizations, often takes the form of a formal document containing a set of goals, principles, rules of conduct, tools of competitive struggle, etc.

As H. Chesbrough and R. S. Rosenbloom point out, the business model can be treated more as an initial assumption about how to create and deliver a value proposition to the customer, rather than a fully formed, defined plan of action (Chesbrough, Rosenbloom, 2002, p. 533). The cited authors also list other differences between a business model and a strategy. The basic element of a business model is to determine how to create value for the buyer, the construction of the model focuses on the issue of delivering that value. In strategy, the focus remains on maintaining competitive advantage (Casandesus-Masanell, Zhu, 2013). Significant differences also relate to the issue of corporate finance. The business model not only often abstracts from the financial issues of a given venture, assuming that internal or external sources of financing are available.

Emphasis on issues related to value generation, creation of mechanisms of capturing and protecting profits means that the business model can be a kind of "test" for the survival and development of a given business. Both a business model and a strategy are planning tools, in particular - strategic planning (Westerweld et al., 2023). Tools of planning can be helpful (sometimes necessary) in the event of building a new venture, diversification of operations, decisions concerning the boundaries of the enterprise (e.g., with regard to outsourcing ventures), but should also be a response to changes in the economic environment of the organization. Both concepts are concerned with the long term, they contain a set of principles to be followed by managers, owners of a business, and although, as indicated earlier, the range of issues covered by these principles may vary, these rules determine the further actions necessary to run a business. Both the business model and the strategy are based on the same theoretical assumptions about organization and management. Such concepts as: "value chain", "competitive position of the organization", "boundaries of the enterprise", "resource approach" or "transaction cost economics" are common to strategy and business models in the sense that they provide the theoretical foundation for their formulation (Morris, Schindehutte, Allen, 2005, p. 728; Drzewiecki, 2011, pp. 335-344).

In conclusion, the thesis of the interdependence of strategy and business model has been confirmed.

The business model influences and consequently shapes the behavioral strategy and, conversely, the strategy shapes the possible business model options. Business model and strategy are distinct concepts that are complementary and interdependent (Lanzola, Markides, 2021, pp. 540-553).

5. Intelligent market behavior

Intelligent market behavior is characteristic of intelligent organizations.

Empirical research indicates that intelligent organization becomes a unique organization through a high degree of alignment between strategy, systems, structures, leadership style, and the skills and work styles of organizational participants, as well as shared values (7S Model). It's an organization that constantly reinvents the way it operates so that it doesn't stop at a state of satisfaction, which could become the beginning of the end (Dyduch, 2013).

Empirically exstract behaviors of intelligent organizations include:

1. proactivity - getting ahead of threats and drivers of change, looking for new and unusual solutions, proactively seeking high-potential opportunities, transcending the status quo in finding new opportunities for growth, taking action aimed at seizing opportunities;
2. innovation - transforming creative ideas into innovations, preparing new products and new services, focusing on new processes in the value chain that translate into value for end users, developing new technologies, orienting to continuous modernization of methods of operation, service delivery and introduction of new technologies;
3. risk-taking - taking risks in search of opportunities, making decisions with uncertain consequences, committing to large amounts of resources, making confident, bold decisions, entering new areas of activity;
4. flexibility in thinking and acting - flexible adaptation to changing conditions without looking at management practices used in the past, ability to adapt to a new situation, no resistance to change;
5. organization's strategy - incorporating creative processes into strategy, creative strategy, orienting strategy to innovation and entrepreneurship, orienting organization to challenge competition, orienting organization to autonomy and setting trends in the market;
6. opportunity-taking orientation - observing best practices in competitors, observing best practices in organizations around the world, imitating and creatively adapting competitors' solutions, taking opportunities regardless of what you have resources (Dyduch, 2013).

In addition, strategic thinking is mentioned. Strategic thinking - is a key element of organizational agility in a turbulent competitive environment. It is conceptualized as a mental process to analyze the environment after through observation and creativity. It should be holistic in nature. This type of thinking is aimed at developing the most important element of a company's strategy and that is permanent competitive advantage. Thus, organizations need leaders and employees with a high level of strategic thinking, i.e. competence sufficient to act effectively when unpredictable market events occur. Strategic thinking also involves staying

ahead of competitors' movements by bringing innovations to the market, which are a source of competitive advantage as a basis for building strategy (Amit, Zott, 2015).

The strategic behaviors of intelligent organizations are the result of the strategic behaviors.

Strategies can be evaluated ex post in terms of their ability to use strategic intelligence and organizational intelligence.

Companies with varying levels of strategic intelligence and strategic thinking can be recognized by the behavioral strategies they use and the effects of their implementation in a particular business ecosystem. Intelligent strategic behavior is therefore the result of strategic decisions made by members of the organization.

According to Well (2014), the term strategic intelligence (Strategic IQ) - refers to the to both individuals and organization. Wells in his book Strategic IQ, Creating Smarter Corporation - relates strategic intelligence both to individual strategists at the highest level of corporate management, as well as to teams and the entire organization. However, the author does not define the term itself - strategic intelligence (Strategic IQ), but describes the market behavior and characteristics of companies with very high, high, medium and low levels of strategic intelligence (Wells, 2014) In this view, intelligent strategic actions of enterprises can be evaluated only after analyzing the effects of the realized strategy of the enterprise. It can be assumed that strategic intelligence is the ability to anticipate the states of the environment and make decisions that will result in the conscious use of opportunities and possessed resources to gain competitive advantage.

According to Wells' concept, companies with low strategic intelligence have The following characteristics: they have no awareness of the need for strategic action, they are unable to respond to strategic challenges, they duplicate strategic behavior from the past, they lack strategic competence, they outsource strategy development to consultants, they do not think strategically, but in the short term.

Companies with average strategic intelligence are those that: can assess their external environment through the lens of strategy and define the conditions for success in the long term, are able to assess their own strengths and limitations to see which opportunities they are best able to exploit, develop strategic thinking throughout the organization, are able to anticipate unexpected events and prepare for them, developing the ability to deal with what cannot be predicted. Executives are able to demonstrate strategic competence, an understanding of strategy and their own participation in its implementation.

Companies with high strategic intelligence are able to induce behaviors favorable to strategic change and strive for higher and higher long-term performance, are never satisfied with their current business model. are always striving to improve it, combine strategic thinking with action, and are able to monitor strategy implementation.

Companies with the highest level of strategic intelligence are characterized by the following characteristics: they have the ability to constantly change while shaping the environment for the benefit of future competitive advantage, they disperse strategic intelligence throughout the

organization, they can shape the operating context in such a way that it is conducive to achieving competitive advantage. They are aware of the erosion of competitive advantage over time and can build a dynamic competitive advantage, they are ahead of the competition in terms of technological and product innovation, they use proactive strategies.

Wells points out what are the characteristics of intelligent actions of enterprises with different level of strategic intelligence and organizational intelligence.

Company strategists express the belief that knowledge is the main force that makes enterprises' ability to effective action.

They work to maintain the company's long-term competitive advantage by developing, accumulating and deploying highly competitive knowledge assets. They believe that consistent intelligent behavior provides competitive leadership and the ability to create value that could not be provided otherwise. Intelligent enterprise behavior according to the concept described influences of organizational intelligence through feedback.

Behavioral strategy provides deep insights into aspects of behavior cognitive related to the intelligent operation of the enterprise. The success of an enterprise depends directly on intelligent action that sets the enterprise apart from its competitors. Consistent intelligent behavior requires both individuals and organizations. Typical actions in this regard are:

- Showing behavioral traits that are effective and acceptable.
- Anticipating the actions of competitors.
- Creating the right attitudes and organizational culture.
- Generating innovative solutions.
- Making optimal decisions and implementing them.

In general, the intelligent behavior of a company comes from having a relevant assets (including organizational intelligence) and how they can be used in practice.

In summary, behavioral strategy also determines intelligent behavior enterprises in the market, or in the sector. Through feedback, intelligent strategic behavior is the basis for developing organizational intelligence as an intelligent enterprise. Experiences of intelligent behavior, or lack thereof, are a source for gaining important information about products, customers, competitors, building competitive advantage, the effects of strategy implementation and the effectiveness of business models. They are also an important part of the enterprise knowledge management process.

6. Summary and conclusion

The purpose of the article was to answer two research questions. The first was the following: what are the relationships between the business model and the behavioral strategy of companies? The second was: how does the business model determine behavioral strategy?

The article presents the business model as a determinant of behavioral strategy.

The relationships occurring between the business model and strategy are outlined in the context of organizational intelligence and intelligent market behavior of the enterprise. The feedbacks occurring between the various components of the concept simplistically explain the dynamics of the analyzed phenomenon.

The answer to the first question is as follows: the business model and strategy should be analized as separate concepts but complementary. In addition, they are complementary and interdependent.

The answer to the second question is as follows: in some extent, the business model influences the shape of the strategy mainly through the system of key activities, competitive advantage and market domain. The enterprise strategy determines the optimal business model in a given context, characterized by relative consistency and flexibility.

Organizational intelligence and strategy have a decisive impact on the formation of the innovative business models within intelligent organizations. A business model can also be an object of innovation and, for this reason, shape a company's competitive advantage, which is the essence of strategy.

Intelligent market behavior of enterprises through feedback influence the level of organizational intelligence through the gain of experience and the process of organizational learning. They enhance a company's innovation, including supporting the generation of innovative business models that are difficult for competitors to replication.

The strategy and business model according to the concept presented should undergo coevolution in order not to lead to the erosion of multidimensional competitive advantages in the long term.

The concept presented is based on the reductionist paradigm and represents a simplification of a complex process. It should be empirically verified.

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TEACHER JOB BURNOUT AND PSYCHOSOCIAL WORKING CONDITIONS IN SCHOOL

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Purpose: The aim is to investigate the relationship between teacher burnout and psychosocial working conditions using the Copenhagen Psychosocial Questionnaire (COPSOQ).
Design/methodology/approach: The research process consisted of the following stages: literature analysis, research gap identification, formulation of research questions and hypotheses, selection of the sample and research tools, data collection and analysis, formulation of conclusions, indication of research limitations and directions for future research. The research hypothesis was formulated as follows: H: Teacher burnout is related to psychosocial working conditions in school. The survey research was conducted in 2023 among 128 Polish teachers. In the study it was used the Oldenburg Burnout Inventory (OLBI). Psychosocial working conditions were surveyed using the Copenhagen Psychosocial Questionnaire (COPSOQ).
Findings: The analysis of the relationships between job burnout-disengagement (JB-D) and psychosocial working conditions found a strong negative correlation for three subscales: 'Meaning of work', 'Possibilities for development', 'Quality of leadership'. A moderate negative correlation was observed for the 'Job satisfaction; and 'Social support' subscales. A strong positive correlation of JB-D with 'Quantitative demands' was also found. By examining the relationships of job burnout-exhaustion (JB-E) with individual aspects of psychosocial working conditions, most correlations were negative (with the exception of 'Quantitative demands'). The two identified correlations were strong. As with the JB-D variable, 'Meaning of work' and 'Possibilities for development' were significant while 'Quality of leadership', 'Influence at work' and 'Social support' were less pronounced (a moderate correlation with JB-E was found). A strong positive correlation was observed between JB-E and 'Quantitative demands'.
Research limitations: The studies were of quantitative rather than qualitative nature and resulted from teachers' self-reporting. The selection of the sample was non-random, which means the findings cannot be generalized. The study was also not longitudinal and the data was lagging, which does not permit strong causal inferences. The use of the survey method might lead to common method bias.
Practical implications: The knowledge derived from the research can be useful to school managers in ensuring a work environment for teachers that prevents job burnout and therefore favors increased work performance.

Social implications: The results offer insight into the relationship between the working environment and teacher job burnout. It can provide school managers with a framework for adopting socially responsible measures focused on the well-being of employees.
Originality/value: There were previously no research studies involving Polish teachers that would identify the COPSOQ-measured relationships of job burnout with psychosocial working conditions against the following variables: 'Quantitative demands', 'Influence at work', 'Meaning of work', 'Social support', 'Job satisfaction', 'Possibilities for development', 'Quality of leadership', 'General health'.

Keywords: job burnout, psychosocial working conditions, teachers, school.

Category of the paper: Research paper.

1. Introduction

The teaching profession is perceived as a support activity associated with a high risk of job burnout. Teachers are expected, among many others, to resolve didactic and educational problems, engage in effective teamwork with coworkers, cooperate with parents in the learning cycle, and keep on developing their professional skills. What sets this profession apart is therefore a high level of interactivity. In this context, numerous work-related burdens become apparent. Pyżalski and Merecz (2010) distinguish five such categories of stressors, which are: lack of social support, incorrect work organization, incorrect relations with student' parents, exposure to pressure from supervisors and coworkers, and poor physical working conditions. In addition, this is accompanied by the depreciation of a teacher's work in society and the increased risk of diseases, especially circulatory-system and heart diseases (Kretschmann, 2011). We can therefore carve out different groups of factors triggering teacher job burnout: individual, interactive (micro-level), organizational at the meso-level, organizational at the macro-level (systemic), those concerning image/reputation - related to social evaluation.

The article focuses on selected dimensions of the teacher's work environment. The aim is to investigate the relationship between teacher burnout and psychosocial working conditions using the Copenhagen Psychosocial Questionnaire (COPSOQ). The paper consists of the following sections: introduction, literature review, methods, results, discussion, and conclusion.

2. Teacher job burnout

The burnout syndrome was first described in two scientific articles published in 1974. One of them was written by Freudenberger (1974; cf. Ginsburg, 1974) who described the state of being burned out as 'becoming exhausted by making excessive demands on energy, strength, or resources' in the workplace (Freudenberger, 1974, p. 159). According to him, staff burnout

is characterized by such physical symptoms as: an exhaustion, a fatigue, frequent headaches and gastrointestinal disorders, a sleeplessness, and a shortness of breath, while behavioral signs include: a frustration, an anger, a suspicious attitude, a feeling of omnipotence or overconfidence, an excessive use of tranquilizers and barbiturates, cynicism, and signs of depression. In the following years, there has been a significant increase in the amount of psychological and medical research conducted in this area. Pines and Aronson (1983, p. 263) defined burnout as 'a state of physical, emotional and mental exhaustion, typically occurs as a result of working with people over long periods of time in situations that are emotionally demanding'. Kahn (1978) stated that burnout results from an individual's pessimistic outlook toward self and others, which gradually leads to psychosomatic exhaustion. The most common definition of job burnout comes from Maslach and Jackson (1981), who defined it as a syndrome consisting of three dimensions: emotional exhaustion, depersonalization and reduced personal accomplishment. Emotional exhaustion refers to the feeling of emotional overload and difficulty in coping with emotions. Depersonalization relates to a cynical, negative or detached response to other people who are usually the recipients of the services or care concerned. Reduced personal accomplishment regards the conviction that it is no longer possible to work effectively with clients or care recipients. Burnout is seen as a process in time: increased coping efforts with external demands leads to emotional exhaustion, which is a trigger for depersonalization, which leads to reduced personal accomplishment, which brings further emotional exhaustion in a vicious circle, etc. (Maslach et al., 2001).

The factors influencing job burnout have been analyzed in various studies. Cordes and Dougherty (1993) categorized burnout-related factors into three following groups: 1. job and role characteristics, 2. organizational characteristics and 3. personal characteristics. Maslach and Leiter (2005) (Demerouti et al., 2001) indicated two groups of factors which dominate the person before burnout. The first group is called situational predictors which include six antecedents: workload, control, award, social network, job fairness, and values. The second group includes individual antecedents such as age, gender, marital status and experience (cf. Bakker et al., 2014; Bakker, Costa, 2014; Shoman et al., 2021).

The consequences of job burnout were also examined. It is a significant predictor of the physical consequences (e.g. hypercholesterolemia, type 2 diabetes, coronary heart disease, musculoskeletal pain, changes in pain experiences, prolonged fatigue, headaches, gastrointestinal issues, respiratory problems, mortality below the age of 45 years) as well as the psychological ones (e.g. insomnia, depressive symptoms, use of psychotropic and antidepressant medications, hospitalization for mental disorders and psychological ill-health symptoms). Job dissatisfaction, absenteeism, new disability pension, job demands, job resources and presenteeism were identified as professional outcomes (Salvagioni et al., 2017; cf. Aronsson et al., 2017; Edú-Valsania et al., 2022; Lizano, 2015; Peterson et al., 2008; Tavella et al., 2021). Ahola et al. (2010, p. 51) concluded that 'burnout, especially work-related exhaustion, may be a risk for overall survival'. Let us add, that organisations are also affected

by employees experiencing job burnout due to increased absenteeism, turnover, reduced interactions with customers and co-workers, decrease in job performance (cf. Jackson et al., 1986; Maslach et al., 2001; Wright, Cropanzano, 1998).

Maslach et al. (1996) initially stated that job burnout affects only representatives of social services, such as doctors, emergency services, care workers. However, over the years, subsequent empirical studies found that burnout concerns all employees, regardless of the type of job they do (Leiter, Schaufeli, 1996; Maslach et al., 2008; Toppinen-Tanner et al., 2002) as long as they face an imbalance between their job demands and the available resources (Demerouti et al., 2001). Numerous studies indicate that job burnout is experienced also by teachers (e.g. Bauer et al., 2006; Brouwers, Tomic, 2000; Burke, Greenglass, 1995; De Heus, Diekstra, 1999; Fiorilli et al., 2019; Hakanen et al., 2006; Maslach, Leiter, 1999; Sarros, J.C., Sarros, A.M., 1987; Skaalvik, E.M., Skaalvik, S., 2020), who have a demanding and in many cases stressful job. The stress which can lead to teacher burnout is multifaceted and it can come in the form of a lack of administrative support, challenging student behavior, role overload, expectation-reality mismatch, etc. (Brunsting et al., 2014).

3. Teacher job burnout and psychosocial working conditions in school

Research results demonstrate a relationship between occupational burnout and individual psychosocial dimensions of the work environment (Seidler et al., 2014). To measure psychosocial working conditions, various tools are used that examine different dimensions of the phenomenon. These instruments include: the Danish Psychosocial Work Environment Questionnaire (Clausen et al., 2019), the Effort-Reward Imbalance (Siegrist et al., 2004), the General Nordic Questionnaire (Lindstrom, 2002), the Job Characteristics Index (Sims et al., 1976), the Job Content Questionnaire (Karasek et al., 1998), the Psychosocial Working Conditions Questionnaire (Widerszal-Bazyl, Cieślak, 2000), the Questionnaire of Occupational Burdens in Teaching (Pyżalski, Plichta, 2007), the Work Environment Scale (Moos, 1994), the Working Conditions and Control Questionnaire (De Keyser, Hansez, 1996).

Relatively new tools for examining the working environment are the Copenhagen Psychosocial Questionnaire (COPSOQ; Kristensen et al., 2005) and its revised version - COPSOQ II (Pejtersen et al., 2010). Their advantage over the other tools is that they refer to different theoretical models (Baka et al., 2022; Dicke et al., 2018). The COPSOQ and COPSOQ II have been used in the research of numerous professions as well as in the analysis of the relationship between teacher burnout and working conditions in schools, e.g. in countries such as Germany (Drüge et al., 2021; Drüge et al., 2016), Sweden (Boström et al., 2020; Kwak et al., 2019), Australia (Dicke et al., 2018), or Italy (Guidetti et al., 2019). To investigate said correlations, different COPSOQ and COPSOQ II scales were used such as: quantitative

demands, emotional demands, work–privacy conflict, role conflict, influence at work, opportunities for development, social support, sense of community (Drüge et al., 2021; Boström et al., 2020), job satisfaction, general health, cognitive stress (Drüge et al., 2016), meaningfulness of work (Guidetti et al., 2019).

The Polish version of the COPSOQ has scales covering a total of eight dimensions of work environment: 'Quantitative demands', 'Influence at work', 'Meaning of work', 'Social support', 'Job satisfaction', 'Possibilities for development', 'Quality of leadership', 'General health'. It might therefore be worthwhile to have a closer look at selected studies exploring the relationship between teacher burnout and these dimensions (some of them examined using tools other than the COPSOQ and COPSOQ II):

1. Quantitative demands. High professional demands have been linked to teacher burnout (Arvidsson et al., 2019). It was established that in what concerns academic teachers, quantitative demands act as risk factors favoring burnout (Stelmokienė et al., 2019; cf. Mudrak et al., 2018). Let us also note that the theoretical basis for research tackling this relationship often relies on the Job Demands-Resources model (similarly as in the case of e.g. social support) (Baka, 2015; Stelmokienė et al., 2019; cf. Mudrak et al., 2018).
2. Influence at work. A study by Clara et al. (2022) conducted among teachers showed that cognitive demands (including influence at work) negatively predict emotional exhaustion and depersonalization, and positively predict personal accomplishment.
3. Meaning of work. Lavy (2022; cf. Pines, 2002) concluded from her research results that teachers' sense of meaning at work may decrease their burnout and increase their engagement. Guidetti et al. (2019) showed that teachers' perceived meaningfulness of work mediates the relationship between mindfulness and both emotional exhaustion and depersonalization. Bracha and Bocos (2015), for their part, found that the Sense of Coherence in Teaching Situations (SOCITS), consisting of three elements - manageability, comprehensibility and meaningfulness - serves as a buffer for occupational burnout - the higher its level, the lower the level of job burnout. The same authors also established that meaningfulness is a source of strength and predicts burnout better than manageability or comprehensibility.
4. Social support. Research has shown a correlation between social support and teacher burnout (Sarros, J.C., Sarros, A.M., 1992; Russell et al., 1987; Burke et al., 1996; Greenglass et al., 1997). Greenglass et al. (1997) found that there is a relationship between coworker support and job burnout, in particular decreased depersonalization and increased feelings of accomplishment. Sarros and Sarros (1992), meanwhile, found that the support received from supervisors is a significant predictor of job burnout.
5. Job satisfaction. Chaplain (1995) argues that, among English teachers, stress and job satisfaction were negatively correlated - high levels of occupational stress were related to low levels of job satisfaction. Skaalvik and Skaalvik (2009) found that teachers' job

satisfaction was directly related to two of the dimensions of burnout: emotional exhaustion and reduced personal accomplishment. A study conducted among physical education teachers in Greece demonstrated that job satisfaction was inversely correlated with burnout (Panagopoulos et al., 2014) and that intrinsic aspects of job satisfaction correlate more strongly to burnout than the extrinsic ones (Koustelios, Tsigilis, 2005).

6. Possibilities for development. Pillay et al. (2005) point to a negative association between the MBI subscale depersonalization and competence. Özer and Beycioglu (2010) found that teachers' attitudes towards professional development are moderately positively related with personal accomplishment and slightly negatively related with depersonalization. Correlations between burnout and competency development in pre-Service Teacher Training have also been studied (Dios et al., 2014).
7. Quality of leadership. Research shows that the quality of relations with school principals influenced the three dimensions of burnout (emotional exhaustion, depersonalization, lack of personal achievement) (Squillaci, 2020). Leithwood et al. (1996) have indicated that leadership had a combined direct and indirect effect on teachers' JB. Numerous researches revealed that transformational leadership has a significant negative predictive effect on teachers' job burnout (cf. Castillo et al., 2017; Tian et al., 2022; Tsang, Teng, 2022) and according to Gong et al. (2013), transformational leadership is negatively related to emotional exhaustion and depersonalization and positively related to personal accomplishment. The research results also showed that the managers' ethical leadership style had a negative relationship with teachers' JB (Eslamieh et al., 2016).
8. General health. It was found, in a sample of school teachers, that many physical and psychological problems (e.g., stomach aches and depression) were related to teacher burnout factors (Seidman, Zager, 1991; cf. Zhong et al., 2009). The studies of Xiao-Ming and Wen-Zeng (2004; cf. Korniseva et al., 2019; Wu, 2020) have shown that teacher JB was correlated with mental health, and a systematic review made by Madigan et al. (2023; cf. Belcastro, 1982) has revealed that teacher JB was consistently associated with somatic complaints (e.g. headaches), illnesses (e.g. gastroenteritis), voice disorders, and biomarkers of hypothalamic-pituitary-adrenal-axis dysregulation (cortisol) and inflammation (cytokines).

According to our best knowledge, the COPSOQ or COPSOQ II have been used in Poland to study the relationships between teacher burnout and only two dimensions of working conditions: quantitative and emotional demands (Charzyńska et al., 2021). The other dimensions have not been tested. The identified research gap was the starting point for this research study whose results are detailed below.

4. Methods

The research process consisted of the following stages: literature analysis, research gap identification, formulation of research questions and hypotheses, selection of the sample and research tools, data collection and analysis, formulation of conclusions, indication of research limitations and directions for future research. The research hypothesis was formulated as follows: H: Teacher burnout is related to psychosocial working conditions in school.

4.1. Characteristics of the research sample

The survey research was conducted in 2023 among 128 Polish teachers[1]. A Google form was used which was sent out to schools from the Lubuskie region. Participation in the study was voluntary.

There were more women (75.78%) than men among the surveyed teachers. The average age of study participants was 42 years. The vast majority (96.09%) taught in public schools. Most (46.09%) had more than 20 years of work experience in their current place of employment. There were twice as many teachers who worked in the current school for 4-10 years (19.53%) or 11-20 years (21.09%). Respondents (13.28%) with less than 3 years of work experience were the fewest. Secondary schools (44.53%) and primary schools (42.19%) were represented most numerously, while higher-education institutions (11.72%) were less numerous. Only one participant was reported working in a vocational school and another one in a post-secondary school (1.56% in total). Usually, more than 49 employees (78.91%) were hired in the workplaces of the study participants, while in the remaining ones the number of staff was lower.

4.2. Research tools

Various research tools are used to measure job burnout, e.g. the. Maslach Burnout Inventory (MBI) (Maslach, Jackson, 1981; Maslach et al., 1996), the Pines Burnout Measure (Pines et al., 1981), the Utrecht Burnout Questionnaire (Schaufeli et al., 2002), or the Copenhagen Burnout Inventory (Kristensen et al., 2005). In our study we used the Oldenburg Burnout Inventory (OLBI)[2] – a tool developed by a team of researchers led by Demerouti et al. (2001) to measure job burnout among employees. Specifically, the Polish-language version of the OLBI, developed by Cieślak (as cited in: Baka, Cieślak, 2010), was applied. This questionnaire consists of 16 items, 8 of which concern disengagement (statement numbers: 1, 3, 6, 7, 9, 11, 13, 15) and the other 8 - exhaustion (statement numbers: 2, 4, 5, 8, 10, 12, 14, 16). Respondents give their answers on a four-point scale, where 1 means 'I strongly agree' and 4 means ‘I strongly disagree’. This questionnaire consists of 16 items, 8 of which concern disengagement

[1]The selection of the sample was non-random. No list of school employees was available for reference.

[2] The OLBI questionnaire was used, as it can be applied to various professional groups and concerns all employees regardless of the industry or sector that they work in (Baka, Basińska, 2016).

(statement numbers: 1, 3, 6, 7, 9, 11, 13, 15) and the other 8 - exhaustion (statement numbers: 2, 4, 5, 8, 10, 12, 14, 16). Respondents give their answers on a four-point scale, where 1 means 'I strongly agree' and 4 means 'I strongly disagree'. It is important to emphasize that each subscale includes 4 items that are positively framed and 4 items that are negatively framed. Positively framed items should be reverse-coded so that high scores would refer to high levels of exhaustion and disengagement. The subscale score (range 1-4) is the sum of the items' scores divided by their number for the subscales of exhaustion and disengagement. The score is positively and proportionally correlated with the two components of job burnout (Baka, Basińska, 2016).

Psychosocial working conditions were surveyed using the Copenhagen Psychosocial Questionnaire (for more information, see e.g. Baka, Łuczak, Najmiec, 2019)[3]. It was developed in 2000 by Kristensen and Borg and is available in 25 languages (https://www.copsoq-network.org/, 7.05.2022).

Participants were asked to fill out the COPSOQ version validated in Poland by Widerszal-Bazyl (2017), who confirmed the reliability of the following eight scales: 'Quantitative demands', 'Influence at work', 'Meaning of work', 'Social support', 'Job satisfaction', 'Possibilities for development' (4-question version; the 2-question version was unreliable), 'Quality of leadership', 'General health'. As in the original tool, the majority of the questions in the questionnaire were answered by participants using a five-point scale (varying from 'to a very little extent' to 'to a very large extent' or 'never/almost never' to 'always/almost always'). The exception was the 'Job satisfaction' scale where the responses were: very satisfied, satisfied, dissatisfied, very dissatisfied, irrelevant / not applicable. The scales of the COPSOQ are formed by adding the points of the individual questions of the scales by giving equal weights to each question. These weights are as follows: 100, 75, 50, 25, 0. According to the instruction, respondent who answered less than half of the questions in a scale is regarded as missing (http://www.mentalhealthpromotion.net/…, 20.05.2022).

4.3. Data analysis

A statistical analysis of the data was performed using the Statistica software. Internal consistency was confirmed using Cronbach's alpha index (Cronbach, 1951). It assumed the following values: 0.855784132 (JB) and 0.818760656 (COPSOQ)[4]. Further analyses showed that none of the analyzed variables had a normal distribution. This was confirmed by the results of the Shapiro-Wilk tests (Shapiro, Wilk, 1965)[5] (Table 1).

[3] COPSOQ III is currently available in short, medium and long versions (Burr et al., 2018; Llorens, 2019).
[4] Cronbach's α coefficient of less than 0.6 should not be used (Brzeziński, 2011).
[5] If the p-value is less than 0.05, we reject the normality hypothesis (Dudley, 2012).

Table 1.
Shapiro -Wilk tests for OLBI and COPSOQ variables

Variables	p (N = 128[6])
JB-Disengagement	.00017
JB-Exhaustion	.00174
Quantitative demands	.00001
Social support	.00000
Influence at work	.00001
Job satisfaction	.00000
Possibilities for development	.00000
Meaning of work	.00001
Quality of leadership	.01164
General health	.00007

Source: own study.

As a result, subsequent analyses of variables were carried out using non-parametric statistics (Spearman's rank correlation coefficient).

5. Results

Teachers were asked to assess the level of their job burnout. It was found that the average score for the disengagement subscale was slightly lower (2.39) than for the exhaustion subscale (2.61). Both values indicate a moderate level of job burnout in the analyzed dimensions[7].

Participants also assessed the psychosocial working conditions in their schools. Average ratings are shown in Table 2 (where items in individual subscales could be assigned 100, 75, 50, 25 or 0 points). A data analysis found that the highest average ratings were recorded for the subscales: 'Job satisfaction', 'Social support', 'Possibilities for development' and 'Meaning of work', while the lowest - for the subscales: 'Quality of leadership' and 'General health'.

Table 2.
Teacher assessment of psychosocial working conditions

Psychosocial working conditions	Averages (N=128[8])
Job satisfaction	75.54
Social support	68.46
Possibilities for development	67.92
Meaning of work	67.38

[6] With the exception of the subscale 'Quality of leadership', where N=127, one respondent did not have a direct supervisor.

[7] In order to facilitate the interpretation of results, Baka and Basińska (2016) developed stanine standards. Exhaustion scores below 1.90 indicate a low level of exhaustion, 1.91–2.74 – a moderate level, and higher than 2.75 – a high level. Disengagement scores below 1.88 indicate a low level, 1.89–2.71 – a moderate level, and higher than 2.72 – a high level.

[8] Calculations were made for N=128, except for the 'Quality of Leadership' scale (where N=127). This difference results from the fact that 1 respondent (in a managerial position) did not have a direct supervisor.

Influence at work	65.95
Quantitative demands	62.32
Quality of leadership	56.50
General health	48.96

Source: own study

To verify the research hypothesis describing the relationship between job burnout (in two dimensions: disengagement and exhaustion) and psychosocial working conditions, a correlation analysis was carried out using Spearman's rho coefficient. The obtained results were interpreted as per the Dancey and Reidy (2004) classification[9].

The analysis of relationships between job burnout-disengagement (JB-D) and psychosocial working conditions found a strong negative correlation with three subscales: 'Meaning of work', 'Possibilities for development', 'Quality of leadership'. A moderate negative correlation was reported for the 'Job satisfaction' and 'Social support' subscales. A strong positive correlation was also reported for 'Quantitative demands' (Table 3).

Table 3.
Spearman's rho coefficient values for variables: job burnout (disengagement) and psychosocial working conditions

Job burnout (disengagement) and:	**Spearman's rho** (N=128)[10]
Meaning of work	-0.635520
Possibilities for development	-0.547973
Quality of leadership	-0.427396
Job satisfaction	-0.395630
Social support	-0.336720
Influence at work	-0.182479
Quantitative demands	0.404314
General health	0.024387

* p<0,05
Source: own study

Examining the relationship of job burnout-exhaustion (JB-E) with individual aspects of psychosocial working conditions, it was found that most of them were negative (with the exception of 'Quantitative demands'). The two identified correlations were strong. As with the JB-D variable, 'Meaning of work' and 'Possibilities for development' were significant while 'Quality of leadership', 'Influence at work' and 'Social support' were less pronounced (a moderate correlation with JB-E was found). A strong positive correlation was observed between JB-E and 'Quantitative demands'(Table 4).

Table 4.
Spearman's rho coefficient values for variables: job burnout (exhaustion) and psychosocial working conditions

[9] Interpretation of Spearman's coefficient rho : ≥0.70 (very strong relationship), 0.40-0.69 (strong relationship), 0.30-0.39 (moderate relationship), 0.20-0.29 (weak relationship), 0.01-0.19 (no or negligible relationship) (Dancey, Reidy, 2004).
[10] With the exception of the subscale 'Quality of leadership', where N=127.

Job burnout (exhaustion) and:	**Spearman's rho** (N=128)[11]
1. Meaning of work	-0,503291
2. Possibilities for development	-0.485076
3. Quality of leadership	-0.284483
4. Influence at work	-0.252825
5. Social support	-0.208154
6. General health	-0.126776
7. Job satisfaction	-0.117506
8. Quantitative demands	0.467075

* p<0,05
Source: own study

Accordingly, the basis for partial confirmation of the hypothesis was found. This applies to both dimensions of job burnout and most aspects of psychosocial working conditions. It is worth emphasizing that, both for disengagement and exhaustion, strong positive correlations with the variable 'Quantitative demands' were found.

6. Discussion and conclusions

The research reveals a moderate level of job burnout among teachers, both in terms of disengagement and exhaustion. Out of eight analyzed aspects of psychosocial working conditions, 'Job satisfaction', 'Social support', 'Possibilities for development' and 'Meaning of work' were rated the highest, while 'Quality of leadership' and 'General health' were rated the lowest.

Teacher job burnout in the area of depersonalization correlated with a slightly larger number of aspects of psychosocial working conditions than in the case of exhaustion. In the case of both these dimensions, 'General health' remained insignificant to JB (the correlations were negligible). It can therefore be concluded that, contrary to some of the previous findings - that many physical and psychological problems (e.g., stomach aches and depression) were related to teacher burnout factors (Seidman, Zager, 1991; cf. Zhong et al., 2009) – 'General health' is not a significant predictor of teacher burnout. Let us also note that in the case of JB- Exhaustion 'Job satisfaction' was reported to be of little importance as well. This differs slightly from the results of Skaalvik and Skaalvik (2009; cf. Panagopoulos et al., 2014) who found that teachers' job satisfaction was directly related to emotional exhaustion.

The strongest negative correlation between job burnout (in both dimensions) and individual aspects of the work environment were identified for the following variables: 'Meaning of work' (cf. Lavy, 2022; Bracha, Bocos, 2015) and 'Possibilities for development' (cf. Pillay et al., 2005). The research results therefore show that in the case of Polish educators both dimensions

[11] As above.

constitute a significant buffer against occupational burnout. They are strongly associated with the mission undertones of the teaching profession which may be of significance in Poland where the educational system is often criticized for its inability to foster good social and organizational working conditions. The actions of those responsible for school management and teachers' work should take this assumption into account.

A slightly smaller (but still strong) negative correlation was also found for JB-D and ‘Quality of leadership’. In the case of JB-E, this relationship was weaker. Let us recall that the impact of leadership on the severity of teacher job burnout was also hinted at among others by Squillaci (2020), Leithwood et al. (1996) or Castillo et al. (2017). Not only that, the relationship between the variable 'Influence at work ' and JB-E is of moderate strength and correlates weakly with JB-D, a finding that was somewhat different from that obtained by Clarà et al. (2022).

A strong positive correlation was also established between JB (also in both dimensions) and ‘Quantitative demands’. In so doing, the findings of other researchers were confirmed (Arvidsson et al., 2019; Stelmokienė et al., 2019; Mudrak et al., 2018).

The results of this study can help us to develop a more sustainable work environment in schools. A more sustainable work environment might encourage teachers to be more effective in their profession.

Finally, let us point out the limitations of the conducted research study. These were of quantitative rather than qualitative nature and resulted from teachers’ self-reporting. The selection of the sample was non-random, which means the findings cannot be generalized. The study was also not longitudinal and the data was lagging, which does not permit strong causal inferences. Furthermore, the use of the survey method might lead to common method bias.

A better understanding of the analyzed problem would require more in-depth qualitative research, using techniques based on face-to-face contact, interviews, observations, case studies, etc. Conducting a longitudinal study is also worth considering.

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GREEN INNOVATIONS IN HEALTHCARE SECTOR IN NIGERIA

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Purpose: The purpose of this scientific article is to explore the concept of green innovations and responsible leadership in the healthcare sector in Nigeria. The study aims to examine the role of responsible leadership in promoting and implementing green innovations in healthcare facilities, assess the current state of green practices and technologies in Nigerian healthcare, and identify the potential benefits and challenges associated with integrating sustainable practices into the healthcare sector.
Design/methodology/approach: This article analyses the official statistics and reports about Healthcare, Green Growth, and Green Innovation (GI) in Nigeria. The selected documents were carefully reviewed, and key findings, trends, and recommendations related to green innovation in Nigeria were extracted and analyzed. The analysis aimed to understand the current state of green innovation in Nigeria, identify barriers and opportunities, and propose strategies for promoting and implementing green technologies and practices in various sectors of the economy.
Findings: The findings reveal the significance of responsible leadership in driving the adoption of green innovations in Nigerian healthcare facilities. Responsible leaders play a crucial role in setting a vision for sustainability, promoting ethical behavior, fostering stakeholder engagement, and creating a culture of environmental responsibility within healthcare organizations. The study identifies successful examples of green innovations in healthcare facilities, such as energy-efficient systems, waste management practices, and sustainable procurement strategies. It also highlights the positive impacts of green innovations on reducing carbon emissions, improving patient outcomes, and enhancing the overall sustainability of healthcare operations.
Research limitations/implications: the study focuses solely on the healthcare sector in Nigeria, and the findings may not be applicable to other countries or regions. The research relies on online available statistics, data and subjective perceptions of responsible leadership and green innovations, which may introduce biases or limitations in the findings. Future research should consider larger sample sizes and quantitative analysis to provide a more comprehensive understanding of the relationship between responsible leadership and green innovations in the healthcare sector. Additionally, investigating the barriers and facilitators of implementing green innovations would provide valuable insights for policymakers and healthcare leaders.

Practical implications: The study suggests that healthcare organizations should explore and adopt green innovations to enhance sustainability. By adopting green innovations, healthcare leaders can demonstrate their commitment to sustainable practices and set an example for others in the industry.
Originality/value: This scientific article contributes to the existing literature by examining the link between green innovations and responsible leadership in the Nigerian healthcare sector. It highlights the importance of responsible leadership in driving sustainable practices and promoting environmental responsibility in healthcare organizations. The study provides insights into the potential benefits of integrating green innovations, such as reducing environmental impact, improving resource efficiency, and enhancing patient satisfaction. The findings of this research can inform policymakers, healthcare administrators, and leaders in the sector about the value of responsible leadership in fostering a culture of sustainability and facilitating the adoption of green innovations in the Nigerian healthcare sector.

Keywords: Responsible Leadership, Green Innovation, Green Growth, Healthcare in Nigeria, employee wellbeing.

Category of the paper: Desk Research.

1. Introduction

The goal of this paper is to investigate the topic of green innovations and responsible leadership in Nigeria's healthcare industry. The study's objectives are to investigate the role of responsible leadership in promoting and implementing green innovations in healthcare facilities, to assess the current state of green practices and technologies in Nigerian healthcare, and to identify the potential benefits and challenges associated with incorporating sustainable practices into the healthcare sector. This article examines official statistics and reports from Nigeria on Healthcare, Green Growth, and Green Innovation (GI). Key findings, trends, and recommendations relating to green innovation in Nigeria were collected and examined from the selected documents.

According to Nigeria Health Sector – Market Study Report (Nigeria Health Sector…, 2022) issued in 2022, Nigeria is the largest economy in Africa, with a GDP exceeding $430 billion. It has a population of approximately 213 million people, with a median age of 18 years. The population is expected to more than double by 2050, which will put significant strain on the healthcare system. Currently, the country is facing challenges such as low economic growth and high inflation. Despite these macroeconomic difficulties, Nigeria remains one of the most important investment destinations in Africa.

Absa Africa Market Index (AFMI)[1] published in 2022, states that Nigeria is ranked as the third most attractive investment destination on the continent as shown in the picture below:

[1] Absa Africa Financial Markets Index 2022. Harnessing the power of African opportunity.

Rank		Country	Score		Comments
2022	2021		2022	2021	
1	1	South Africa	88	90	Strong performance but market sell-off and weak growth weigh on score
2	2	Mauritius	76	76	Robust financial market but lower reported pension assets
3	3	Nigeria	69	67	Better adoption of standard master agreements
4	6	Uganda	66	60	Improved ESG incentives and standards
5	5	Botswana	66	62	Strong macroeconomic fundamentals and transparency

Figure 1. Absa Africa Financial Markets Index 2022. Harnessing the power of African opportunity.

The index assesses six strategic pillars, including market depth, access to foreign exchange, market transparency, tax and regulatory environment, capacity of local investors, macroeconomic opportunities, and enforceability of standard master agreements.

Studies have found that a higher level of economic development can have a positive effect on the health of the society (Jahanshahi et al., 2020, Haque, 2020; Javed et al., 2020). However, the country Nigeria suffers from brain drain syndrome and find it difficult to innovate in technology. Hence, Nigerian health care system should address the subject of responsible leadership from the angle of why it is important to imbibe green innovation that will be beneficial to employees and society.

More so, the companies need to be more open in how they approach and manage green environmental challenges related to the execution of their supply base due to the increased knowledge and demand from stakeholders and the general public. In order to create and maintain Green Innovation (GI) skills and practice, it is crucial to concentrate on stakeholders' perspectives inside a company.

2. Literature Review

2.1. Responsible Leadership and Green Innovation

As underlines Nkrumah (Omede, 2018), Africa should first seek the political kingdom and afterwards everything else will follow. Leadership and governance in health systems, known as stewardship, are crucial components of any healthcare system. According to Ezeoha et al. (2012), it involves the government's role in overseeing and guiding the entire health system to protect the public interest. Inadequate stewardship in low- to middle-income countries like Nigeria contributes to the failure of their health systems. The Nigerian government faces challenges such as poorly defined roles, lack of management tools and policies, limited collaboration, weak policy implementation, insufficient private sector involvement, budgeting and planning issues, and inadequate funding.

Effective leadership requires inclusive policies, realistic resource utilization, and a focus on achieving systemic goals. The health workforce plays a pivotal role, and their sufficiency is vital for health-related development goals. The WHO highlights the positive correlation between the density of health workers, service coverage, system performance, and health outcomes. Addressing leadership and governance challenges is essential for improving healthcare delivery and outcomes overall (Ezeoha, 2012).

Throughout history, the role of leadership has been to facilitate development and progress in societies, communities, and organizations. The primary objective of leadership is transformation. Effective leadership has the ability to transform individuals, societies, communities, and institutions by providing role models to emulate (Omede et al., 2018). Responsible and stakeholder leadership are closely intertwined concepts, as suggested by Bass and Steidlmeier (1999). Responsible leadership offers a compelling perspective on connecting leadership with stakeholder theory by focusing on the responsibilities that leaders have towards various stakeholder groups.

Responsible Leadership (RL), as defined by Maak and Pless (2006), is a sustainable and relational phenomenon that arises from interactions with individuals who are influenced by leadership and have a vested interest in achieving positive outcomes. RL entails the responsibility to create progressive systems that benefit various stakeholders. When a leader behaves ethically, it fosters a positive and beneficial relationship between employees and society as a whole.

Schneider (2002) emphasizes that the context of organizations and the significant changes they undergo, such as becoming flatter, less bureaucratic, and more decentralized, add complexity to the leadership process and present new implications for what constitutes effective leadership. According to Trevino et al. (2000) responsible leadership emphasizes the leader as a positive role model who exhibits virtuous behavior, adheres to ethical standards, ensures ethical and pro-social conduct in the workplace, and utilizes moral reasoning principles to make decisions.

Additionally, the link between responsible leadership and green innovation has led to investigate the leadership style and the environmental and society outcome. For example, Liao and Zhang (2020) carried out a study of how responsible leadership has a positive relationship with environmental performance through innovation, while Zhao & Zhou (2020) carried out a study of how RL has a strong relationship with Organizational Citizenship Behavior for the Environment (OCBE) through leader identification. Moreover, a current review on the responsible leadership influence on employee well-being (EWB) and social well-being (SWB) through green innovation is few (Liao and Zhang, 2020). Therefore, in attempting to advance this research, the author offers to explain why and how responsible leadership drives EWB and SWB through green innovation.

Management must practice some normative guidelines or rules to demonstrate proper behaviour of the employees (Linderberg, 2002; Pache, Santos, 2015). The manager has procedures that surround the environmental management action of reducing pollution during manufacturing process of product and services (Carmona-Moreno et al., 2004). Present research has revealed how some contextual factors have influenced green behaviour management in the workplace (Javed et al., 2020; Norton et al., 2015). Also, there are other factors that influence the management practice and leadership of the green work place.

Leadership has faced some negative consequences of meeting profit while paying attention to the environmental issues (Abbas, Sagsan, 2019). RL constitutes dimensions that cover effectiveness, ethics and sustainability. The effectiveness involves the managers and employees benefit from responsible behaviour and the outcome involves enhanced business performance and reputation in the organisation (Javed et al., 2020) and trust in management (Akhtar et al., 2020). The ethics by RL involves the exemplary leadership that encourages employees to do the right thing in business practice (Voegtlin, 2011).

A study by Voegtlin (2011) discovered that RL can reduce the unethical behaviour of employees. Therefore, this paper claims that RL should incorporate green innovation strategies for the organisation to overcome the brain drain situation because of the following justification. Firstly, researchers have recommended that RL provides social conditions for talented employees who are one of the important stakeholders of the organisation so as to motivate and maintain their wellbeing in the organisation (Enwereuzor et al., 2020). Hence, this paper notes that integrating RL with green innovation may improve the employees wellbeing because of this personal perspective to overcome the brain drain situation.

Secondly, from the society perspective, RL can identify and respond proactively to the demand of sociocultural problems in the society which has to do with difference in lifestyle and cultural structure of the country, addressing also the socio-economic challenges so that organisation can respond effectively (Maak, Pless, 2006). Therefore, the green innovation strategy in health care services in alignment with responsible leadership will lead to sustainability in social wellbeing to eliminate brain drain syndrome.

Thirdly, RL can also go beyond establishing relationship between the leaders (strategic head) of the organisation with the macro and micro (tactical and low level managers) level members of the organisation to stop brain drain syndrome. The decision of the health care service organisation to apply RL with green innovation can go beyond the employees' and social wellbeing. For example, foreign medical personnel from other countries seeking interest in Nigeria health care sector to curb the brain drain syndrome.

2.2. The concept of Green Innovation in an organization

Technology encompasses skills, knowledge, systems, processes, and techniques used to achieve organizational goals. When technology is applied to address environmental concerns, it is referred to as green or sustainable technology. Green technology aims to use technological resources efficiently and ecologically to improve organizational performance and productivity, leading to a sustainable competitive advantage in the industry (Murugesan in Issa, Jabbouri, 2022).

The concept of green innovation was established in the 20th century (Unsworth et al., 2021). GI with regards to organisations are the innovative activities of organisation adopting the software and hardware that is related to green goods, services and processes which include prevention of toxic waste, conservation of energy and protecting the environment through recycling waste materials and responsible management of the environment. GI does not only focus on protecting the environment but deals with technological innovation and design of environmental management of products.

Therefore, a simplified definition of GI is green technology and green product innovation. GI is regarded as a business strategy that deals with the core competence of the orgnisation. Green innovation takes into consideration the environmental benefits and adds the society concern in the entire business process (Ghisetti, Pontoni, 2015). The improvement in the society dimension will result in customer satisfaction and increase in market share (Dangelico, 2010).

Green growth is a policy framework that integrates environmental and economic aspects to promote economic growth, reduce poverty, create green and clean jobs, and enhance the well-being of citizens. It involves developing management policies to regulate activities within the environment. Fay (2012) highlights that green growth is crucial for sustainable development in developing countries by alleviating poverty and raising public awareness of environmental issues. The proper adoption of green growth brings numerous benefits. To achieve this, African countries need to prioritize innovation and remove barriers to the diffusion of green growth products and technologies.

The World Bank defines green growth as inclusive growth that efficiently utilizes natural resources, minimizes pollution, considers natural hazards, and acknowledges the role of environmental management and natural capital in preventing disasters. The OECD refers to green growth as a strategy that ensures economic growth and development without harming the ecosystem, while also promoting social welfare (Oyebanji et al., 2017). Green investment and innovations play a crucial role in achieving sustainable growth and development. Bowen sees the green growth framework as a comprehensive economic progress that creates a sustainable environment by reducing carbon emissions and pollution, fostering a business-friendly environment, boosting productivity, and improving people's welfare (Oyebanji et al., 2017).

GI obviously requires adopting new technologies. The fact that customers can buy products that are less harmful to the environment can assist firm in increasing their sales and generating profit. In meeting functional value, GI can fulfill the psychological need of the society with regards to addressing the wellbeing and protection of the environment (Pujari, 2006). Organization which has a brand image that is linked with ecofriendly concept will thrive better in the market place than other competitors.

The job of GI is not to improve income but to pay better attention to the social image and achieve environmental sustainability. The adoption of GI does not directly lead to economic performance, instead it is the societal performance of GI that allows the organization to improve its economic performance. Therefore, the influence of GI on economic performance is indirectly through the improvement of the societal performance. There are 4 dimensions of GI namely green technology innovation, green product innovation, green institutional innovation and green environment innovation. A report by BusinessWire in 2019 predicts that the Green Technology and Sustainability Market will reach $28.9 billion by 2024 (https://www.businesswire.com/…).

Green Technology Innovation (GTI) will assist in replacing the traditional technologies with modern technologies that can provide environmental benefits such as adopting recyclable processes which can reduce the emission of toxic materials. Green product innovation according to the European Commission is the product that reduces negative impact and risk to the environment. Green Institutional Innovation (GII) refers to the support system of an organisation to provide guidance and guarantee for organisational green behaviour. Global Enterprise Innovation (GEI) is the dimension of organisational green innovation that emphasizes the external forces from the performance of the organisation green innovation and focuses on the benefit of the environment and society.

This paper includes GI into the conceptual model for the following reasons. First, the dimension of GTI will motivate the medical personnel to adopt GTI by using clean energy in reducing air pollution to contribute to sustainability for the growth of the economy. The usage of technological innovation will lead to an increase of the organisation efficiency.

Secondly, the dimension of the GPI will enable the organisation to increase their profitability in the long run because customers will prefer a company's product to contribute to the competitiveness of the organisation. The dimension of GII will promote the efficacy of the healthcare organisation in proper policy formulation that focuses on total environmental quality management, while GEI dimension will assist the organisation in paying attention to the environmental issues that can harm the society and also promote a positive image for the society.

2.3. Linking Green Innovation and Responsible Leadership to employee wellbeing

In 2021, a world economic forum study showed that 60% of employees leave their jobs to join organization that aligns with their values. This is reason to believe that sustainability is an important concern for many medical personnel brain drain. In 2021, IBM study found that majority of employees' view an organization that is environmental sustainable as an attractive employer. The findings have suggested that making sustainability part of the business values may not only be good for the environment but also good for the employee well-being and business opportunities. Employees want and need work for their organization that embraces their values which is inclusive of sustainability. Given the evidence that taking action in green innovation is a part of solution rather than a problem will assist in mitigating ecological anxiety and the organization that accepts sustainability will contribute to reducing employee stress and anxiety levels.

As organization face tremendous environmental changes, this changes have led an organization to adopt green innovation to achieve a sustainable performance. GI is a strategy for fighting the excessive burden in the environment (Singh et al, 2020). In the bid to reduce ecological footprint, the organization have learnt to redesign their strategies in an innovatively beneficial way that can strengthen the employees well-being (Yusliza et al., 2020). The stimulation of green innovation can improve the firms' production process and lead to reduction of pollution effect on the operations of the business organization (Singh et al., 2020).

Grigore and Kifor (2021) state that employees' green innovation can play a critical role in minimizing the environmental impact and achieve sustainability goals, as the awareness of people in the environmental sustainability has grown, the company has motivated their employees in adopting green innovation to improve their quality of life. Cultivating green innovation practice will help the employee to be efficient, competitive and profitable. The fact that employees are the actors that drive the organisation activities means that they are the leaders whose action must meet the society expectations.

Present research has suggested that green innovation is inclusive of team members and practice of good leadership will significantly affect employees wellbeing (Van Bogaert et al., 2014), work schedule and job satisfaction (Mafini, 2016). The research has shown a positive association between green innovation and employee wellbeing (Yusliza et al., 2020; Unsworth et al., 2021).

However, there is a need to explore team member relationship on responsible leadership at the micro level of team member (Singh et al., 2020; Unsworth et al., 2021). Several researchers have suggested that green innovation directs the leaders of the organization to select, recruit, train, develop and reward the practice of the employees so as to increase their wellbeing (Haque, 2018; Mafini, 2016). When responsible leaders enable green innovation in the health care service organization, it can assist in employee retention and wellbeing thereby eliminating the brain drain mindset (Pless, 2007).

Leadership practices have revealed an important relationship with employee motivation (Cornell, 2020). However, responsible leaders should not ignore this brain drain situation. Researchers suggest that the increase of green innovation can enable responsible behaviour of the managers or executives in their roles as leaders to be able to improve the performance and wellbeing of employees (Marifini, 2016; Haque et al., 2019).

Several studies have mentioned the relevance of healthcare service organization and green innovation as a drive to increase a higher level of employee wellbeing (Harley, 2007). Hence, scare literature exist in explaining the combination of green innovation and responsible leadership (Haque et al., 2019). Therefore, it is important to explore the combined influence of RL and GI on employees wellbeing to meet the challenges of brain drain syndrome in Nigeria.

2.4. Green innovation integrates with responsible leadership to influence society wellbeing

The society wellbeing for health care service organization is challenging due to lack of adoption of green innovation and includes the culture of responsible leaders to establish a continuous improvement of health care system and solve problems of the brain drain (Aarons et al., 2014). Researchers have suggested that green innovation of an organization depends on the employee shared perception in exhibiting behaviour and practicing green innovation actions to ensure good leadership for the betterment of society. How an organization adopts GI in alignment with RL to implement social sustainability will address their success in accomplishing a competitive advantage (Aarons et al., 2014).

Employees innovative action play a role in ensuring the development of sustainable health care products (Turi, Sarfraz, 2022). Numerous organisations are adopting green innovation for the survival of their business. GI is a sustainable way to achieve ecofriendly products which influences society wellbeing (Zhang et al., 2021). When responsible leadership aligns with green innovation, it will essentially make the health care service organization to overcome brain drain situation and the organization will work towards the health and safety of the employees and society.

The healthcare service organization requires the combination of the social and environmental factors in adopting the green innovation to maintain or deliver society wellbeing. Combining RL with GI will enable healthcare service organization to survive in the most profitable way as they generate ethical values that will increase the contribution of society and build a healthy community (Cornell, 2020; Aarons et al., 2014).

RL does not only engage in the commitment of managing the business of the health care service organization but they also develop and adopt a green innovation with the positive consequences for employees and society. Moreover, RL can address the changes in the organization that is needed for the brain drain crisis and negotiate with different society groups such as government, suppliers, distributors, local community and patients on why and how the problems can be solved to benefit these group of people (Haque et al., 2020). Researchers claim

that RL play an important role in aligning GI for competitive advantage and for profitable benefit of the society (Singh et al., 2020). Therefore, this paper notes that there is a positive influence between GI integrating with RL to promote the society wellbeing.

2.5. Moderating role of GI in alignment with RL

Researchers have suggested that GI and RL have a simple effect on motivating employee and improving society well-being (Haque et al., 2019). According to Arici et al. (2022) organisation moderates the effect of leadership role and outcome of the employee. The conceptual model suggests that GI integrating RL can influence and reduce the impact of employee well-being and society well-being. The moderating role of GI in this paper includes the following points. First, GI integrated to RL may improve and increase the quality of life outcome of the medical personnel and society. Several theories have justified the relationship and positive influence of RL on employee motivation, job satisfaction, prosperity, general well-being and that it directly improves social well-being.

SET theory of leadership (Fuller et al., 2006) is the most influential conceptual paradigm in organisational behaviour. SET postulates that an employee enters a professional relationship to acquire valuable resources including salaries, social appreciation and trust (Blau, 1964). Therefore, it requires the action of each member of the organisation to influence each other's communicative interaction. Employees can receive support from their organisation in the form of physical reward from colleagues when they cooperate and collaborate to accomplish several activities in the organisation. The understanding of these relationship have a positive outcome on employee engagement and social commitment.

In the study, RL is accountable to ensure the employee health, safety and wellbeing and also make them to be committed to society welfare to address the brain drain syndrome (Shan, Tang, 2020). Similarly, the social contract theory of leadership is the contract of association where the contract of individuals within the company make decisions in a way that is acceptable to everybody. This can have a significant impact on employee wellbeing if they take a positive decision to adopt GI (Shan, Tang, 2020). The decision of the organisation to adopt GI will lead to positive outcome from both internal and external stakeholders (Shan, Tang, 2020).

Therefore, employee wellbeing and knowledge, health safety can lead to an improvement of organisation and directly link society wellbeing (Shan & Tang, 2020). This is in agreement with the study of Singh et al. (2020) that demonstrates a positive link between GI and society wellbeing through the increase of employee green innovation. Scholars have recommended a focus on employee motivation for the betterment of society to overcome brain drain syndrome.

Secondly, the proposed model expects that the integration of RL and GI will reinforce the positive outcome of employee quality of life in the organisation especially at the current state of brain drain. This is because allowing a responsible leader to adopt the GI will assist members of the organisation to avert the brain drain syndrome. For example, the management and

government of the healthcare service organisation should provide meaningful and conductive work environment that will promote higher level of employee wellbeing.

Following the stakeholders theory (Freeman, 2002, 2004, 2011) medical personnel serve as a stakeholder through their patient and provide the role of the health care service organisational responsible leaders to their communities. These ideas from the medical personnel can create positive reputation through RL for healthcare service organisation and increase their sustainability performance (Freeman et al., 2004). Knowing about this brain drain syndrome, the Nigerian society expect a more responsible support from the medical personnel and the leadership of the organisations. Hence, the contribution of RL in alignment to GI would improve the wellbeing of medical personnel and can increase trust, social appreciation and ethical relationship among employees, leaders and society. Therefore, this paper claims that GI integration with RL may moderate both the level of medical personnel wellbeing and society wellbeing.

3. Methodology

This article analyses the official statistics and reports about Healthcare, Green Growth, and Green Innovation (GI) in Nigeria. The selected documents are as follows: Nigeria Health Sector – Market Study Report; Green Growth and Developing Countries; Long-Term Vision for Nigeria (LTV-2050) - Towards the Development of Nigeria's Long-Term Low Emissions Development Strategy (LT-LEDS); Diffusion Strategy of Green Technology And Green Industry in Africa. A Study of Renewable Energy Technology Market and Energy Efficiency Adoption in Maize and Cassava Processing Industries in Kenya and Nigeria.

The above mentioned documents were carefully reviewed, and key findings, trends, and recommendations related to green innovation in Nigeria were extracted and analyzed. The analysis aimed to understand the current state of green innovation in Nigeria, identify barriers and opportunities, and propose strategies for promoting and implementing green technologies and practices in various sectors of the economy.

4. Healthcare sector in Nigeria

According to Nigeria Health Sector – Market Study Report released in 2022, Nigeria, with a GDP exceeding US$430 billion, holds the position of the largest economy in Africa. Its population of approximately 213 million people, with a median age of 18 years, is expected to more than double by 2050, posing challenges to the healthcare system. Despite facing

macroeconomic difficulties such as low growth and high inflation, Nigeria remains an important investment destination in Africa. According to the Absa Africa Market Index (AFMI) for 2021, Nigeria ranks as the third most attractive investment destination on the continent. The index considers factors such as market depth, access to foreign exchange, market transparency, tax and regulatory environment, capacity of local investors, macroeconomic opportunities, and enforceability of standard agreements.

As stated in the report, the healthcare sector in Nigeria is inadequately developed and fails to meet the needs of the local population. Access to healthcare is significantly skewed towards urban areas, with people living in cities having four times more access than those in rural areas. The private health sector is dominant but highly fragmented, consisting of numerous small privately-owned medical facilities with limited resources.

According to the Health Facility Registry (HFR) of the Federal Ministry of Health, there were approximately 39,983 hospitals and clinics in Nigeria in 2019, with over 70% being government-owned. Primary healthcare centers make up the majority (85.2%) of these facilities, while secondary and tertiary healthcare facilities account for 14.4% and 0.4%, respectively. The country has an estimated 154 tertiary health facilities, including both public and private institutions.

In 2014, Nigeria had an estimated 134,000 hospital beds, equivalent to 0.8 beds per thousand population, which is below the average for the African region. Although the number of hospital beds has shown some growth, it has been insufficient to significantly impact the population-to-bed ratio.

The demand for healthcare services in Nigeria is projected to increase from US$15 billion in 2018 to over US$18 billion in 2023 over a five-year period. The health sector contributes around 4% to the country's Real GDP, with a significant portion (over 74%) of healthcare expenses being covered by out-of-pocket payments.

Interestingly, during the COVID-19 pandemic, the health sector outperformed the overall economy in terms of real GDP growth. This growth can be attributed to increased investments from both the public and private sectors, aimed at curbing the pandemic and addressing other healthcare needs in the market.

According to data from the US Department of Trade in 2015, Nigeria's population was estimated to be 200 million by the end of 2018, growing at a rate of 3.2% per year. The population is predominantly young, with 63% below the age of 25. Urbanization has been on the rise, reaching 48.5% in 2016, which has put pressure on urban social services, including healthcare. Infectious and parasitic diseases are the primary contributors to the disease burden in Nigeria, with maternal, neonatal, and nutritional factors, HIV, tuberculosis, malaria, and respiratory infections being the leading causes. These factors account for a significant portion of years of life lost. As a result, there is a need for increased services in reproductive, maternal, newborn, child, and adolescent health (RMNCAH). The government is prioritizing

RMNCAH services, particularly in primary care, and there are investment opportunities in both public-private partnerships (PPPs) and the private sector in this area.

The following table from the report demonstrates the indices of the situation in Nigeria in terms of health and human capital.

S/N		HEALTH, ECONOMIC & HUMAN CAPITAL INDICES AND VARIABLES	VALUES
1	1.1	Estimated Number of Doctors Trained in Nigeria (2014)	65,000
	1.2	Number of Doctors practicing in Nigeria (2014)	25,000
2	2.1	Estimated Number of Doctors Trained in Nigeria (2016)	72,000
	2.2	Number of Doctors that Travelled abroad (2016)	20,000
Health And Economic Indicators Based on Disease Burden (2015)			
3	3.1	Under 5 Mortality Rate	117
4	4.1	Maternal Mortality Rate	560.0
5	5.1	Prevalence of HIV	3.10%
6	6.1	Estimated Proportion of Cardiovascular Disease Mortality	12.00%
7	7.1	Estimated Diabetes Prevalence	4.04%
8	8.1	Public Hospitals Per Million People	87.8
9	9.1	Private Hospitals Per Million People	53.8
10	10.1	Primary Health Centres Percentage of Health Facilities	85.60%
11	11.1	Secondary Hospitals Percentage of Health Facilities	14.00%
12	12.1	Tertiary Hospitals Percentage of Health Facilities	0.20%
Increasing Burden and gap of Non Communicable Diseases			
13	13.1	Population (2020 est.)	206 mil.
14	14.1	Consultant Oncologist	25
15	15.1	Neurologist	50
16	16.1	Neuro Surgeons	40
17	17.1	Consultant Paediatricians	600
18	18.1	Population of Children In Nigeria	70.0 mil.
19	19.1	Estimated Spending on Medical Tourism annually in Nigeria	US$1bn
20	20.1	Health Insurance Coverage In 2013	5.00%
Average Hospital Beds Per 10, 000			
21	21.1	Sub Saharan Africa	12.0
22	22.1	Europe and Central Asia	56.0
23	23.1	East Asia And Pacific	36.0
24	24.1	Nigeria	5.0
25	25.1	Global Average	26.0
Other Indices			
26	26.1	Life Expectancy at Birth (Male and Female)	34 years
27	27.1	Global Average of Life Expectancy at Birth (Male and Female)	70 years
28	28.1	Under Five Mortality Rate (Per 100, 000 Live Birth)	560
29	29.1	Global Average of under 5 Mortality Rate (Per 100, 000 Live Birth)	201
30	30.1	Nigeria's Rank on Proportion of GDP spent on health	109/191

Figure 2. Health & Human Capital Indices in Nigeria.

Source: Market Study Report…, 2022.

When it comes to clinics and hospitals in Nigeria, the report states that there are 34,076 Primary Healthcare Centers (PHCs), which make up 85.3% of the total number of hospitals and clinics in the country. However, it is estimated that only 20% of these PHCs are fully operational. Many of these centers face challenges such as insufficient staff, inadequate equipment, poor infrastructure, and a lack of essential drugs. According to the World Health Organization (WHO), only a quarter of PHCs have more than 25% of the necessary equipment. Additionally, only around 20% of PHCs have the capacity to provide basic emergency obstetrics services.

On the other hand, in Nigeria, there are 5,753 secondary healthcare facilities and 154 tertiary healthcare facilities. From 2010 to 2017, secondary facilities accounted for an average of 61% of total provider expenditure receipts, while tertiary facilities accounted for 21%. As a result,

a significant amount of funding, approximately N1.95 trillion (US$5.4 billion), which represents 84% of primary healthcare expenditures, was allocated to non-primary healthcare facilities, specifically secondary and tertiary care facilities, in 2017. The numbers are based on the National Health Account (NHA) and were presented in the following table in the Nigeria Health Sector – Market Study Report:

Healthcare Providers	NGN'Billion							
	2010	2011	2012	2013	2014	2015	2016	2017
Tertiary hospital	143	145	207	207	255	229	241	372
Secondary hospital	404	479	574	625	675	695	783	970
Primary Health Centres	130	131	165	178	176	190	223	370
Total Expenditure Received (NGN'Billion)	**677**	**755**	**946**	**1,010**	**1,105**	**1,114**	**1,247**	**1,712**
Avg. FX Rate (NGN:US$)	122.26	155.94	158.8	159.3	165.2	197.88	257.66	333.71
Total Expenditure Received (US$'Billion)	5.54	4.84	5.96	6.34	6.69	5.63	4.84	5.13

Tertiary hospital	21%	19%	22%	20%	23%	21%	19%	22%	21%
Secondary hospital	60%	64%	61%	62%	61%	62%	63%	57%	61%
Primary Health Centres	19%	17%	17%	18%	16%	17%	18%	22%	18%

Figure 3. Nigeria Health Provider Expenditure Receipts.

Source: Nigeria Health Sector – Market Study Report, 2022.

The Nigeria Health Sector – Market Study Report 2022 presents also the number of personnel and their distribution per Million population based on Bukunmi M.I., Tolulope A.O., "The Journal of Global Radiology", 2020. The professions that are mentioned in the statistics are: radiologists, radiographers, medical physicists, biomedical engineers, X-Ray ("Dark Room") and Technicians. The data was gathered between 2015-2018 as can be observed in the following table:

Personnel	Year estimate was made	Estimated No. of Personnel	Personnel per Million population
Radiologists	2015	300	1.5
Radiographers	2016	1,318	6.7
Medical Physicists	2019	100	0.57
Biomedical Engineers	2017	280	1.4
X-Ray ("Dark Room") Technicians	2018	1,111	5.63

Figure 4. Nigeria Diagnostic Imaging Personnel Distribution.

Source: Nigeria Health Sector – Market Study Report, 2022.

5. Green Innovation (GI) in Nigeria

In the document "Green Growth and Developing Countries" issued by OECD in 2012 there is a broad outline of the green growth concept in developing countries in general, however Nigeria counts to developing countries, this is why the information included in the report refers also to this African country.

According to the definition by OECD, green growth is an approach that aims to achieve sustainable development by focusing on the interface between the economy and the environment. It is not a replacement for sustainable development but rather a means to attain it. Green growth emphasizes creating the necessary conditions for innovation, investment, and competition to foster new sources of economic growth while maintaining resilient ecosystems.

Implementing green growth strategies requires specific attention to social issues and equity concerns that may arise from transitioning to a greener economy. These strategies should be implemented alongside initiatives that address the broader social aspects of sustainable development.

For developing economies, the goal is to achieve diversified and sustainable growth, leading to poverty reduction, improved well-being, and a higher quality of life for their citizens. This involves recognizing the value of natural capital and its role in economic growth. A green growth model promotes cost-effective and resource-efficient approaches to guide sustainable production and consumption choices, ultimately helping developing countries achieve sustainable development.

Implementing green growth strategies in developing countries poses unique challenges. Policy choices need to consider the environmental costs of expanding agricultural land versus the high levels of rural poverty. Exploring ways to increase productivity on existing cultivated land can be a potential solution. Payment for ecosystem services, sustainable resource extraction, and promoting sectoral sustainability have shown economic opportunities for developing countries.

In the short term, green growth policies can deliver local benefits such as improved environmental management, better access to water and energy, and enhanced health outcomes. However, these short-term benefits must be weighed against the immediate costs of implementing such policies. Trade-offs exist, and the scale of these trade-offs depends on the nature of the economy and the specific green growth measures implemented. In some cases, the poor may be adversely affected, and powerful actors may face disadvantages from deviating from current development plans. To mitigate these challenges, targeted social policies should accompany green growth measures.

In the long run, there is a need to address infrastructure deficits to support economic activities. However, there is potential for technology leapfrogging and climate-resilient implementation. Efficient energy and public transportation systems are needed to address electricity shortages and urbanization rates. Green growth initiatives also have the potential for job creation, particularly in rural areas, and can help preserve local livelihoods from the impacts of climate change.

According to the document 2050 Long-Term Vision for Nigeria (LTV-2050) - Towards the Development of Nigeria's Long-Term Low Emissions Development Strategy (LT-LEDS) (2050 Long-Term Vision…, 2021) issued in 2021 by the Department of Climate Change,

Federal Ministry of Environment in Nigeria, to achieve a low emission development future in Nigeria amidst population growth and economic expansion, emphasis must be placed on innovation. This includes technological, policy, governance, economic, and environmental innovation.

In terms of social innovation, there is a need for societal values to be reoriented to support the transition to a carbon-neutral future. This involves creating green cities that interact with nature in an equitable and sustainable manner. The transition to a green economy requires fundamental changes to macro and micro-economic conditions and institutions. Maintaining the status quo in economic policy is not viable, and new social innovations must be developed to meet future demands.

Nigeria's industrial policy, as outlined in the Nigeria Industrial Revolution Plan 2014 (as stated in 2050 Long-Term Vision for Nigeria (LTV-2050)), aims to revitalize the country's manufacturing industries to drive growth, job creation, and food security. However, the current reliance on natural gas and diesel for power generation in the industrial sector contributes to greenhouse gas (GHG) emissions. Without measures to improve energy efficiency, the sector's emissions are projected to increase from 4.2 Mt CO2e in 2010 to 14.8 Mt CO2e in 2030, according to the sectoral analysis of Nigeria's Nationally Determined Contributions (NDCs).

Recognizing the need to address this issue, the government acknowledges the necessity of a coordinated shift towards low-emission production systems as the sector continues to grow. The adoption of green technology throughout the industrial process, from the development of factory facilities to the fabrication and installation of production equipment, can help reduce the demand for fossil fuels and enhance overall efficiency. This approach will not only mitigate GHG emissions but also ensure sustainable and efficient industrial development.

Economic innovation is crucial in overcoming the challenges faced in implementing climate action in Nigeria. While the country aspires to be a low carbon and climate-friendly economy, economic circumstances often limit the government's ability to pursue a low carbon development path. Efforts to diversify the economy and address the trade-offs between economic growth and environmental sustainability are necessary for long-term success.

Technological innovation plays a vital role in Nigeria's long-term vision. Advancements in technology are essential for mitigating climate change and achieving sustainable development. Innovation in energy generation, storage, efficiency, carbon capture, and renewable energy has shown promising results globally. Nigeria should invest in promoting these technologies, as well as indigenous technology innovations, to support its long-term low emission development strategy.

Environmental innovation focuses on implementing and driving organizational changes to protect the environment. It encompasses economic, social, and technological changes aimed at promoting environmental integrity. This includes sustainable production processes, equitable distribution of wealth, incorporation of environmental risks in economic frameworks, and strategic planning for sustainable development and poverty alleviation. Citizens should

have access to environmental information and be involved in decision-making processes. Overall, innovation in various aspects is crucial for Nigeria's transition to a low emission development future, and it encompasses social, economic, technological, and environmental dimensions.

According to the document “Diffusion Strategy of Green Technology And Green Industry in Africa. A Study of Renewable Energy Technology Market and Energy Efficiency Adoption in Maize and Cassava Processing Industries in Kenya and Nigeria” issued by United Nations University UNU-MERIT in 2014, Nigeria's renewable energy potential remains largely untapped, with only a few existing projects funded by international agencies and NGOs. The adoption of renewable energy technologies (RETs) in Nigeria is relatively recent compared to developed countries. Solar photovoltaic (PV) technology, in particular, is not well-developed in Nigeria, with limited local research and investment.

However, solar energy is being used for traffic systems, billboards, street lighting, and household appliances. Nigeria has a significant solar energy resource, with an average annual solar energy intensity that exceeds the projected energy demand for the country. Wind power is mainly used for water supply and has been revitalized in some northern states. Biomass, including agricultural crop residues and waste, is a major source of energy in Nigeria, but its full potential has not been realized. Hydropower contributes about 32% to Nigeria's electricity supply, with significant untapped hydropower potential. Despite the technical and economic prospects for renewables, renewable energy education is lacking in Nigeria's academic curriculum, limiting awareness and expertise in the field.

There are various documents and reports concerning Green Innovation in African countries and Nigeria, however there is lack of information about GI in the health sector.

6. Summary

Green innovation and responsible leadership creates a positive and psychologically safe environment for health care workers, green innovation and responsible leadership increases the standard of living among health personnel, green innovation and responsible leadership helps in creating a good relationship among employees, green innovation and responsible leadership helps employees to carry out good health care services are the ways green Innovation and responsible leadership positively enhance employee well-being.

The ways green innovation and responsible leadership positively enhance society well-being are green innovation and responsible leadership promotes high usage of health facilities in the society, green innovation and responsible leadership positively enhance the health life of citizens in the society, green innovation and responsible leadership promotes job opportunity for health workers in the society.

The ways green innovation in alignment with responsible leadership moderates the relationship among employees' and society well-being are green innovation in alignment with responsible leadership helps in promoting good health care services through the employees for society well-being, green innovation in alignment with responsible leadership improves transparency among employees for society well-being, green innovation in alignment with responsible leadership creates a positive environment among employees for society well-being.

The importance of this research lies in its identification of the limitations and weaknesses of the healthcare sector in Nigeria. It highlights the need for improved infrastructure, resources, and access to healthcare services, especially in rural areas. The information obtained can be further used to guide policymakers, investors, and healthcare providers in addressing these challenges and developing strategies to enhance the healthcare system in Nigeria. It also emphasizes the significance of prioritizing RMNCAH services and exploring opportunities for public-private partnerships to improve healthcare delivery.

The research on green innovation in Nigeria provides important aspects to the concept of green growth and its application in developing countries, including Nigeria. It emphasizes the importance of achieving sustainable development by balancing economic growth with environmental preservation.

On the one hand, the research highlights the challenges and trade-offs associated with implementing green growth strategies, including the need for social innovation, infrastructure development, and economic diversification. Moreover, it emphasizes the need for renewable energy education and awareness to fully harness the country's renewable energy potential.

On the other hand, it underscores the role of technological, policy, governance, economic, and environmental innovation in achieving a low emission development future. The research emphasizes the need for renewable energy education and awareness to fully harness the country's renewable energy potential.

While there is limited information about green innovation in the healthcare sector specifically, the study offers insightful information about the broader context of green growth and innovation in Nigeria. The lack of information highlights a potential research gap and the need for further exploration of green innovation opportunities in the healthcare sector to promote sustainability and environmental responsibility in healthcare delivery.

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THE BRAIN DRAIN SYNDROME AND THE ROLE OF RESPONSIBLE LEADERSHIP IN HEALTH CARE SERVICE ORGANISATION IN NIGERIA

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Purpose: The purpose of this article is to explore the role of responsible leadership in mitigating the brain drain syndrome in Nigerian healthcare service organizations. It aims to provide a conceptual model that highlights the need for responsible leadership and its impact on employee and social well-being.
Design/methodology/approach: The article is based on a review of existing literature on responsible leadership, employee well-being, and social well-being in the context of healthcare service organizations. It incorporates and analyses studies that examine the causes and consequences of the brain drain syndrome and proposes responsible leadership as a solution. The conceptual model is developed by extending the role of responsible leadership and its relationship with employee and social well-being.
Findings: The findings suggest that responsible leadership can positively influence organizational citizenship behaviour, innovative behaviour, commitment, job satisfaction, and overall wellbeing of medical personnel. The brain drain syndrome negatively affects employee wellbeing and social wellbeing in healthcare service organizations. The proposed conceptual model highlights the importance of responsible leadership in addressing the brain drain syndrome and promoting the well-being of medical personnel and society.
Research limitations/implications: The article is based on a conceptual model of experiments undertaken by various scholars and their outcomes. The study is focused on the Nigerian context, and its findings may have limited generalizability to other countries or regions.
Practical implications: The article emphasizes the need for healthcare service organizations to adopt responsible leadership practices to minimize the brain drain syndrome. It highlights the importance of providing employment opportunities and delivering innovative healthcare services to retain medical personnel and promote employee and social well-being.
Originality/value: The article contributes to the literature by providing a comprehensive conceptual model that extends the role of responsible leadership in overcoming the brain drain syndrome in healthcare service organizations. The article offers a unique perspective on the role of responsible leadership in the Nigerian healthcare context and provides insights that can be valuable for policymakers, leaders, and researchers.

Keywords: Responsible Leadership, Brain Drain Syndrome, Social Wellbeing, Employee Wellbeing, Healthcare in Nigeria.

Category of the paper: Desk Research.

1. Introduction

The current situation in Nigeria reveals a significant impact on healthcare delivery due to a shortage of skilled healthcare professionals and their migration, leading to a decline in the quality of care experienced by the majority of patients and attendees Olusegun and Olusoji (2022). The brain drain syndrome has imposed an unprecedented challenge to the health care service organisation.

The need for responsible leaders came to limelight with the collapse of major health care system which negatively affected the country (Arici et al., 2022). In the pursuit of improving employee wellbeing and social wellbeing, health care service organisations need to adopt green innovation and demand more responsibility in their leadership approach to minimise the brain drain syndrome (Hamouche, 2020; Leite et al., 2020). Therefore, it is the country's job to provide employment to health care workers and deliver innovative health care services to the people.

The interest of responsible leadership (RL) was emphasized by irresponsible corporate health care providers who were blamed for their gross unethical practices (Verschoor, 2015). Responsible leadership has an effect on organizational citizenship behavior which means that a responsible leader is not only seen as a method of motivate employee (Brown, Trevino, 2014), it can also lead to innovative behavior (Brumm, Drury, 2013) and promotes commitment and job satisfaction (Celik, DeDeglu, Inanir, 2015) which is beneficial to wellbeing (Ruiz et al., 2013) of the business, employees and society at large (Hughes, 2012).

Extending the role of RL (Maak, Pless, 2006; Zhao, Zhou, 2020), this paper provides a multilevel conceptual model to overcome the brain drain syndrome and promotes the wellbeing of medical personnel and society. Extending the role of RL (Maak, Pless, 2006; Zhao, Zhou, 2020), this paper provides a multilevel conceptual model to overcome the brain drain syndrome and promotes the wellbeing of medical personnel and society. The model contributes to the need for a detailed and contextual understanding of brain drain in the health care service organisation in several ways. Most of all, helps to understand the challenges of brain drain and the need to use the responsible leadership as a point of addressing this issues

2. Responsible leadership

Responsible leadership (RL) is a phenomenon that connects the social and ethical aspects of leadership through the interaction of different stakeholders (Maak, Pless, 2006). Responsible leadership has attracted the attention of scholars and policymakers (Frangieh, Yaacoub, 2017). Therefore, RL constitutes effective leadership which focuses on ethics in businesses. Maak and Pless (2006) defined RL as the relationship and sustainable phenomenon that is experience from the interaction with people who are involved and affected by leadership and have a stake in realising a positive outcome. RL has a responsibility to build progressive system that benefits different stakeholders (Maak, Pless, 2006). Ethical behaviour of a responsible leader can lead to a positive beneficial relationship from the employee to the society (Maak, Pless, 2006). This reconciles the companies' goal to balance three considerations: profit, society welfare and satisfaction (Maak, Pless, 2006).

3. Impact of brain drain on employee well-being

The concept of employee well-being is defined as the subjective and objective individual experience of health in physical, emotional, mental and psychological aspect and also the accomplishment of prosperity in the workplace (Rafimnia, Sharifirad, 2015). Medical personnel's quality of life promotes benefit to the health care service organization as their well-being and motivation that can affect their performance at work (Rahimnia, Sharifirad, 2015).

The idea of medical personnel well-being has been examined in various disciples such as sociology (Peccei, 2004) or science (Warr, 2002). Hence, medical personnel well-being facilitates to improve their motivation and overall organisation performance either economic and environmental performance (Rahimnia, Sharfirad, 2015). The brain drain syndrome has put an enormous challenge on the Nigerian health care service organisations and impacted negatively the emotional, physical and mental well-being of the medical personnel (Hamouche, 2020).

Currently, the brain drain syndrome is influenced by several factors such as economic, natural disaster, socio political variables, demographic growth (Carbajal, Demiguel Caloo, 2021). As these medical personnel migrate, it jeopardizes the health care system and quality delivery services (Atte, 2020). The medical personnel well-being should be a programme that is planned through responsible leadership to foster their satisfaction in the workplace (Storman et al., 2022).

The concept of brain drain impacts medical personnel and has a negative consequence on the organisations' cultural values (Eche et al., 2022) that leads to burnout and stress which can negatively trigger the well-being of the employees. The medical personnel quality of life and well-being is not available in Nigeria that is why the country loses its most skilled personnel through migration to developed countries.

The impact of brain drain on EWB reveals a lack of quality of life which enabled them to support the brain drain syndrome and find a quality environment where their skills can be appreciated, motivated and valued (Khalid, Urbanski, 2021). Hence, research has continuously documented reasons behind the movement of medical personnel from developing countries to developed countries. This paper reflects the importance of medical personnel well-being when the organization experiences brain drain syndrome.

4. Impact of brain drain on the social well-being

WHO defined health "is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (https://www.who.int/...). In the economic field, SWB is the use of quantitative criteria (gross domestic product) to reflect the prosperity of the community and society. While in social science discipline, social wellbeing is the behaviour that is reflective of organisation participation, communities, group membership, social capital and community members.

The concept of social well-being involves societal and environmental system the business operates (Boudreau, Ramstad, 2005). More so, the definition of social wellbeing is the idea of achieving success in the society and environment without compromising the future needs from the perspective of leadership (Colbert, Kurucz, 2007), society well-being is an aspect of managerial ideology that plays a role in accomplishing strategies outside of the organization (Howieson et al., 2019).

The pursuit of society well-being will require leaders to expand their versatile role in the environment to accommodate different stakeholders. Additionally, society wellbeing is the relationship within the organisation that can promote a sound, safe and healthy environment by meeting the needs and demand of society (Cornell, 2020). Promoting society wellbeing creates a meaningful value that shapes managerial strategies to make decision in building a culture for different stakeholders (Cornell, 2020).

Brain drain has unleased some challenges that has led to the limitation of health care service organisations in response to SWB. The brain drain of the medical personnel may affect the outcome of health through its negative aspect in the society due to the increased rate of migration of medical personnel. The medical personnel who remain in the hospitals are few and experience more workload and stress that have a serious physical and emotional health on their

wellbeing. Consequently, these few number of medical personnel leave public hospitals to find jobs in private hospitals.

The brain drain has imposed a huge threat to social sustainability for the health care of the medical personnel, organization and external stakeholders. For example, Obokoh (2020) has noted that the mismanagement of the country by irresponsible leaders is one major cause of brain drain. Obokoh (2020) expressed that the Nigerian health care quality have been recognized as an unbalanced force to society welfare and also to the economy. In this situation, society wellbeing for health care service organisation is threatened and patients will be at risk for shortage of medical personnel.

Hence, it is critical for healthcare organization to be socially sustainable so that they can accomplish their role to medical personnel and the society at large. Poor administration of the government and lack of funding has rendered the public hospitals to be at the point of extinction. Therefore, the biggest challenge in the Nigerian health care service organization is the lack of policy formulation. According to Omoleke and Taleat (2001) the Nigerian Ministry of Health needs to formulate policies that are generated from the federal government and other agencies so that it can improve the society well-being.

Hence, the leaders of the health care service organization have the responsibility to overcome the brain drain syndrome and survive their business through social sustainability. In addition, medical personnel must stay in the country to fight for their own and society well-being. Therefore, brain drain syndrome creates a long term crisis for vulnerability and leads to challenges to overcome the long term society benefit.

5. Medical Personnel Brain Drain Syndrome in the Nigerian Context

In the bid to explain the brain drain syndrome in under-developed nations, Adesote and Osunkoya (2018) have revealed that in the last 30 years, the African continent as a whole has gradually thrown away skilled workforce to foreign countries especially in the health care sector. The Nigerian Medical association (NMA) has stated that Nigeria has a large population of 200 million citizens which will affect the number of medical personnel to manage patients in the next 15 years (Kareem, 2021). This unequal ratio of medical personnel to patients has led to poor quality of health care services. For example, research has recorded the low number of medical personnel to rate of mortality in Nigeria (Suleiman, Mikail, 2020). This low number is as a result of emigration of medical personnel for a better quality of life.

In the year 2021, the NMA denoted only a national budget of 7% approved for health care services which is below the 15% that has been approved and accepted by the World Health Organisation (WHO) and the African countries (Kareem, 2021). The NMA have reported that over 5000 medical personnel who are well-trained have migrated to the United Kingdom

between 2020 to 2022 which ranks Nigerian doctors as the highest number of emigrate in three years (Amorha, Irobi, Udoh, 2022). This situation has created a huge gap in the health care service organisation and caused that citizens have lost their trust for the sector.

Adesote and Osunkuya (2018) attributed reasons of brain drain syndrome in Nigeria. The push factors that are cited for medical personnel leaving are poor working conditions, infrastructural deficit for proper health care service, systematic breakdown of leadership while the pull factors that pull medical personnel away is the part of better career fulfillment, safe environment and better salaries or wages. O'Connor (2018) described factors that led to dissatisfaction, mental and emotional health drain such as inadequate communication, performance and inadequate opportunity for growth, excessive supervision, poor salaries and lack of recognition for their performance.

Therefore, brain drain syndrome is a threat to medical personnel physical and mental health (Ripp et al., 2020). Several researchers have suggested that the brain drain of the medical personnel are negatively influenced and call for need for the provision of innovative infrastructure, adequate salaries and wages, organizational support and security of the medical personnel (Ripp et al., 2020)

6. Methodology

This articles presents the outcomes of the analysis of selected scientific articles and their surveys and experiments on the topic of Responsible Leadership and Brain Drain Syndrome in Nigeria. Three articles are going to be analysed: "Challenges of Clinical Leadership in Nigeria"; "Exploring Issues and Challenges of Leadership among Early Career Doctors in Nigeria Using a Mixed-Method Approach: Charting Study"; and "Personnel brain-drain syndrome and quality healthcare delivery among public healthcare workforce in Nigeria".

The choice of the above mentioned articles was made because of their relevance to the topic of this article. Two first articles deal with the concept of leadership in the healthcare sector in Nigeria, and the last one provides an extensive description of the research on brain drain among healthcare personnel in Nigeria.

The analysis is divided into two parts, the first one demonstrates the results in terms of Brain Drain Syndrome in Health Care in Nigeria and the second one deals with Responsible Leadership in Healthcare sector in Nigeria based on the analysis and summary of collected data from above-mentioned articles.

7. Brain Drain Syndrome in Health Care in Nigeria

The research methods undertaken by Akinwale, O.E. & George, O.J. (2020) used in a study on the brain drain syndrome of Nigerian medical personnel in government hospitals in Lagos State are going to be discussed in this subchapter. The study employed a diagnostic research design, which aims to investigate the causes and relationships associated with the brain drain phenomenon. The design was chosen to understand the factors that led to the migration of Nigerian physicians and healthcare workers in these hospitals. The research focused on discovering associations between variables.

The population of the study consisted of several government hospitals in Lagos State, including Federal Medical Centres, Lagos, Lagos State University Teaching Hospital (LASUTH), Lagos University Teaching Hospital (LUTH), Federal Medical Centre (FMC), Lagos, and National Orthopedic Hospital, Igbobi, Lagos. The total population of medical staff in LASUTH and LUTH was 3,565 and 2,775, respectively, while FMC, Lagos State had a population of 1,200, and National Orthopedic Hospital, Igbobi, Lagos had a staff population of 1,250. Thus, the cumulative population for the study was 8,790.

To gather data, a probability random sampling technique was used among the participants in government hospitals. This technique ensured that all medical personnel in the population had an equal chance of being included in the study, allowing for a comprehensive representation of the population. The use of probability sampling also enhances the external validity of the study and enables generalization of the findings to a broader population.

The research was conducted in 2022 and as can be observed in the outcomes of the survey, 450 respondents took part in the survey and nearly half of them were men (46.7%) with a with a slight predominance of women (53.3%). In terms of education, 23.1% held a Bachelor's degree, 42.4% had a Master's degree, 18.2% were professionals, and 16.2% had a PhD. The age distribution shows that 34.4% of the respondents were between 20-30 years old, 35.4% were between 30-40 years old, and 30.2% were 40 years and above. Regarding work experience, 21.2% had 1-5 years of experience, 24.4% had 5-10 years, 21.3% had 10-15 years, 17.1% had 15-20 years, and 16% had 20 years or more. When it comes to professional length of service, 20.3% had 1-5 years, 24.2% had 5-10 years, 22.2% had 10-15 years, 21.3% had 15-20 years, and 12% had 20 years or more.

The survey included various professions, with physicians accounting for 31.6% of the respondents, nurses 34.9%, pharmacists 23.8%, X-ray operators 4.6%, and medical laboratory operators 5.1%. In terms of salary/income, 4.4% earned 1 million Naira, 31.6% earned 1-3 million Naira, 34.9% earned 3-5 million Naira, 23.8% earned 5-10 million Naira, and 4.6% earned 10 million Naira.

In terms of salary/income in Naira annually, 31.6% of the respondents earned 1 million, 34.9% of earned between 1 to 3 million, 23.8% had a salary/income ranging from 3 to 5 million. Furthermore, 4.6% of the respondents had a salary/income of 5 to 10 million and a small proportion of 5.1% of the respondents had a salary/income of 10 million Naira per year.

The analysis reveals that poor job satisfaction is the most influential predictor with a 34.8% level of prediction and a high degree of normalized importance. Poor quality of work life is another significant predictor, with a 30.1% level of prediction and a significant degree of normalized importance. Low remuneration is also a major concern, showing a 35.1% level of prediction and a maximum level of normalized importance. Overall, these variables indicate their association with brain-drain issues in the healthcare sector.

Based on the analysis undertaken by Akinwale, O.E. & George, O.J. (2020). Olusegun and Olusoji (2022) it can be concluded that poor quality work life as a predictor, poor job satisfaction as a predictor, and low wage/poor remuneration as a predictor, are all significant in influencing the brain-drain syndrome among medical personnel in Nigerian government healthcare facilities. The results of the hypotheses evaluation confirm the impact of the predictors on quality healthcare delivery.

The findings highlight the influential role of poor job satisfaction, poor quality of work life, and low remuneration in the brain-drain syndrome among medical personnel in Nigerian government healthcare facilities. These factors have a direct impact on the quality of healthcare delivery, emphasizing the need for addressing these issues to retain healthcare professionals and improve healthcare services.

The discussion of the findings highlights three key factors that contribute to the brain-drain syndrome among medical personnel in Nigerian government hospitals: poor quality work life, low job satisfaction, and poor remuneration.

Firstly, the study reveals that healthcare professionals in Nigeria face a poor quality work life, which drives many of them to seek opportunities in foreign countries where their skills and expertise are better appreciated. This negatively impacts both the healthcare workforce and the quality of healthcare delivery provided to the public. The study emphasizes the importance of improving the quality of work life for medical personnel, as it is crucial not only for their well-being but also for the overall quality of healthcare services. The study aligns with previous research that has highlighted the detrimental effects of inadequate work conditions on healthcare professionals and service delivery.

Secondly, the findings indicate that low job satisfaction among physicians in Nigerian government hospitals contributes to the insufficient quality of healthcare delivery. Medical personnel express dissatisfaction with their careers due to factors such as lack of autonomy and restrictive professional practices. The absence of recognition and rewards further exacerbates their discontentment. This study corroborates earlier research that has identified high levels of job dissatisfaction among healthcare professionals, linking it to negative patient outcomes and diminished healthcare service quality.

Lastly, poor remuneration and income serve as another significant factor contributing to the brain-drain syndrome among Nigerian medical personnel in the public health sector. The healthcare workforce often resorts to strikes to demand better pay and improved working conditions. The low wages demotivate medical professionals, leading them to seek higher-paying job opportunities abroad. Insufficient remuneration not only drives the brain drain but also hinders healthcare professionals from delivering quality services to patients. This finding aligns with other studies that have highlighted the role of low wages in demotivating the Nigerian healthcare workforce and promoting brain drain.

In conclusion, the study underscores the importance of addressing poor quality work life, low job satisfaction, and inadequate remuneration to mitigate the brain-drain syndrome and improve the quality of healthcare delivery in Nigerian government hospitals. By improving these factors, the healthcare system can retain medical professionals and enhance patient outcomes.

8. Responsible Leadership in Healthcare sector in Nigeria

According to Donald's article (2015) "Challenges of Clinical Leadership in Nigeria" in the Journal of Psychiatry, to unlock high performance in the healthcare sector, it is crucial to prioritize clinical leadership. This means involving clinicians in shaping and running clinical services, making it an integral part of their professional identity. Competency frameworks, such as the Medical Leadership Competency Framework in the UK, have been developed to support clinical leadership and can be used for empirical research. A functional health system is essential for delivering basic healthcare, requiring various components like human resources, transportation, ICT, facilities, and medicines.

Governments have a responsibility to ensure equitable healthcare with transparent leadership and effective governance. Legislation and regulation play a crucial role in supporting healthcare policies. Collaboration with communities, the private sector, civil society organizations, and development partners is necessary to create an environment conducive to good health and efficient healthcare delivery.

Despite the complexity of health systems, research suggests that clinical leadership has a positive impact on organizational performance. Hospitals with high clinician involvement in management have been found to outperform those with low clinical leadership. Studies have also shown that organizations with stronger clinical leadership are more successful in delivering service improvements. Involving clinicians in leadership and management leads to higher service performance, both clinically and financially. Clinicians' involvement becomes even

more challenging in times of economic recession, but their input is crucial for resource allocation and decision-making.

Governments, like in the US and UK, have recognized the importance of engaging clinicians and have implemented policies to promote clinical leadership. The emphasis on clinical leadership has proven successful in improving patient care. The continued focus on professionally-led healthcare is evident through initiatives like competency frameworks and the involvement of general practitioners in commissioning.

As Donald (2015) states, Nigeria can learn from successful healthcare institutions in developed societies and implement policies to prioritize clinical leadership. Despite progress in healthcare quality worldwide, transformation requires leadership, particularly from doctors and clinicians who make crucial decisions and possess technical knowledge for strategic service delivery choices. However, there are barriers to clinical leadership in Nigeria, including clinicians' suspicion about the value of time spent on leadership and the lack of recognition and training in leadership and management. Changing perceptions and highlighting the value of clinical leadership can encourage clinician involvement.

Building a credible evidence base and reorganizing incentives are also important. Organizations can track clinical leadership development and its impact on quality and costs, while rewarding high-performing institutions and creating consequences for underperforming ones. Professional development support should be provided, focusing on real work and addressing practical issues. Selective processes can emphasize the value of leadership programs and create a sense of prestige. Political interferences and challenges in policy formation and implementation need to be addressed to expand clinical leadership in healthcare management in Nigeria. Effective assessment and performance appraisal, along with a commitment to building high-performing organizations, are essential for sustainable quality care.

Another article that was analysed for the following study was "Exploring Issues and Challenges of Leadership among Early Career Doctors in Nigeria Using a Mixed-Method Approach: CHARTING Study" which presents the outcomes of the research undertaken by a group of scientists, i.a. Isibor et al. (2020) As the name of the article indicates deals with the topic of leadership among young professionals in the health sector.

This study utilized a mixed research method approach to investigate leadership among Early Career Doctors (ECDs) in Nigeria. It was part of a larger ongoing study called CHARTING. Qualitative data was collected through two focus group discussions involving 14 participants, while quantitative data was obtained from a survey of 474 ECDs in seven Nigerian hospitals using a self-administered questionnaire. The participants were recruited from hospitals in different geographical zones in Nigeria.

The results of the qualitative analysis revealed four main themes related to effective clinical leadership and its impact on hospital performance. These themes were perception, experience, types of leadership skills, and recommendations. The participants expressed varied views on leadership, with some considering it an innate quality or a bestowed responsibility, while others

viewed it as a passion for making a positive change and contributing to the healthcare system. The findings were supported by quotes from the participants and were attributed to the following categories:

1. General View/Perceived Attitude Towards Acquiring Leadership Skills:
   a) Inborn Quality and Bestowed Responsibility;
   b) Passion to Make a Notable Change;
2. Experience of Leadership Positions in Medical and Clinical Settings:
   a) Challenging Experiences;
3. Types of Leadership Skills Essential in Clinical Settings:
   a) Communication Skills;
   b) Listening and Decision-Making Skills;
   c) Integrity and Being Unbiased;
4. Recommendation:
   a) Curriculum Review

This questionnaire survey was conducted among Early Career Doctors (ECDs) in seven selected hospitals in Nigeria. The survey included 474 out of a total of 2,317 ECDs, representing about 20.5% of the population. The majority of these hospitals (4 out of 7) were located in the South-West region of Nigeria. A significant portion (83.6%) of the surveyed ECDs were affiliated with hospitals in the South-West. The gender distribution of the respondents was skewed, with 67.3% being males. Most of the respondents (62.4%) were married, 36.1% were registrars, and on average, they had spent 3.3 years in their current job position.

The survey revealed that 91.1% of the respondents considered leadership and management skills important for doctors. However, only 55.9% of them had received training on management and leadership. Among those who received training, the majority (38.1%) received it while in medical school. About half of the respondents (52.7%) had assumed leadership roles in their medical practice.

When it came to challenges faced in leadership positions, the most common issue reported by over a third of the respondents (36.8%) was a lack of understanding from other members of the management team. However, senior colleagues and fellow trainees were identified as the most helpful sources of support when engaging in leadership and management roles.

The survey data analysis also showed that respondents' opinions on the importance of leadership and management skills, the incorporation of skill acquisition programs into medical training, and their preferred sources of acquiring these skills were significantly related to their consideration of leadership and management skills as important for doctors.

The authors of the article indicate that in the 21st century, doctors are expected to possess not only clinical skills but also strong administrative and managerial abilities. Effective clinical leadership is crucial for optimal hospital performance and is an integral part of the healthcare system. However, the Nigerian healthcare system has long been plagued by poor administration and leadership, leading to industrial actions and unrest. To address this, it is essential to develop

clinical leadership skills among Early Career Doctors (ECDs) and other healthcare professionals.

Despite the recognition of the importance of effective clinical leadership, there are significant barriers preventing ECDs from participating in leadership roles. Only a small fraction of ECDs in Nigeria show interest in such positions, and not all have access to leadership training programs that can prepare them for the demands of modern healthcare.

The challenges faced by ECDs in leadership positions include a lack of training experience, confidence, support from colleagues and senior doctors, understanding from the management team, and overall support. To overcome these challenges, it is crucial to provide targeted leadership skill acquisition training for ECDs and medical students. Currently, the postgraduate medical specialist training program focuses primarily on clinical knowledge and skills, with limited attention to leadership and management training.

Efforts should be made to incorporate leadership training modules into both undergraduate and postgraduate medical curricula. Encouraging ECDs to pursue master's degrees in medical leadership, health policy, or health management and establishing professional bodies for physician/surgeon leadership training and accreditation can also be beneficial. Leadership skills such as communication, decision-making, and integrity should be emphasized in these training programs.

Multidisciplinary leadership training should not be limited to ECDs but extended to other healthcare professionals to facilitate better communication and collaboration. Structured training platforms, including online lectures, webinars, classroom lectures, and role-playing methods, should be implemented to enhance leadership skill development in clinical settings.

Promoting leadership responsibilities for ECDs during their career progression can boost their confidence and foster a team-building spirit. This training is essential for those planning to pursue private medical practice after completing their specialist training.

While this study had limitations, its findings contribute valuable knowledge about leadership and ECDs in Nigeria. Further research and funding are needed in this under-researched area. The insights gained from this study can guide policymakers in addressing the challenges faced by ECDs and improving leadership roles in Nigerian healthcare settings.

9. Summary of Findings

The article is based on experiments undertaken by various scholars and their outcomes. The study is focused on the Nigerian context, and its findings may have limited generalizability to other countries or regions in terms of responsible leadership and brain drain syndrome.

The research findings on the brain drain syndrome in healthcare in Nigeria reveal several significant factors contributing to the migration of medical personnel from government hospitals in Lagos State. The study focused on understanding the causes and relationships associated with brain drain and its impact on healthcare delivery. The key findings are as follows:

1. Demographic Profile: The study included 450 respondents, with a slight majority of women (53.3%). The age distribution showed that a significant portion of the respondents were between 30-40 years old (35.4%). The majority of respondents held a Master's degree (42.4%) and had 5-10 years of work experience (24.4%).
2. Professions and Salary: Physicians accounted for 31.6% of the respondents, followed by nurses (34.9%), pharmacists (23.8%), X-ray operators (4.6%), and medical laboratory operators (5.1%). The majority of respondents (34.9%) earned a salary/income ranging from 1-3 million Naira annually.
3. Predictors of Brain Drain: The analysis identified three significant predictors of brain drain syndrome: poor job satisfaction (34.8%), poor quality of work life (30.1%), and low remuneration (35.1%). These factors were strongly associated with the brain drain phenomenon in Nigerian government healthcare facilities.

Based on these findings, it can be concluded that the brain drain syndrome among medical personnel in Nigerian government hospitals is influenced by poor job satisfaction, poor quality of work life, and low remuneration. These factors negatively impact the healthcare workforce and the quality of healthcare services provided to the public.

The study undertaken by Olusegun and Olusoji (2020) provides valuable insights into the factors contributing to the migration of medical personnel in Nigeria, however there are some limitations. First of all, the experiments took place in Lagos State, which may not be representative of the entire healthcare system in Nigeria. The findings may not fully capture the experiences and perspectives of medical personnel in other regions of the country. The authors mention a population of 8,790 medical staff, however the final sample size includes 450 respondents who participated in the survey. The study primarily relies on quantitative data and does not incorporate in-depth qualitative analysis. Moreover, it would be beneficial to compare the brain drain syndrome in Nigeria with other countries or explore potential differences in push and pull factors affecting medical personnel migration. Such comparisons could have provided a broader context for understanding the issue.

To address the brain drain syndrome and improve healthcare delivery, it is crucial to prioritize interventions that enhance job satisfaction, improve the quality of work life, and provide better remuneration for medical professionals. By addressing these factors, the healthcare system can retain healthcare professionals and ultimately enhance patient outcomes.

Moving on to the topic of responsible leadership in the healthcare sector in Nigeria, the research emphasizes the importance of clinical leadership in unlocking high performance in healthcare. Clinical leadership means involving clinicians in shaping and running clinical services, making it an integral part of their professional identity.

The research led by Isibor et al. (2020) focuses on clinical leadership in Nigeria and its impact on healthcare performance. One limitation is that the research primarily relies on qualitative data from focus group discussions and self-administered questionnaires and the sample size for the survey is relatively small which may introduce bias. Moreover, the research mainly explores the perspectives and experiences of Early Career Doctors (ECDs), potentially overlooking the viewpoints of other healthcare professionals.

Donald' s article (2015) emphasizes the importance of clinical leadership in the healthcare sector but lacks empirical research or specific studies to support its claims. Nevertheless, the study by Isibor et al (ibid.) and Donald (2015) suggest that clinical leadership has a positive impact on organizational performance and can lead to improved patient care. However, there are barriers to clinical leadership in Nigeria, such as clinicians' suspicion about the value of leadership, lack of recognition and training in leadership and management, and challenges in policy formation and implementation.

To promote clinical leadership in Nigeria's healthcare sector, the study recommends implementing policies that prioritize clinical leadership, providing training and support for clinicians in leadership and management, building an evidence base to track the impact of clinical leadership on quality and costs, and addressing challenges in policy formation and implementation.

In conclusion, the findings underscore the need to prioritize clinical leadership and address barriers to leadership development in Nigeria's healthcare sector. By fostering effective clinical leadership, the healthcare system can improve organizational performance, enhance patient care, and achieve sustainable quality care. Comprehensive interventions considering multiple factors are necessary to mitigate the brain drain syndrome effectively.

The research findings can guide the development of policies and interventions to address poor job satisfaction, work-life balance, and remuneration in the healthcare sector. The above mentioned articles contribute to the ongoing discourse on healthcare leadership and brain drain and can inspire further research and initiatives in the field.

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APPLYING VIDEO GAME MOTIVATION FOR CREATING ENGAGING EDUCATIONAL ACTIVITIES

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Purpose: The aim of this article is to analyze students' preferences and motivations regarding video games and present ideas and opportunities to improve education.
Design/methodology/approach: The author conveyed a survey among students from the Silesian University of Technology and compared the results with data from more than 1.25 million gamers from all over the world.
Findings: Most students are very interested in virtual games and it presents the possibility to increase engagement in classes.
Research limitations/implications: Better results would be achieved if students from more faculties participated in the survey.
Practical implications: The author hopes that this article will inspire lecturers to use presented class ideas and come up with more creative and interactive tasks during lectures to better connect with the new generation of gamers and to make classes more engaging and educating.
Social implications: The author hopes that society will see the impact and usefulness that virtual games have in modern times and that it is a medium worthy of attention, cognition, and use.
Originality/value: The author saw an opportunity to improve education through the use of a large database of gaming preferences. This research paper is addressed to lecturers and gamers.

Keywords: game, motivation, player, student, education.

Category of the paper: Research paper.

1. Introduction

The video game market is developing intensively. Millions of people around the world play video games every second (Vigato, Babić, 2021). Esports has been growing at a great rate throughout the world and the gaming industry is predicted to continue to grow (Palma-Ruiz et al., 2022). The entertainment industry is developing at a very fast pace; new branches of the video games industry are being created, e.g., mobile games and virtual reality games, which are

introducing new unique solutions and mechanics each year (Stecuła, 2022). Over the years, the methods, ways, and techniques of playing video games have changed significantly. Players use various mobile devices to play on the go using a laptop, tablet, handheld console, or smartphone, which can also be used in education (Gao et al., 2020). In modern times, players can also play online cooperating or competing with other players from around the world in real time. The video game industry is very profitable and popular, but still little research has been undertaken on the subject of esports, as Young Hoon Kim mentions while presenting the possible direction of development (Kim et al., 2020).

Computer games are becoming a respected medium, which is the subject of many scientific dissertations and is used both in business, education (Dinis et al., 2017), and in mental health improvement (Xu et al., 2021). This was particularly noticeable during the Covid-19 pandemic, as online games allowed one to maintain social contacts (Chen, 2022).

Today, young people have a different lifestyle than previous generations. Modern man uses mobile devices, reacts to stimuli, and uses information and data that are provided to him in an instant. Therefore, companies compete with each other to get the attention of people. The modern young person uses very fast and short content and does not focus for long. Some students who go through the deluge of one-minute content may have problems concentrating on a long lecture lasting 3 hours (Faradis, Reksiana, 2022). Therefore, the subject of this article is an attempt to take into account the gaming motivation of modern man when conducting classes and to present ideas that can contribute to the development of modern teaching methods, thus increasing the attractiveness and efficiency of learning in a university.

This article is based on available findings obtained from the Quantic Foundry survey of more than 1.25 million players around the world, but in order to focus on students, I distributed similar survey among students of the Silesian University of Technology, thanks to which I obtained not only a comparison between students, but I also compared their results with the rest of the world.

2. Methods

2.1. Original survey

Thanks to my interest in the development of the video game market and research carried out on them, I found an interesting survey about the motivation of computer players and decided to use the publicly available results to conduct a similar study on students of the Silesian University of Technology (SUT). The original survey was created by Quantic Foundry and is available on their website (Quantic Foundry, 2023). After providing our basic personal data in the form of gender and age, we get 6 questions about our habits from playing virtual games,

i.e., computer, console, mobile, virtual reality games, and about our last favorite games played. Then we answer 16 questions in which we declare what is important to us in games, then there are 17 questions about what we enjoy in games, and finally we mark the answers to 7 questions about our game behavior. After completing the entire survey, we receive our type of player and percentage results, which means what percentage of players are less motivated by each of the 6 motivation groups. The division into motivation groups is as follows:

- Action.
- Social.
- Mastery.
- Achievement.
- Creativity.
- Immersion.

Each of these six groups consists of two secondary motivations presented in the table below (Table 1).

Table 1.
Motivations and secondary motivations

Motivation	**Secondary motivations**	
Action	Excitement	Destruction
Social	Competition	Community
Mastery	Challenge	Strategy
Achievement	Completion	Power
Creativity	Discovery	Design
Immersion	Fantasy	Story

Source: Own study.

Each secondary motivation has listed few representations among popular games (Quantic Foundry, 2023):

- Action:
  - Excitement: adrenaline rush in Halo, Street Fighter, or Injustice.
  - Destruction: eruptions in Call of Duty, or Battlefield.
- Social:
  - Competition: matches in Starcraft, or League of Legends.
  - Community: multiplayer in Portal 2, or Mario Kart.
- Mastery:
  - Challenge: practicing skills in Dark Souls.
  - Strategy: planning in XCOM, Civilization, or Europa Universalis.
- Achievement:
  - Completion: collecting costumed in World of Warcraft.
  - Power: acquiring powerful weapons in RPGs, or action games.

- Creativity:
  - Discovery: exploration in MMO, or MineCraft.
  - Design: customization in Mass Effect.
- Immersion:
  - Fantasy: immersion in Skyrim, Fallout, or Mass Effect.
  - Story: narration in The Last of Us, or BioShock.

In addition to the motivation profile, respondents also get a list of games that they may enjoy based on the results of their surveys.

2.2. Player game motivation research

Research on player motivation began as early as 2005 thanks to Nick Yee, who has founded Quantic Foundry and started intensively developing motivation concepts in 2015. His most cited work 'Motivations for Play in Online Games' was published already in year 2006 (Yee, 2006), and his work grew from data from 3000 MMORPG players to more than 1.25 million diverse players from all over the world as of year 2023. He published dozens of papers on video games, with the last publication 'Gamer motivation profiling: Uses and applications' released in 2018 (Yee, 2018). He has also tackled the subject of how games influence business and education in his book 'The Proteus paradox: How online games and virtual worlds change us-and how they don't' (Yee, 2014), which encourages learning from the game industry and inspires the improvement of education methods, which is closely related to the discussion of this conducted research.

To this day there have been many scientific publications based on his work. Many works such as 'Differences in students' stem identity, game play motivations, and game preferences' by Kathleen S. Jeremiassen were studying connections between STEM identity of students and game play motivations (Jeremiassen, 2018). Sofia Sabrini examines associations of those Gamer Types with narrative preferences (Sabarini, 2021). Based on the Quantic Foundry Survey, Matija Vigato and Tihana Babić conducted a survey on Algebra University College students (Vigato, Babić, 2021). A similar survey was also conducted on Australian Mobile Gamers (Greenwood et al., 2020).

2.3. Gamer Types

The original survey always returned one main Gamer Type, but when the responses were defining values of two Gamer Types, the secondary type was also presented. In my version of the survey, I was only asking about the primary result.

Here are the defining motivations of the 9 Gamer Types distinguished by Quantic Foundry (Quantic Foundry, 2023):

- Acrobat – challenge and discovery.
- Architect – strategy and completion.

- Bard – design, community and fantasy.
- Bounty Hunter – destruction and fantasy.
- Gardener – completion.
- Gladiator – challenge, completion and community.
- Ninja – competition and challenge.
- Skirmisher – destruction and competition.
- Slayer – fantasy, story and destruction.

The combination of the primary player type with the secondary type allows one to get 81 unique combinations of player types to be distinguished.

2.4. Created survey

To compare the motivation of SUT students with the rest of the world, I created my own survey, consisting of 10 close-end questions, to collect this information (Table 2):

- Gamer Type (answers: Acrobat, Architect, Bard, Bounty Hunter, Gardener, Gladiator, Ninja, Skirmisher, Slayer).
- Six questions about score in each main motivation category.
- How many days a week do you play for at least half an hour (answers: 0-1, 2-3, 4-5, 6-7).
- Gender (answers: Man, Woman).
- Age (answers: 0-17, 18-25, 26-35, 36-53, 54+).

Table 2.
Example of collected answers

Question	Answer
Gamer Type	Bounty Hunter
Action (%)	69
Social (%)	2
Mastery (%)	32
Achievement (%)	42
Creativity (%)	24
Immersion (%)	54
Days a week	6-7
Gender	Man
Age	26-35

Source: Own study.

Completing the created survey consists of solving the original Quantic Foundry survey (5-7 minutes) and answering the survey created by me using the percentage answers obtained in individual categories (3-5 minutes).

2.5. Survey population

The survey was created using Google Forms and sent to more than 220 students from a few classes of the Faculty of Applied Mathematics and the Faculty of Organization and Management to complete the survey during classes or at home. Therefore, 107 survey responses were obtained during a few months, from December 2022 to March 2023.

3. Results

3.1. Review and data correction

Blank fields have appeared in several responses; however, even if someone did not provide percentages of motivation, their answers were still used to study associations about Gamer Type, gender, and weekly frequency of play.

One survey was incorrectly filled out for a joke, where the percentage data exceeded 100. The other responses contained values in the range of 0-100. Some text fields required manual removal of the percent sign.

3.2. Examination of the form of the original quiz

To verify whether some respondents decided to answer all questions with a neutral value of the five-point scale (middle answer), I carried out such a simulation and obtained the values presented in Figure 1. As you can see, these are not 50% values because respondents most often answered the questions with positive motivation feedback. In two categories, the average answers gave very low scores, which means that players from all over the world highly value Immersion and Creativity in computer games.

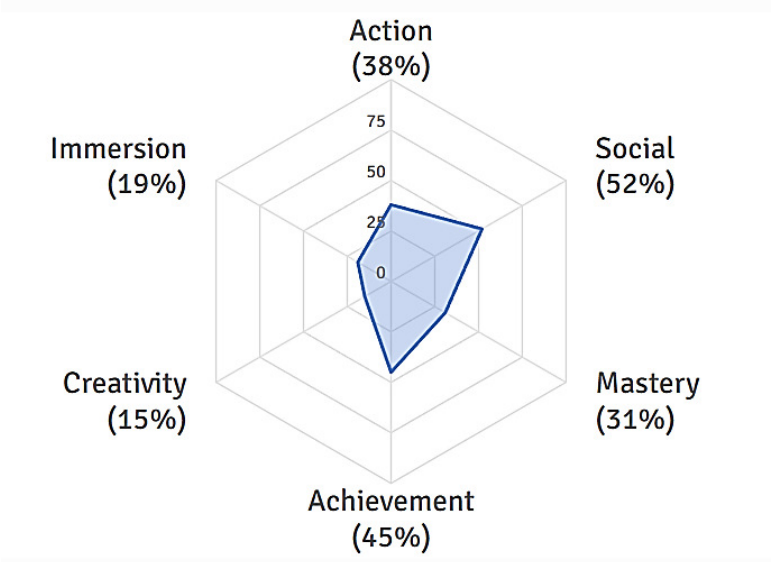

Figure 1. Scores obtained by choosing always the middle, neutral answer from the Quantic Foundry survey.

After reviewing the data that I obtained from the students, it turned out that I did not get such responses. I also did not get all the 0% or 100% answers anywhere. After such a verification of the data, the answers can be considered correct, so I used all the other data.

3.3. Motivation scores

The first analysis was to compare the motivation scores between the surveyed students, the male students, the female students, the global average score (always 50%) and the score obtained by giving neutral responses (Figure 2).

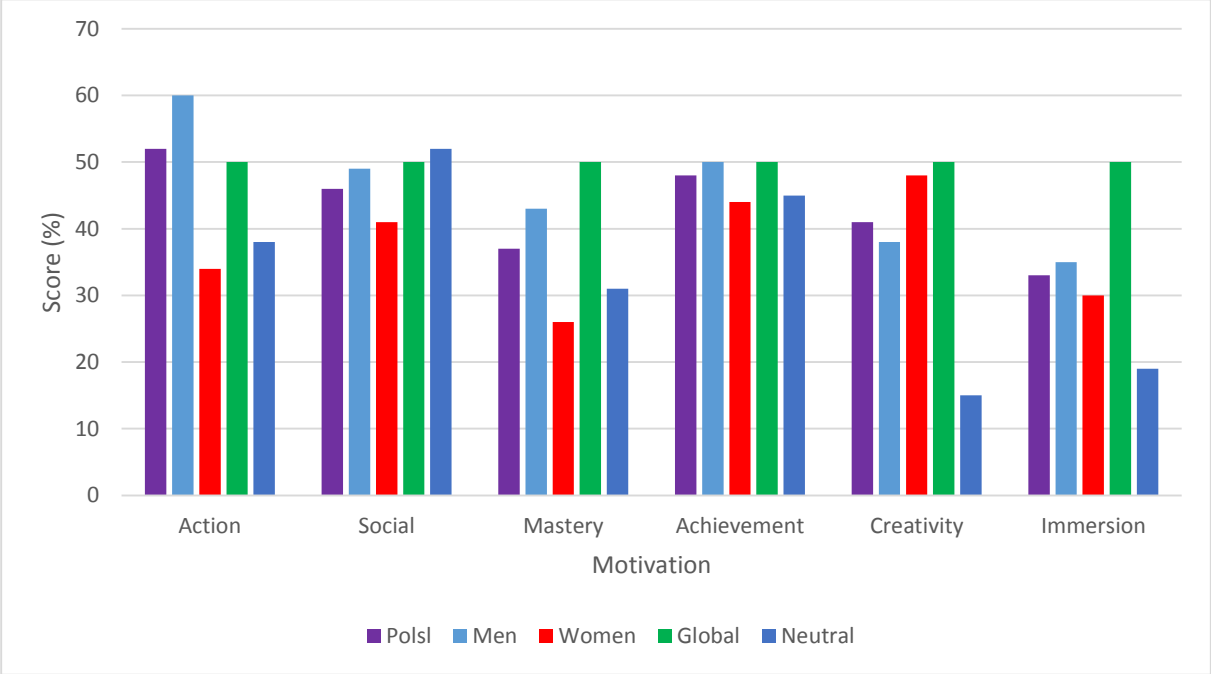

Figure 2. Comparison of motivation scores between surveyed students (n = 101), male students (n = 69), female students (n = 31), global median score (always 50%) and score obtained by giving neutral responses.

The comparison shows that our students are less motivated to play video games than the rest of the world in 5 out of 6 categories.

In Action I obtained diverse responses because that was the only category in which male students tended to score higher than the global average. Female students gave responses that were below neutral.

The Social category obtained results that suggest that there is a low motivation for both players from Silesian University of Technology and from all over the world, because that is the only category in which neutral responses gave a score that is above 50%.

In the Mastery and the Achievement categories, male students tended to respond similarly to the global average, and female students slightly less.

Despite obtaining in the last two categories scores lower than 50%, Silesian University of Technology students rated Creativity and Immersion as highly motivating (41% and 33%), which can be seen in comparison to neutral responses (15% and 19%) but less motivating compared to the rest of the world.

The next figure presents the correlation between motivation scores in each category with respect to weekly playing frequency (Figure 3).

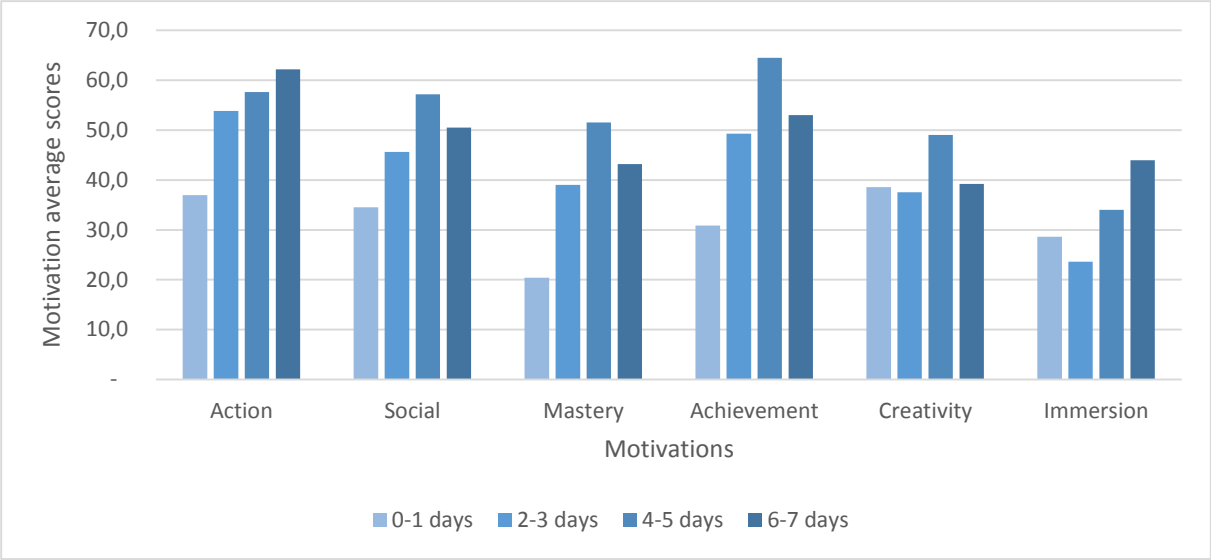

Figure 3. Comparison of motivation scores in regard to the number of days of play in a week.

It can be seen that in most categories the highest motivation scores occurred when playing 4 to 5 days a week, except for the Action and the Immersion category, where the highest motivation takes place when students play every day or almost every day.

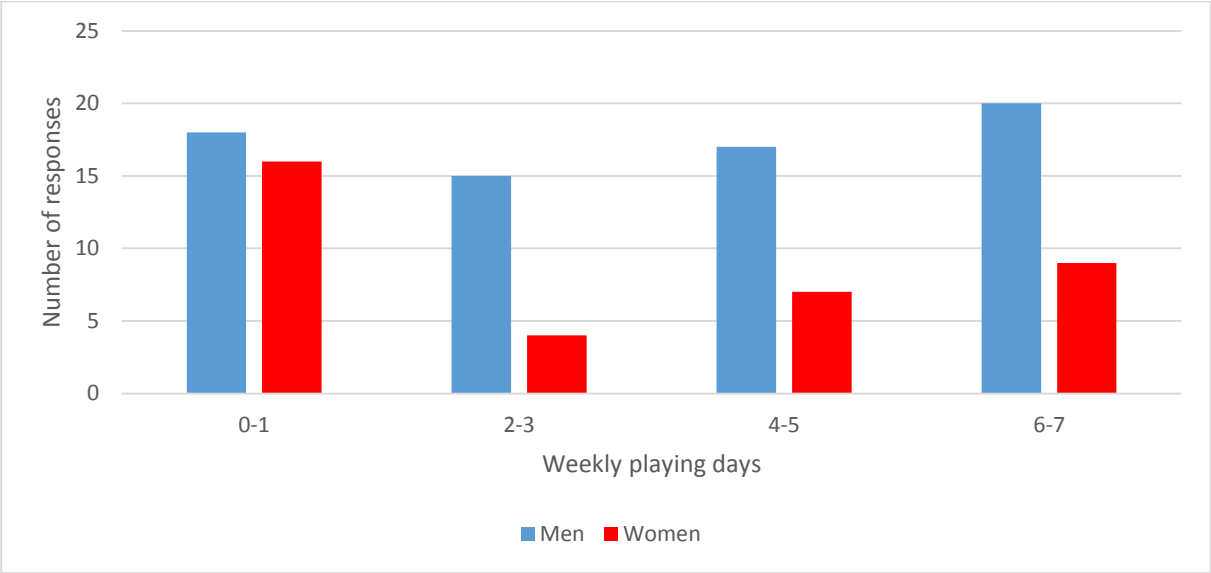

Figure 4. How often do students play video games per week broken down by gender.

It is also worth noting that many students tend to play very frequently or do not play at all, this can be seen especially among female students (Figure 4).

3.4. Gamer Types

Each set of unique motivation scores translates into one of nine types of player (Figure 5).

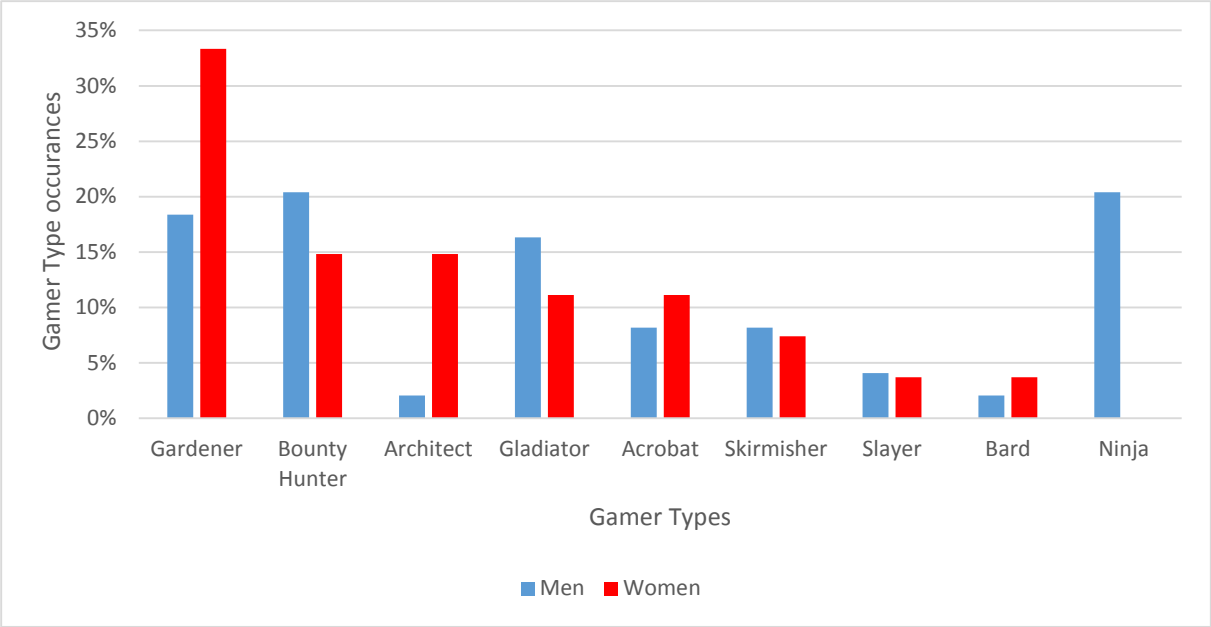

Figure 5. The Gamer Type frequency broken down by gender, sorted descending by the women scores.

The first observation is that female students have the highest agreement on choosing the most common category, which is the Gardener with a score of 33%, while the highest score among men is ex aequo the Ninja and the Bounty Hunter with a score of only 20%. Men group is more diverse because it obtained representants of all categories while among women there was no occurrences of the Ninja Gamer Type between all 34 responders.

The two biggest differences, beside named the Gardener Game Type, are shown on the example of the Ninja, which was the most frequent category among men compared to the least frequent category among women, and the Architect, which was the least popular among men and the second most popular among women.

4. Discussion

4.1. Survey improvement ideas

The survey in its current form can be considered a pilot study, which allowed to obtain an indicative, approximate picture of the issue against the background of the survey results. In the second version of the survey, more answers could be obtained from more departments, and additional questions on secondary motivations could be inserted, which will also allow you to verify the correctness of the entered data, because the value of the primary motivation score value must always be between two secondary motivation scores.

A Jotform survey (Jotform, 2023) could be used to make use of an analog scale in the form of a slider with values from 0 to 100, to make typing easier and so that you do not have to correct mistyped data, although then it will be more difficult to sift out data filled in for a joke.

One might consider discarding data with a lot of 0% responses for people not interested in games, because it is reasonable to assume that there were very few people not interested in games who filled out the original survey, which was dedicated specifically for enthusiast gamers.

You can also additionally verify and reject responses that contain suspicious features such as too many values divisible by 10. In the current version, they were not rejected because they could simply be explained by fair answers being rounded by the respondents, but next time one should ask such people to confirm the reason for filling data that way.

4.2. Global data

To obtain more precise and specific data, I have written a request for Quantic Foundry to share their survey data from over 1.25 million players, but I was refused on the grounds that their data is sold to gaming companies and cannot be published. However, the public data provided sufficient information to conduct this investigation.

4.3. Gamer Types

The most dominant secondary motivation among female students was the Completion. It was a dominant motivation in three out of four most popular Gamer Types (Gardener, Architect, and Gladiator). There was no such clear dominant secondary motivation among male students, but the Completion and the Challenge occurred twice in four most popular Gamer Types. Therefore, the potential way to increase motivation of students during classes may be by assigning students cognitive tasks which allow them to get improved repeatedly to obtain a flawless result. However, making use of the Challenge motivation discovery, it is recommended to give one subpoint or a special task that will be an additional challenge, which will allow students to collect additional points or allow them to gain some benefit of another kind, such as a free hint during the next test.

4.4. Ideas for harnessing video game solutions to conduct classes based on personal thoughts and experience

The author successfully introduced many modern and game-like activities to classes, which resulted in great popularity, interest, commitment, and positive reaction among students. The following are already tried and there are some new ideas which were inspired by the results obtained during this research. These ideas can be divided into 6 categories in relation to the motivation that contributed the most to the creation of the idea:

- Action – Adding surprising questions to increase concentration. To create a positive tension, the lecturer can make use of time-limited quizzes during tests or during casual activities using free tools like Kahoot or to give a point to the first person answering correctly to a given question. The Action motivation category presents the largest difference between the average score of male and female students. Men could

statistically be less stressed while the group focus is on them and they are in the center of the room. It is worth noting that a more shy person could feel aggrieved, so this should not be a main type of activity to gain points and grades.

- Social – Introducing group projects. Presenting exam preparation materials in the form of a list of topics that could be developed together by a group.
- Mastery – Encouraging correction of errors in submitted reports, documentation, and even tests and exams to practice and correct the mistakes made.
- Achievement – Including catchy questions on tests that encouraged careful reading and active thinking while solving it. Providing points for noticing errors. Adding a special, more difficult sub-point to let students differentiate themselves from the group, earn bonus points, grades, or a special profit such as a free hint during the next test or an allowance to postpone a homework assignment.
- Creativity – Introducing tasks that have no rigid rules and let students come up with their own topic regarded to the subject and develop it in the most interesting and creative way.
- Immersion – Interactive and colorful questions in various forms, such as dragging responses to fit the text. Using interactive online quizzes on Brilliant (Brilliant, 2023) that grant points for responding correctly, counting the daily learning streak, and congratulating on another day of learning. Many times, students voluntarily did not leave the class after the end because they did not finish the extra-compulsory courses, which may indicate high immersion.

In many video games, there is also a highly controversial topic discussed regarding the gambling aspect of loot boxes (Czerska, Majerska, 2023). It could be used to encourage students to optional activities, such as filling out an Education Quality Survey by rewarding one randomly selected participant with an additional point for the activity. However, this is not always recommended because not selected students may feel treated unfairly. The use of this method should be considered for each group individually.

5. Summary

Students of the SUT are highly interested in virtual games, but they have a slightly different average score in gaming motivation from the rest of the world.

The research required conducting a survey among students, an extensive review of the data to screen out the erroneous ones, analysis, and coming up with conclusions on the application of the acquired knowledge to improve the state of teaching at the SUT.

Data obtained during this research shows that students are highly engaged in virtual games thanks to six main motivations. The difference between male and female students was visible, but conducting a survey on a larger population would be advised. However, conducting a survey on students of the entire university of technology is a time-consuming and problematic task due to the fact that not all students are willing to fill in questionnaires. The next version of the survey could include questions about secondary motivations which will help to verify the correctness of the students' answers.

Motivations presented in this study can be easily adapted from the video game industry to education by conducting classes that let students become more engaged in many ways presented in the previous section. Some ideas were already introduced and have already received a positive response from students.

One can hope that thanks to more research conducted on computer games, it will be possible to continue raising the level of education at Polish universities.

Acknowledgments

Quantic Foundry created a professional survey that was used as a comparison to the results obtained from the students of SUT. Unfortunately, they did not want to share the private part of their data because their business model depends on selling this collected user data to companies that create computer games.

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ANALYSIS OF THE IMPORTANCE AND CHANGES OF STAKEHOLDERS USING THE EXAMPLE OF A UNIVERSITY-BASED SPECIAL PURPOSE ENTITY

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Purpose: The purpose of this article is to analyse the importance and changes of stakeholders using the Mitchell, Agle and Wood model with the example of a university-based special purpose entity (SPE).
Design/methodology/approach: A review of national and international literature has helped to demonstrate the theoretical basis for the application of stakeholder theory based on the Mitchell, Agle and Wood model. In addition, research material collected during a qualitative study conducted among university-based SPEs in Poland and secondary material on these entities was used. Based on the analysis of the content of the interviews, conclusions were prepared on the use of stakeholder analysis of relevance and change in university-based SPEs.
Findings: The article shows an analysis of stakeholders – their importance and possible changes – using the example of a university-based SPE as an interesting research subject in terms of stakeholder diversity and the challenges involved.
Research limitations/implications: Further research into the use of the Mitchell, Agle and Wood model in university-based SPEs could be enriched by grading individual attributes to further analyse the importance and dynamics of the impact of different stakeholder groups on the organisation.
Practical implications: Stakeholder analysis using the Mitchell, Agle and Wood model can provide a tool to support the management of university-based SPEs in developing appropriate – value-adding – stakeholder relationships.
Originality/value: The article fills a research gap in the area of the management of university-based SPEs, in particular in the analysis of the relevance and possible changes of stakeholders as a tool to help develop appropriate stakeholder relations.

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

Keywords: university-based special purpose entities (SPE), stakeholders theory, stakeholder salience model.

1. Introduction

Changes in the way organisations were approached created the bases for the creation of stakeholder theory in the 1960s at the Stanford Research Institute (Freeman et al., 2020). According to the Penrose (1959) approach, an organisation is a collection of resources and relationships between the units of the organisation and between the organisation and individuals or groups of the environment. In such an arrangement, the importance of the strategic perspective and decision-making system is emphasised (Valentinov, Chia, 2022; Tantalo, Priem 2016; Freeman 1984). It is crucial in the functioning of an organisation to take into account the needs and expectations of many different groups of actors, cooperating but also competing and creating expected values for them (Hall et al., 2015).

Freeman (1984), in laying the theoretical foundations of stakeholder theory, defined a stakeholder as any group or individual who influences, or is influenced, by the achievement of a company's objectives. The literature also includes the concept of key stakeholders attributed to groups or entities essential to the survival of an organisation (Tantalo, Priem 2016; Freeman, 2010; Parmar et al., 2010). In addition, attention is drawn to the ways of managing relationships with a wide range of stakeholders (Freeman et al., 2010, Savage et al., 1991). From the 1980s onwards, stakeholder theory has been increasingly gaining use in organisational practice among managers (Mascena, Stocker, 2020), which may be due to the pragmatic nature of stakeholder theory, close to practical problems (Grucza, 2019). The evolution of stakeholder theory has addressed, among other issues: how to classify stakeholders, how to determine which groups are more important to an organisation than others, and which strategies should be implemented towards particular stakeholder groups (Mascena, Stocker, 2020).

There are many divisions and stakeholder models, including:

- primary stakeholders and secondary stakeholders (Clarkson, 1999),
- internal stakeholders and external stakeholders (Stoner et al., 2001),
- the stakeholder model, taking into account two dimensions: the potential to cooperate and the potential to threaten, divides stakeholders into: supportive, key, non-supportive, marginal (Savage et al., 1991),
- among external stakeholders: economic stakeholders, technological stakeholders, social and political stakeholders (Johnson et al., 2008).

Mitchell, Agle and Wood (1997) classify an organisation's stakeholders according to the number and combination of attributes they possess. These attributes are as follows:

- The power manifested in the ability to push through one's own opinion against resistance. It can occur under three types as coercive power (posing a direct threat, e.g. with physical force, strike, sabotage), utilitarian power (resulting from the stakeholder's possession of resources, e.g. financial resources, specific competences), normative power (resulting from the possession of symbolic resources, e.g. authority).

Power can come from within the organisation (e.g. formal authority derived from hierarchy) as well as from external stakeholders (e.g. control of strategic resources by funding institutions, possessing knowledge and skills by strategic partners).

- Legitimacy manifested in the legality of the demands made by the stakeholder on the basis of a legal, administrative or contractual relationship, as well as moral rights or social responsibility.
- Urgency is a two-element construct, consisting of time sensitivity and criticality of the claim for the stakeholder, and is therefore a measure of the determination of the demands being made, while determining their validity from a stakeholder perspective.

Based on the Mitchell, Agle and Wood model (the MAW model), it is possible to identify stakeholders with one attribute each - latent (3 groups: dormant, discretionary and demanding), combinations of two attributes - expectant (3 groups: dominant, dangerous and dependent) and so-called definitive stakeholders with a package of three attributes (Table 1). The model can be used to analyse the importance of stakeholders, where according to the model's general statement, the essence of the stakeholders is positively related to the cumulative number of attributes they possess. Due to the above, the more attributes that characterise a relationship with a particular stakeholder group, the more attention should be paid to establishing and maintaining a relationship with that stakeholder group (focusing on meeting its expectations). The MAW model helps to understand how managers perceive their stakeholders and enables more informed management of stakeholder relationships (Wood et al., 2021). Many researchers (e.g. Hall et al., 2015; Parent, Deephouse, 2007; Freeman, 1984) emphasise the critical importance of stakeholder identification and prioritisation when it comes to stakeholder management. Determining the importance of stakeholders is the starting point for developing a strategy applicable to specific stakeholder groups. The MAW model is supported empirically, because since the first study by Agle, Mitchell and Sonnenfeld (1999), many researchers have applied it to different situations (e.g. Konaty, Robbins (2021); Magness (2008); Parent, Deephouse (2007), Heaton et al., 2012). The impact of the MAW model on the development of the Stakeholder Circle model (Bourne, Walker, 2006) and the stakeholder matrix model (Johnson et al., 2008) can be noticed.

Table 1.
The Salience Model for Stakeholder Classification

Class of Stakeholder		Attributes	Level of Salience
Definitive Stakeholders	Definitive	Power, legitimacy and urgency	High
Expectant Stakeholders	Dependent	Legitimacy and urgency	Moderate
	Dangerous	Power and urgency	Moderate
	Dominant	Power and legitimacy	Moderate
Latent Stakeholders	Demanding	Urgency	Low
	Discretionary	Legitimacy	Low
	Dormant	Power	Low

Source: Khurram, Pestre, Charreire-Petit, 2019.

Relationships between an organisation and its stakeholders occur on the basis of mutual expectations (Austen, Czakon, 2012). These expectations are not fixed and their varying nature makes it necessary for organisations to have an ongoing dialogue with the stakeholders (Langrafe et al., 2020). The MAW model is a tool that addresses the need for continuous monitoring of stakeholder expectations and analysis of their impact on organisational performance. The dynamic nature of the model is caused by the variability of the attributes, which are impacted by variables such as, for example, the life cycle of an organisation, its position in the industry, coalition building between the stakeholders, and access to resources of both the organisation and the stakeholders (Wood et al., 2021). Individual stakeholders may gain further attributes or form a coalition with another stakeholder group, or, conversely, lose an attribute or alliance they previously held (Wood et al., 2021). Accordingly, the level of stakeholder materiality is transient and, like the stakeholders' expectations, it changes over time (Magness, 2008). Analysing the potential changes in stakeholder groups or recognising the changing expectations is important in order to appropriately allocate strategic resources and develop effective ways to address stakeholder relations (Heaton et al., 2012).

The identification of stakeholders and the analysis of their relevance becomes particularly significant when an organisation operates in a diverse environment and its key stakeholders often represent conflicting expectations towards one another due to different performance objectives. An interesting case in terms of research is that of university-based special purpose entities (SPEs). As entities under commercial law, they operate on market terms, although they are appointed by the university authorities, they are legally or organisationally independent of the university. The domain of SPE operation is to combine the interests of science and business through the commercialisation of research results into business practice, in particular through the creation of academic spin-off companies (Higher Education and Science Act of 20 July 2018; Najwyższa Izba Kontroli, 2018). The configuration of SPE stakeholders follows the Triple Helix model, as it brings together entities from the private sector, public administration, and science. The freedom to make decisions and, consequently, the flexibility to act of SPEs simplifies dialogue. The challenge for SPEs is to establish collaborations between entrepreneurs and scientists, among other things, due to the differences in organisational culture and motives (Trzmielak et al., 2017). The purpose of entrepreneurs is to generate profit through the development of a new product or technology (Lee, 2000), so they expect a business-like approach that primarily involves quick decision-making, acting efficiently, and offering products with a high degree of readiness for implementation. On the other hand, researchers are primarily driven in their work by the development of scientific output, prestige and recognition, rather than by achieving financial benefits from the commercialisation of research results (Hayter, 2015). The MAW model, as well as the identification of stakeholders and the analysis of their impact on SPE within the model, can be a useful tool to help shape appropriate stakeholder relationships (Langrafe et al., 2020).

In connection with the above, a research gap was identified in the area of the management of university special purpose entities, in particular in the analysis of the relevance and possible changes of stakeholders as a tool to help develop appropriate stakeholder relations, and the following research question was posed: what is the importance of individual stakeholders for SPE? The purpose of this article is to analyse the importance and changes of stakeholders using the MAW model with the example of a SPE. The article was developed using the case study method. The originality of the article results from filling the research gap in the area of the management of SPEs and creating by them appropriate – value-adding – relations with stakeholders.

2. Methods

The research material collected during the qualitative research conducted in SPEs in 2022 was used to write this article. At the preliminary study stage, a critical review of the literature on stakeholder theory (focusing on the validity of the use of the MAW model in developing stakeholder relations and its dynamics) and secondary documents on the functioning of SPEs in Poland was carried out. A case study method was then used to show the applicability of the MAW model in the SPE environment and to analyse its dynamics to identify the possible changes in the impact of different stakeholders on SPE functioning. The examined case is an actively operating in the area of commercialization (and in accordance with the statutory purpose of operation) SPE[1]. In May 2022, an interview was conducted with the President of the SPE as well as interviews with stakeholders: a representative of the authorities of the scientific unit, scientists and entrepreneurs cooperating with SPE, members of the Supervisory Board, and a representative of the regional public administration. The theoretical study presented in this article indicates the usefulness of the MAW model in the conscious creation of relations with stakeholders. Therefore, the scripts of the in-depth interview conducted with the President of the SPE and stakeholders focused on issues related to relations with individual stakeholders (how does cooperation with SC look like). Based on the material collected during the interviews, the Entity's stakeholders and the nature of the relationship between an SPE and its stakeholders were identified by assigning specific attributes. Conclusions obtained from the analysis of the content of the interviews are presented later in the article.

[1]At the President's request, the SPE remains anonymous, as do the President and other SPE stakeholders.

3. Results

The use of the MAW model in the Entity's stakeholder analysis makes it possible to classify stakeholders according to their impact on the Entity's operations and to monitor the possible changes in the stakeholders' impact on the Entity. If the importance of stakeholders within the MAW model is based on attributes assigned to individual stakeholders, it is worth explaining the importance of individual attributes for the SPE environment here:

1. Power (authority) – it is associated with exerting a stakeholder's impact over the SPE and making it perform certain actions that it would not perform without it. Thus, the stakeholder with power will impact the SPE to act according to its will. According to the three types of sources of power, a stakeholder may be characterised by utilitarian power resulting from, among other things, financial resources, technology for commercialisation, commercialisation expertise; normative power based on symbolic resources, e.g. towards the owner of the SPE, coercive power resulting from physical resources of coercive power.
2. Legitimacy – consists in the fact that the expectations and claims made against an SPE by the stakeholder are in line with the socially established legal system, e.g. according to the Higher Education Act; contractual, e.g. an agreement with a business partner for the implementation project or with the parent university for the management of intellectual property rights; administrative, e.g. financial reporting.
3. Urgency – will be characterised by a stakeholder who demands immediate attention of an SPE and the fulfilment of their expectations first, e.g. when waiting for the effects of an SPE's actions (the generated value for a specific stakeholder).

The combination of different backgrounds has resulted in a unique set of stakeholders for the Entity, which include:

- stakeholders operating in the scientific field: Senate and Rector of the University, Supervisory Board, scientists-creators (scientists with whom the Entity has collaborated), other scientists (scientists with whom SPE has not yet collaborated), Technology Transfer Centre (TTC),
- stakeholders operating in the business field: entrepreneurs, other SPEs and the SPE Agreement,
- stakeholders operating in the public administration field: grant-provision institutions (e.g. the National Centre for Research and Development, Marshal's Office), local government, state control institutions (e.g. Supreme Audit Office, Tax Office),
- internal stakeholders, which include a one-man management board[2].

[2] Described Special Purpose Entity does not employ staff based on a contract of employment.

Table 2.
Attributes of SPE stakeholders

Stakeholders	Stakeholder attributes	Dynamics
Management Board	Power (resulting from knowledge and skills). Legitimacy (resulting from the contract).	Urgency (in the absence of professional development or development opportunities for the entity itself).
Senate and Rector of the University	Power (resulting from symbolic resources – formal consent to implement certain projects; from material resources – consent to use the university's infrastructural, technical resources and access to the university's human resources). Legitimacy (the owner can liquidate the Entity at any time). Urgency (resulting from expectations of the Entity's performance).	Legitimacy is strengthened when there is ongoing financial support of the entity provided by the owner, e.g. under the university's intellectual property management agreement.
Supervisory Board	Legitimacy (resulting from corporate governance and reporting obligations under the applicable code).	Power (resulting from the Entity's professional support in the activities carried out, or the threat of "triggering" the owner's power). Urgency (in the event of non-compliance with obligations under the applicable code).
Researchers-authors	Power (resulting from research outcome passed for commercialisation). Legitimacy (resulting from the cooperation agreement). Urgency (resulting from expectations of cooperation results).	
Other researchers	Power (derived from intangible resources whose potential they are often unaware of).	They can acquire both legitimacy and urgency by reaching out to a group of "collaborative" scientists.
Technology Transfer Centre	Legitimacy (resulting from personal union and joint management).	Power (in a situation of exclusive "takeover" of support from university authorities). Urgency (resulting from the division of tasks and competences in terms of commercialisation, competition between the Entity and the TTC).
Entrepreneurs	Power (resulting from the material resources brought in to an implemented project and the demand for innovative solutions). Legitimacy (resulting from a concluded contract). Urgency (resulting from expected capital returns).	
Other special purpose entities, SPE agreements	Legitimacy (resulting from SPE agreement membership).	Power (when benefitting from the experience of other SPEs, undertaking joint ventures using complementary resources). Urgency (resulting from the desire to intensify cooperation, the need for immediate lobbying).
Grant-providing institutions	Power (resulting from the distribution of project funding). Legitimacy (resulting from the implementation of the project and applicable legislation).	Urgency (due to expectations of SPE performance, which translates into regional and national innovation development and in case of procedural irregularities).
State control institutions	Legitimacy (resulting from reporting obligations and control function).	Power (possibility of applying fines). Urgency (the need for an immediate response in the event of non-compliance with the reporting obligation).

Source: own study.

Table 2 presents the results of the analysis of the importance of stakeholders for the Entity with the use of attributes and their possible changes (dynamics). As part of the described analysis using the MAW model, it is possible to select groups of SPE stakeholders characterised by one attribute, the so-called latent stakeholders: the Supervisory Board, other scientists, TTC, other SPEs and SPE agreements, state control institutions; two attributes, the so-called expectant stakeholders: the management board and grant-provision institutions as well as definitive stakeholders, characterised by a set of three attributes: scientists-creators, entrepreneurs, university authorities. Table 3. contains a synthetic prioritisation of stakeholders (determining their importance) according to their attributes of power, legitimacy and urgency.

Table 3.
Prioritisation of SPE stakeholders

Stakeholders	Number of attributes	Stakeholder category
Researchers - creators	3	DEFINITIVE
Entrepreneurs	3	DEFINITIVE
Senate and Rector of the University	3	DEFINITIVE
Grant-providing institutions	2	EXPECTANT
Management Board	2	EXPECTANT
Supervisory Board	1	LATENT
Other researchers	1	LATENT
Technology Transfer Centre	1	LATENT
Other special purpose entities, SPE agreements	1	LATENT
State control institutions	1	LATENT

Source: own study.

4. Discussion

The analysis of the MAW model (Wood et al., 2021; Mitchell et al., 1997) shows that the key stakeholders of the Entity are the scientists-creators (scientists who cooperate with the Entity), representatives operating in the economic environment: entrepreneurs and the owner (the university authorities). The potential for development of the Entity depends on the potential for commercialisation of scientists with whom the Entity will cooperate (Najwyższa Izba Kontroli, 2018). First, the Entity's task is to locate scientists who have generated scientific research results of high commercial value, and then to show these opportunities to the scientists themselves and motivate them to undertake entrepreneurial activities. The scientist-creator is a co-founder of the spin-off company, but can also be the project developer on behalf of the entrepreneur. The Entity deals with the organisation of cooperation in conceptual and formal terms. The key task, according to scientists, is to match the expectations of the entrepreneurs with the potential of the scientists. Entrepreneurs purchase ready technologies or invest in their development, thus providing financial support to ongoing projects, while the Entity, as in the case of scientists-creators, takes responsibility for efficient project management. According to

the Entity President, the university authorities have the greatest impact on the survival and development of the Entity, because it was established by the decision of the owner of the Entity and may be liquidated by the owner at any time (Higher Education and Science Act of 20 July 2018). Furthermore, the university authorities provide material security for the Entity in the first years of operation by funding the share capital and access to the university's resources (human and infrastructure). The university authorities do not guarantee a permanent source of funding for the Entity's activities, which, in the opposite situation, would allow them to strengthen the attribute of legitimacy (for example, by concluding a contract to manage the intellectual property rights of the academic staff).

The group of expectant stakeholders includes grant-providing institutions that deal with the distribution of national or EU funds for the implementation of innovative projects. In the event of failure to comply with the obligations in accordance with the concluded agreement on the use of funds, the granting institution may acquire the attribute of urgency and become a key stakeholder. Additionally, the urgency may also be the result of the expectations of the Entity's performance impacting the development of regional and national innovation. The Management Board is the main driving force of the Entity, because due to the lack of financial stability, the Entity cannot afford to employ staff on the basis of employment contracts. The motivation for the president's activity is satisfaction with successful commercialisation projects, and in the absence of professional development opportunities, this stakeholder may acquire the attribute of urgency.

A significant group of stakeholders remains latent. The Supervisory Board controls and provides an opinion on the Entity's activities in accordance with the applicable regulations. On the other hand, if the President of the Entity is supported in the field of professional advice (members of the Supervisory Board are experts in the field of law and administration as well as human resources and payroll), the Supervisory Board would gain the attribute of power. The attribute of urgency will be acquired by the Supervisory Board when the Entity defaults on its obligations to the Supervisory Board. Other scientists who have not yet collaborated with the Entity have an attribute of power resulting from their scientific research results, the potential of which they are often unaware of. They can gain both the attribute of legitimacy and urgency by becoming scientist-creators. The Entity President is also the director of the TTC, which facilitates cooperation between the units. However, in the absence of a division of competences in the field of commercialisation or concentration of the university authorities on supporting (or favouring) only one of the entities, competition between the entities may arise, which will contribute to the acquisition of the attributes of power and urgency by the TTC. The SPE Agreement membership provides the Entity with space for the exchange of information and good practices. Other SPEs may gain power as a result of having complementary resources, desirable for use in joint ventures, and urgency when there is a need for immediate lobbying in the grant-providing community. The legitimacy of the control institutions results from the control function and the Entity's reporting obligation. Irregularities

in this area can lead to consequences in the form of fines or a ban on doing business (attribute of power and urgency).

According to the MAW model (Wood et al., 2021; Khurram et al., 2019; Mitchell et al., 1997), due to limited resources, the Entity should first focus on meeting the expectations of scientists - creators, entrepreneurs and university authorities, from which the survival and development of the Entity depends. Next, the expectations of the expectant stakeholders (management board and grant-providing institution) should be taken into account and attention should be paid to what can make them become definitive stakeholders. Finally, the SPE should remember about latent stakeholders (the Supervisory Board, other scientists, CTT, other SPEs and SPE agreements, state control institutions) - their expectations and possible changes in their importance.

5. Summary

Identifying SPE stakeholders, analysing their impact and possible changes in this respect allows for effective relationship formation and the creation of expected values for individual stakeholders (Freeman, 2017), which is a difficult task with the diverse stakeholder groups that SPE has (Trzmielak et al., 2017). Stakeholder analysis using the MAW model can provide a tool to support the management of university-based SPEs in selective decision-making regarding meeting stakeholder expectations and developing appropriate – value-adding – stakeholder relationships from the private sector, public administration, and science.

The main limitation resulting from case study research is the difficulty in generalizing the obtained research results due to the lack of representativeness of a single case for the entire population (Jemielniak, 2012). In the case of SPEs, the list of stakeholders will be slightly different (e.g. not every SPE has a Supervisory Board; some SPEs employ employees and others do not).

The analysis of the importance of stakeholders depends largely on how managers perceive them, which is a limitation of the MAW model itself. Managers do not necessarily have full knowledge of who their stakeholders are, from which their unawareness or misinterpretation of stakeholder expectations and influence on SPE may result (Wood et al., 2021). Therefore, contextual factors influencing managers' perceptions of stakeholder materiality are becoming an emerging research topic in this area (Khurram, Pestre, Charreire-Petit, 2019; Joos, 2019). Furthermore, in its classical conception, the MAW model does not provide for attribute grading. In contrast, a similar solution has been proposed in the Stakeholder Circle model[3] (Bourne,

[3] The attribute of power and proximity are rated on a scale of 1 to 4, where 4 indicates a high degree of impact or direct relationship with the organisation, while urgency is rated on a scale of 1 to 5, where 5 indicates the need for immediate action towards the stakeholder.

Walker, 2006). The assessment of the degree of intensity of each of the attributes makes it possible to more accurately determine the dynamics of the stakeholder's impact on the organisation. For example, as Magness (2008) notes, regulatory institutions (e.g. the Supreme Audit Office) have power (albeit through blocking the conduct of business when procedural irregularities are noted), as do the owners, but until they signal the possibility of its use, it will have a low degree of impact in the minds of the managers. Therefore, supplementing the MAW model with an assessment of the intensity of the attributes, as well as an examination of the contextual factors influencing managers' perceptions of stakeholder salience, would allow for a more detailed analysis of the importance and dynamics of the impact of different stakeholder groups on an organisation, including SPEs.

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BARRIERS TO THE IMPLEMENTATION OF PROJECTS WITHIN SCIENTIFIC AND INDUSTRIAL CONSORTIA – ANALYSIS FROM THE POINT OF VIEW OF ENTERPRISES

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Purpose: to identify and assess barriers to enterprises within scientific and industrial consortia implementing projects.
Design/methodology/approach: this paper presents the results of mixed studies involving preliminary qualitative research in the form of unstructured interviews with project managers implemented within scientific and industrial consortia, followed by quantitative research using a questionnaire among representatives of enterprises from a group of such consortia.
Findings: the effect of the research is the identification of key barriers from the point of view of enterprises in the implementation of projects by scientific and industrial consortia.
Research limitations/implications: the results of the research will improve our understanding of the barriers encountered by enterprises participating in the implementation of projects within scientific and industrial consortia. The next stage of research should include an assessment of barriers from the point of view of public HEIs participating in the joint implementation of projects by scientific and industrial consortia.
Practical implications: the results of the research will contribute to an increase in the absorption capacity of consortia consisting of private enterprises and public universities and may affect the intensification of work aimed at obtaining funds and joint implementation of projects within scientific and industrial consortia.
Social implications: the results of the research may help to increase interest in implementing research and development projects by scientific and industrial consortia, which will result in the transfer of modern solutions from the world of science to industry, bringing specific economic and social benefits.
Originality/value: to identify key barriers to scientific and industrial consortia implementing projects and the scope for enterprises to eliminate these barriers.

Keywords: barriers, projects, scientific and industrial consortia.

Category of the paper: research paper.

1. Introduction

Public universities and private enterprises may cooperate by creating scientific and industrial consortia applying jointly in competitions for co-financing projects from external funds. In Poland, the main source of financing for such projects are funds from European funds. The previous financial perspective for 2014-2020, for which the period of eligibility of costs will end on 31 December 2023, made it possible to obtain significant funds for the implementation of innovative projects implemented in cooperation between universities and enterprises. One key condition for obtaining funds was to ensure the possibility of commercial use of the project, possibly by implementing its effects within the consortium's own activities.

Implementing research and development projects is burdened with a high risk of failure resulting from many barriers that appear during cooperation between public universities and enterprises. They may affect both the stage of establishing cooperation and joint preparation of the application for co-financing, as well as the implementation and settlement of the project itself. Therefore, not all projects that have received funding will ultimately achieve their goals to the full.

On the basis of literature studies and qualitative research, an attempt was made to identify, and then quantify, as part of quantitative research, key barriers to enterprises within scientific and industrial consortia implementing projects. The results of the research will improve our understanding of the barriers encountered by enterprises participating in the implementation of projects within scientific and industrial consortia. They will also contribute to the increase in the absorption capacity of these entities and may affect the intensification of work aimed at obtaining funds and joint implementation of projects by enterprises and public universities.

2. Cooperation between universities and enterprises

The growing importance of university-led research for innovation systems has been highlighted by numerous authors, including Brekke (2020); Etzkowitz and Leydesdorff (2000); Lam (2011); Shi et al. (2020) and Caviggioli (2023). Nevertheless, innovative activity requires significant financial resources, funds that are available primarily to large corporations, public institutions financing research and development as well as the largest universities. Roncancio-Marin et al. (2022) points out that the literature on university-business collaboration is based heavily on research from Western Europe and North America, where universities have a well-developed R&D infrastructure and significant budgets.

In recent years, the turbulent state of the global economy and the intensifying process of globalisation have seriously affected the activities of international and multinational corporations (Alon, 2020; Peretz, Morley, 2021). It should be noted that the current economic situation is not conducive to large investments in research and development or the introduction of expensive and innovative products to the market (Yurevich et al., 2023). Therefore, financing innovative research involves seeking additional external funds, which may be possible to obtain as part of calls announced for scientific and industrial consortia by public institutions financing research.

As Bernal, Carree and Lokshin (2022) point out, the primary motive for which innovative companies seek to collaborate is to gain access to knowledge resources. They emphasise that cooperation in the field of R+D plays an important role in creating innovations; it can facilitate access to resources that companies do not have internally and enable consortium partners to share costs and risks in R&D projects.

Aksoy, Pulizzotto, and Beaudry (2022) point out that universities can become accelerators of innovation and regional economic growth provided that the cognitive gap between universities and industry is reduced by increasing technological proximity or by funding organisations that act as intermediaries in the process of incubating research results.

Numerous studies on cooperation between academic institutions and industry look at how such partnerships develop and what benefits they bring (Attour, Lazaric, 2020; Compagnucci, Spigarelli, 2020; De Silva et al., 2020; Rajalo, Vadi, 2017). Interesting results on the processes underlying the evolution of university-industry collaboration were presented by Patnaik, Pereira and Temouri. The case they investigated involved a collaboration between a university and a large company that then evolved into a tripartite partnership with the entry of a health organisation (Patnaik et al., 2022). This case well reflects the opportunities offered by cooperation between universities and enterprises in the context of implementing joint research and development projects with co-financing from the European Union funds provided by the Intermediate Body. Examples of this in Poland include the National Centre for Research and Development or the European Commission (in the case of Horizon projects).

Research on collaboration between industry, academia, and government based on an analysis of eight Brazilian universities was presented by Andrade et al. (2022). They point to four reasons for cooperation: funding, the existence of innovation environments and specific innovation legislation as well as the regional context. On the basis of an empirical study on the impact of government-enterprise-university cooperation on startups incubated by new research and development institutions in China, Zhou and Wang (2023) indicate that cooperation between the government and the academic community in creating new R+D institutions has a positive effect on business incubation. The results of research presented by Belderbos et al. (2018) indicate that sustained R&D cooperation with institutional partners is a prerequisite for establishing new R&D cooperation with industrial partners and that the interruption of a certain type of R&D cooperation is likely to lead to the resumption of such cooperation. They point

out that past innovation-related achievements increase the likelihood of companies cooperate in research and development with further partners (except competitors as there is a high risk of these acquiring key knowledge and strengthening their competitive position).

Partnerships in the field of research and development of universities with entities from industry can be implemented in various forms, such as partnership programmes, commissioned research or the establishment of spin-off companies (Rybnicek, Königsgruber, 2019; Skute et al., 2019; Thune, Gulbrandsen, 2014; Sjöö, Hellström, 2019). A new type of university-business collaboration involves creating joint university-industrial laboratories to carry out research and development projects (Gomes et al., 2023). These laboratories are an example of long-term joint ventures between universities and companies aimed at achieving benefits for all those involved. Bearing in mind the diverse objectives of universities and enterprises, they constitute a significant management challenge that involves overcoming many barriers to the joint implementation of projects (Meissner et al., 2022).

Cooperation between science and business can develop within consortia established for the purpose of joint application in competitions for co-financing projects from public funds. As research shows, not only can it turn not only into a long-term relationship; it can also develop into new entities. This will help to the intensify the transfer of new knowledge to enterprises and, as a result, an increase the entire economy's level of innovation.

3. Barriers to the implementation of projects by public universities and private enterprises

In recent years, public universities and private enterprises have actively participated in the joint implementation of projects within the framework of scientific and industrial consortia. Many of these projects have achieved the intended effects, but not all. The fact is that implementing research and development projects is burdened with a high risk of failure (Szczepaniak, 2022) resulting from many barriers that appear during cooperation between public universities and enterprises. Contemporary foreign literature points to various factors that may hinder the joint implementation of projects by public universities and private enterprises. The difficulties in developing and maintaining successful cooperation between universities and industry are highlighted by Steinmo and Rasmussen (2018). Ambos et al. (2008) point to the tension between academic and commercial activities. In their research devoted to the microbasics of management of cooperation between universities and industry, Borah and Ellwood (2022) draw attention to the sources of conflicts between entities conducting R+D activities within joint laboratories being one of the barriers to cooperation.

On the other hand, Bruneel et al. (2010) draw attention to organisational barriers in cooperation between universities and industry. They analyse two types of barriers: the first related to differences in the orientation of industry and universities, and the second related to conflicts over intellectual property and contacts with university administrations. Most researchers face barriers to orientation with regard to the limited time spent on research activities of academic staff due to their traditional roles and responsibilities, such as teaching, seminar attendance and administrative tasks (Ramli, Senin, 2015). In addition, resource barriers relate to financial issues and limited infrastructure (Hanel, St-Pierre, 2006; Abeda et al., 2011).

McCabe, Parker and Osegowitsch point to three key barriers to university-business collaboration: structural differences between partners, poor conflict management, and traditional knowledge perspectives. In addition, barriers to cooperation between universities and enterprises in joint ventures include (Lhuillery, Pfister, 2009; Lemos, Cario, 2017):

- universities' emphasis on basic research to expand existing knowledge, while companies are interested in application research,
- different time standards: researchers perceive research in the long term when employees of enterprises are interested in obtaining results as soon as possible,
- high level of bureaucracy and formaliSation of the rules for cooperation on the part of universities and public institutions financing research.

Santalova et al. (2019), in turn, draw attention to the importance of communication in project management and the barriers that interfere with this communication. I particular, they point to the distortion of messages, information overload and unsatisfactory structure of the organisation. As a result, distortions and loss of information are a significant barrier to the effective implementation of projects. This is particularly important when the implementation of the project involves the participation of several independent entities. In this case, communication may be disrupted both internally within each consortium member and externally between the members of the consortium.

In the national literature, one can also find many studies devoted to barriers to joint implementation of projects between public and private entities (Michalski et al., 2013; Różański, 2013; Zontek, 2015; Skwarek, Dzirba, 2017; Zasadzki, 2019; Tomaszewski, 2019). According to Cyran (2015), the barriers hindering cooperation between universities and enterprises include: the excessively high costs of entering and maintaining cooperation, high risk of failure, bureaucracy and formal barriers as well as the excessively long waiting time for results.

Bryła, Jurczyk, Domański (2013) present in detail the barriers in cooperation between universities and enterprises within the framework of joint ventures. These include lack of interest in cooperation, complicated procedures accompanying the establishment of cooperation and bureaucracy, deficiencies in infrastructure and insufficient financial resources, risk of failure, weakness of intermediary institutions and an unfavourable organisational culture.

According to Zajko K. (2013), the main barriers to cooperation between universities and enterprises include: insufficient legal regulations, insufficient information on the potential scope for cooperation, lack of interest among companies in financing research projects with insufficient application features and unsatisfactory effects of previous cooperation for enterprises.

To sum up, in the relevant literature, one may notice a diverse approach to identifying barriers in the implementation of projects in cooperation between universities and enterprises. Nevertheless, there are some common barriers to all these studies, although these are not always defined in the same way: insufficient resources (financial, human and infrastructural), errors in project management (communication problems, poor planning, lack of training), bureaucracy and lack of support from senior management.

4. Research methodology

The study uses an explanatory sequential model, involving preliminary qualitative research, followed by quantitative research on a larger sample. In order to identify barriers that may hinder the implementation of the project within a consortium consisting of universities and private enterprises, unstructured interviews were conducted with five managers of projects implemented as part of this type of cooperation. These interviews were aimed at gathering empirical material based on the use of open-ended questions, which enable the interlocutor to speak directly and freely. During the unstructured interviews, barriers to the implementation of joint projects of public universities and enterprises were identified. The results obtained were used to develop a questionnaire and conduct a survey among persons managing projects implemented by consortia consisting of at least one public university and at least one private enterprise. The study was carried out using the mixed mode method combining CATI and CAWI techniques. The study concerned one project.

The research used a random selection of respondents: first of all, a database was created, containing a list of projects implemented since 2014 by consortia composed of at least one public university and at least one private enterprise. Next, an invitation to complete the survey was sent to 192 people, 120 fully completed surveys were obtained, giving a manoeuvrability rate of 62.5%.

One of the objectives of the study was to identify barriers to the implementation of projects within the consortium of public universities and enterprises. The barriers identified during the qualitative study and assessed during the quantitative study included:

1. Making ones own contribution.
2. No adequate infrastructure.
3. No specific procedures in the entity.
4. No properly prepared staff.

5. No such need.
6. Reluctance of the authorities of the entity.

The question posed to the respondents regarding the indication of barriers in the implementation of the project within the framework of the scientific and industrial consortium was semi-open, next to the indicated barrier proposals, the last answer "Other, which..." allowed respondents to indicate their own barriers that were not mentioned in the survey.

Characteristics of the study population

The survey was addressed to persons managing projects implemented by consortia consisting of at least one public university and at least one private enterprise. Among the respondents, the largest group were people representing medium-sized enterprises 30.83%. A detailed distribution of respondents by company size is shown in Figure 1.

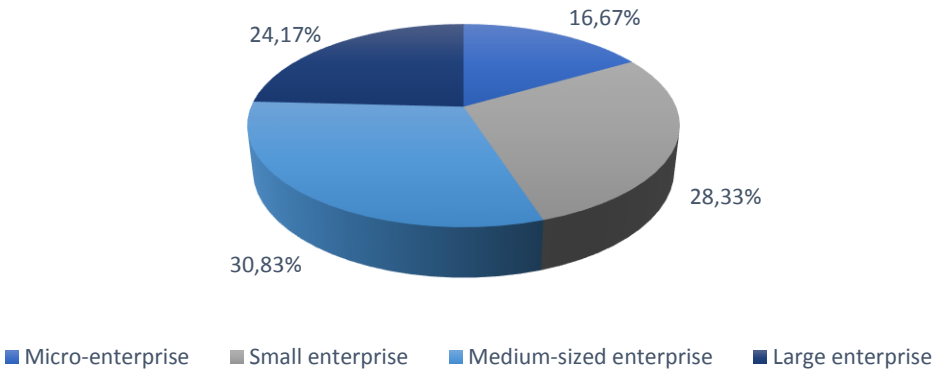

Figure 1. Size of surveyed enterprises.

Source: Own elaboration based on the results of the survey, N = 120.

The number of entities forming the consortium has a significant impact on the implementation of projects within the consortium. Figure 2 shows the distribution of respondents according to the number of entities included in the consortium.

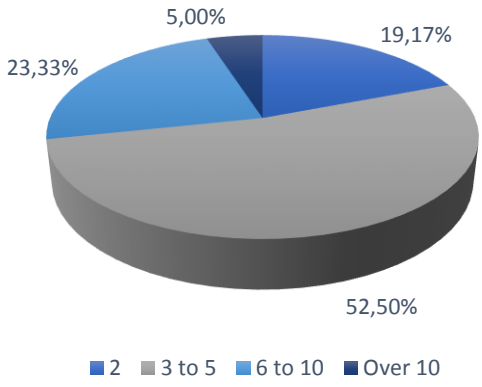

Figure 2. Number of entities in the consortium.

Source: Own elaboration based on the results of the survey, N = 120.

The largest part of the examined projects were those implemented within consortia consisting of at least three, but not more than five entities, so it can be assumed that these were medium-sized consortia formed for the joint implementation of the project. In addition to public universities and private enterprises, the participants in the consortium also included private universities and other types of entities.

5. Research results

As part of the survey, representatives of enterprises were asked to identify barriers to the implementation of projects within the consortium of public universities and enterprises. The question was semi-open-ended; respondents could indicate one or more of the proposed barriers or present another, not included in the list. The results are presented in Table 1.

Table 1.
Barriers to the implementation of projects within scientific and industrial consortia from the point of view of enterprises

Barriers	Number of Indications	Percentage
Making ones own contribution	59	49,17%
No adequate infrastructure	45	37,50%
No specific procedures in the entity	38	31,67%
No properly prepared staff	33	27,50%
No such need	19	15,83%
Reluctance of the authorities of the entity	13	10,83%
Other	6	5,00%

Source: Own elaboration based on the results of the survey, N = 120.

The largest group of respondents (almost 50%) indicated that the implementation of projects within scientific and industrial consortia is hindered by the need to make own contribution. Unlike research units, enterprises cannot receive funding in the amount of 100% of eligible costs, this is due to restrictions related to state aid. Therefore, every time they plan the implementation of the project, they must secure adequate funds to cover their own contribution.

The second most frequently indicated barrier was the lack of adequate infrastructure, which was indicated by 37.5% of respondents. Receipt of public funding for the joint implementation of the project by a scientific and industrial consortium takes place on the basis of an open competition, under which one of the evaluation criteria is the potential of the applicants. Therefore, the lack of appropriate infrastructure may be one of the elements hindering the process of obtaining funding and the subsequent implementation of the project. This barrier is also connected with the option of making own contribution: existing infrastructure may be used as part of the entity's own contribution and reduce the need to engage additional funds.

The lack of specific procedures in the company, a barrier that is not directly related to the financial resources, is indicated by almost 32% of respondents. The process of applying for public funds and the subsequent implementation of co-financed projects are very formalised and require many conditions to be met. First of all, the requirements related to the eligibility of costs and procurement procedures are crucial.

The lack of specific procedures may to some extent result from another barrier, which was indicated by 27.5% of respondents: the lack of properly prepared staff. Members of the project team with the manager at the helm have a lot of duties, both formal and substantive.

Among other barriers, respondents pointed to (original spelling):

- Extensive bureaucracy involved in documenting project costs, selecting suppliers of materials for research work.
- VAT refund tax procedures.
- A changing environment.
- No preparation of public Higher Education Institutes for such cooperation.
- Communication issues.
- Inability to obtain a project due to the fact that a large number of projects have not been implemented in the past (no additional points in the project scoring) (a closed circle is created).

In order to better understand existing dependencies, the analysis was deepened by the presentation of the main barriers in the implementation of projects, within a consortium of public universities and enterprises, in individual groups of enterprises. These data are presented in Table 2.

Table 2.
Barriers to the implementation of projects within scientific and industrial consortia depending on the size of the company

Barriers	% of answers depending on the size of the company			
	Micro	Small	Medium-Sized	Large
No properly prepared staff	20,00%	26,47%	37,84%	20,69%
No specific procedures in the entity	10,00%	17,65%	29,73%	65,52%
No adequate infrastructure	30,00%	32,35%	40,54%	44,83%
Making ones own contribution	70,00%	47,06%	48,65%	37,93%
No such need	5,00%	20,59%	10,81%	24,14%
Reluctance of the authorities of the entity	20,00%	2,94%	18,92%	3,45%
Other	10,00%	2,94%	2,70%	6,90%

Source: Own elaboration based on the results of the survey, N = 120.

The most frequently indicated barrier in the case of micro-enterprises, which is not surprising, was making ones own contribution; 70% of respondents representing micro-enterprises indicated it as an obstacle in the implementation of projects within scientific and industrial consortia. This barrier was also most often indicated by small and medium-sized enterprises, it was 47.06% of respondents representing small enterprises and 48.65% of

responses among respondents representing medium-sized enterprises. What might seem surprising in the answers given is the very high percentage of responses regarding the lack of specific procedures in the entity in the case of large enterprises. This barrier in the implementation of projects within scientific and industrial consortia was indicated by 65.52% of respondents representing the largest enterprises. However, by conducting an in-depth cause-and-effect analysis, it can be pointed out that micro, small and medium-sized enterprises have a much less complicated and extensive management structure, hence they can more easily and quickly introduce specific procedures for new projects. In the case of large entities, only general procedures are most often introduced, which may not always meet the requirements of the institutions providing co-financing.

6. Summary

The research indicates four main barriers to the implementation of projects within the consortium of public universities and enterprises. The most frequently indicated barrier by respondents (49.17% of responses) was making ones own contribution. This was particularly evident in the responses of respondents representing micro-enterprises (70.00% of indications), small enterprises (47.06%) and medium-sized enterprises (48.65%). In these three groups of companies, this barrier was indicated most frequently. Only in the case of large enterprises was the frequency of its indications lower (37.93%).

In second place, respondents pointed to a lack of adequate infrastructure (37.50% of responses). The implementation of projects within scientific and industrial consortia mainly affects research projects requiring the use of specialised equipment. Therefore, this answer, like the previous one, should not come as a surprise. In all surveyed groups of companies, this barrier was the second most frequently indicated.

The podium is closed by a lack of specific procedures in the entity (31.67% of responses). This barrier was in first place among large enterprises (65.52% of responses) and in fourth place among other groups of enterprises. In the case of large enterprises implementing many projects at the same time, the procedures introduced are of a general nature, because it would be difficult to develop specific procedures for each individual project. In the case of smaller companies that implement several or only one project within a scientific and industrial consortium, the development of specific procedures for individual projects is no longer so troublesome. In the case of micro-enterprises, only every tenth respondent indicated this barrier. However, it can be noted that with the increase in the size of enterprises, the number of indications of this barrier increased significantly.

As a significant barrier, the respondents also indicated a lack of properly prepared staff (27.50% of responses). This barrier was most often indicated by representatives of medium-sized enterprises (37.48% of responses). In the case of both micro-enterprises and large enterprises, this answer was indicated by every fifth respondent.

Presentation of barriers involves identifying agents and actions that will assist in eliminating them or reduce their negative impact on the implementation of projects by enterprises within scientific and industrial consortia. When planning their own contribution, enterprises should first use their own resources. One can make ones own contribution using ones own machinery and equipment and also by delegating employees to perform tasks in the project. Secondment of an employee to perform tasks under the project means that all or part of their remuneration (depending on the type of secondment) will constitute an eligible cost and may complement the unit's own contribution.

Eliminating the second barrier may require the involvement of additional consortium members who will have the necessary infrastructure. Fixed assets can also be acquired as part of a hire, holding or lease. The indicated forms of financing do not require incurring the full cost of acquiring infrastructure, but only their temporary use for the needs of the project.

The barrier related to a lack of specific procedures in the entity can be eliminated by using the appropriate knowledge management within the company. The use of knowledge and experience from previously completed projects can provide a foundation for the developing and applying specific procedures for the implementation of projects within scientific and industrial consortia within the enterprise.

Eliminating the fourth of the key barriers in the implementation of projects within scientific and industrial consortia may involve the need to attract new employees, which is not always possible. An alternative may be to provide appropriate courses and training for your own staff. However, unfortunately this solution also has its limitations as it will take time to give staff the necessary preparation.

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ANALYSIS OF FINANCIAL SUPPORT FOR AIR CARRIERS TO COUNTERACT THE EFFECTS OF THE COVID-19 PANDEMIC, WITH PARTICULAR EMPHASIS ON THE EUROPEAN UNION

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Purpose: The aim of the article is to analyse the actions taken in individual regions and countries in the field of state aid for air carriers and to verify its impact on counteracting the effects of the crisis caused by the COVID-19 pandemic, in particular in the European Union.
Design/methodology/approach: The research was mainly based on the comparative analysis of the International Air Transport Association, European Commission and selected air carriers' data.
Findings: The diversity of forms and values of public aid between regions of the world was identified. No links were found between the volume of financial support and the pace of market recovery, both globally and within the European Union. In EU, private-owned unsubsidised entities have been recovering faster than state-owned so-called 'national carriers' which received substantial amount of public funds.
Research limitations/implications: The research was based on limited number of entities and on limited number of operational and financial indicators. Some data comparisons are burdened with error due to inconsistency between reporting (fiscal) periods of selected air carriers.
Originality/value: The research summarizes and describes the different forms of public aid implemented for the air carriers and shows ineffectiveness of government support granted for these entities.

Keywords: aviation market, COVID-19 pandemic, crisis, state aid.

Category of the paper: Research paper.

1. Introduction

The global crisis of unprecedented scale had a significant impact on the situation on the aviation market. The market size, measured by revenues, fell by several tens of percent, in a way inadequate to the economic changes recorded in parallel. The governments of individual countries have implemented administrative bans, which have prohibited air operations. These actions have put air market companies, especially air carriers, in a very difficult situation, preventing them from performing their core activities.

Market entities constantly maintained operational readiness at a high level and looked forward to restrictions lifting and the return of demand. High uncertainty about the development of the market situation created the dangerous phenomenon of so called 'cash burn'. The implementation of cost reduction could not take place without consequences in the form of a permanent reduction in the potential of a given company. Breaking lease agreements for the use of aircraft and dismissing key employees, such as pilots, whose training is a relatively high cost (not only in terms of funds, but also in terms of time) – would have improved the financial situation, but at the same time would result in a permanent loss of market share. This forced managers to choose between the ability to preserve the potential for a rapid recovery from the crisis and the policy of implementing significant cost cuts necessary for survival. It should also be pointed out that the delayed development of changes in the rules for allocating the slots for subsequent aviation seasons has exposed companies to additional and unreasonable costs in order to maintain the right to operate at a given airport at a certain time in subsequent periods by making 'empty' flights.

The aim of this study is to analyse the form and amount of public aid granted in individual regions of the world, with particular emphasis on the European Union countries. To achieve this objective, materials and analytical data prepared by the International Air Transport Association (IATA) and data on state aid published by the European Commission were used and compared.

2. Literature review

According to recent researches (Abate, Christidis, Purwanto, 2020) it should be expected that public aid provided by the governments of individual countries will be directed mainly to state-owned or national enterprises, but not to all carriers operating on the market in a given country. The conclusion was drawn that countries that are unable to provide such support, in particular those in South America and Africa, may permanently lose some air connections. As a result of such developments, an increase in concentration on the market is expected, consisting in an increase in its share of so called 'national carriers' and the termination of activity by relatively smaller enterprises. It was also pointed out that the economies of scale and the benefits of the extensive connection network held by market leaders will play to their advantage and will allow them to better cope with the effects of the crisis. Authors also provided for the possibility of directing further development of aviation towards hubs, which are considered by them as an unfavourable solution in terms of the environment. It was also indicated that air carriers are not financially stable and will require further public support, which will have negative effects on competitiveness and, as a result, will increase prices and reduce the supply of services. According to the authors, financial aid addressed to carriers should be

distinguished into the one that is aimed at improving the economic situation and the one that is aimed at balancing the sustainable development of a given enterprise. Thus, the actions and decisions of governments can have a key impact on the future image of aviation.

Other authors (Dube, Nhamo, Chikodzi, 2021) analysed the impact of the traffic drop as a consequence of the outbreak of the COVID-19 pandemic on the global aviation industry. It has been concluded that the recovery process will be slow and will vary between geographic regions. It was emphasized that the crisis caused by the pandemic has grounded air carriers, which in turn has significantly increased the costs of restarting operations and made it necessary to receive recapitalisation. According to the authors, it is vital to ensure affordable financing by private and public institutions, yet they should be directed primarily to ensure sustainable development of aviation. The authors argue that 'the pandemic cannot be used as an excuse' and the environmental commitments of the aviation market made before the crisis should be kept. The authors stated that the aviation sector is not well prepared to deal with emergencies and crises, which must change as events similar to the COVID-19 pandemic are likely to occur in the future. They have prepared a solution in the form of making transport offer for passengers more flexible and call for unifying health, safety and sanitary procedures. Authors propose cooperation in this field between air carriers, airports and governments of individual countries.

Other researchers (Scheelhaase et al., 2022) analysed the advantages and disadvantages of granting and not granting government aid to air carriers in various forms. In conclusion, they stated that preferential loans and state guarantees are the best solution, provided that the criteria for granting them to entities would be transparent and non-discriminatory. In the opinion of these authors, such a solution would be the golden mean that would minimise the political impact on the market situation and would maintain a high level of competitiveness between carriers. However, they point out that protracted market problems will result in a significant increase of debt, which may eventually be considered as unstable and the situation will require costly non-repayable state subsidies, directly burdening the public debt and taxpayers.

3. Analysis of state aid granted to air carriers

3.1. Global view

The analysis of the aviation market shows that since the outbreak of the COVID-19 pandemic, the aviation market has not yet recorded very spectacular falls among the largest entities operating on it. This was related to the financial support granted to these enterprises by the governments of individual countries. Its scale depended on the region, which is presented in Figure 1. It is noticeable that the largest public aid was provided in the regions of the world where the largest air carriers mainly operate, i.e. in North America (United States), Asia (China) and in Europe.

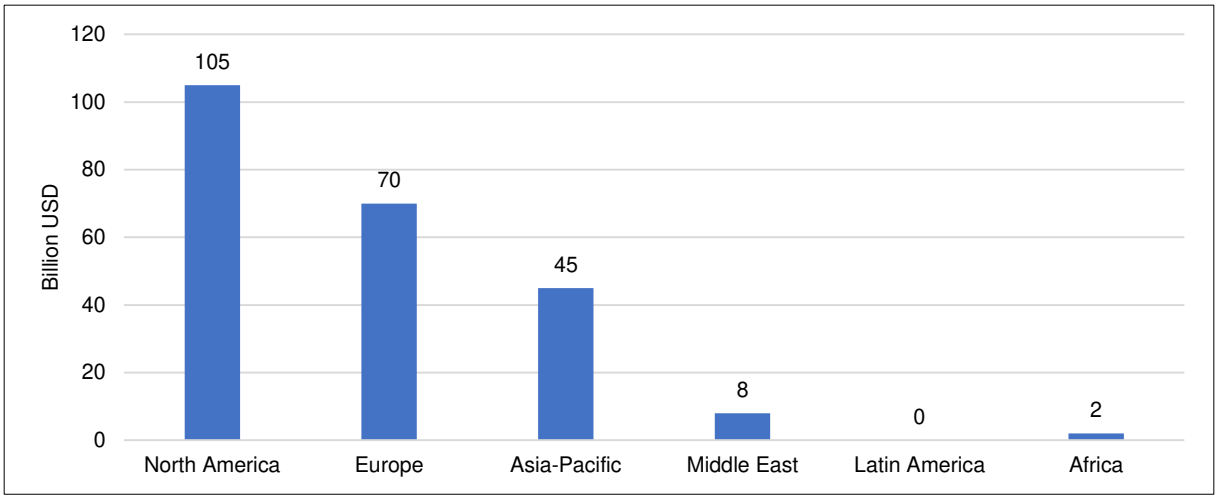


Figure 1. Value of state aid granted to air carriers, broken down by geographic regions (billion USD).

Source: Own elaboration based on data: *IATA Annual Review 2021*. Retrieved from: https://www.iata.org/contentassets/c81222d96c9a4e0bb4ff6ced0126f0bb/iata-annual-review-2021.pdf, 30.11.2022.

The International Air Transport Association (IATA) indicated that air carriers around the world could count on a total amount of support of approximately 230 billion USD as the first tranches of assistance provided to them (i.e. for the first year and a half of the crisis caused by the COVID-19 pandemic), of which about half of this value was non-repayable aid. The most popular form of aid in North America (and also worldwide) was wage subsidies, while European countries more often decided to provide direct recapitalization and grant loans on preferential terms. Other forms of assistance included granting loan guarantees and lowering or deferring taxes – such as the reduction of excise duty on aviation fuel and income taxes (IATA Annual Review, 2021). The financial situation of air carriers was also affected by other actions taken by individual countries and organisations, such as revisions of programs aimed at balancing the sustainable development of the aviation market (Szczypiński, 2022). The directions of these are diverse on a global scale and financial effects are difficult to quantify in relation to individual enterprises due to the interregional nature of air carriers' activities.

The largest part of the above-mentioned amount of financial support was provided for the North American market (105 billion USD) and the European market (70 billion USD). Entities in the Asia-Pacific market could count on smaller amounts (45 billion USD). In the Middle East, Africa and the Latin American region, air carriers received significantly less or even no state aid.

Nevertheless, despite the provision of relatively large public aid, not all carriers were able to continue their operations. According to IATA data (IATA Annual Review, 2021), the number of air carriers that went bankrupt or were subject to administration processes is quite high, but there are no companies among them that are on the top of the lists of the largest global enterprises in this sector. Detailed data are presented in Figure 2. The difficulty in maintaining financial liquidity has been also increased due to the unwillingness of potential lenders to secure debts with pledges on key fixed assets owned by air carriers. The possible cashing of aircraft

during the COVID-19 pandemic would be difficult due to the risk of not receiving an amount consistent with the valuation of the asset under non-crisis conditions. This was due to the low market demand for such assets resulting from the impossibility of their proper use due to administrative restrictions. It should be emphasized that there are some regions of the world where the market model in which air carriers are state-owned enterprises operating in non-deregulated markets still dominates, which changes the approach to the analysis of the possible bankruptcy of such enterprises.

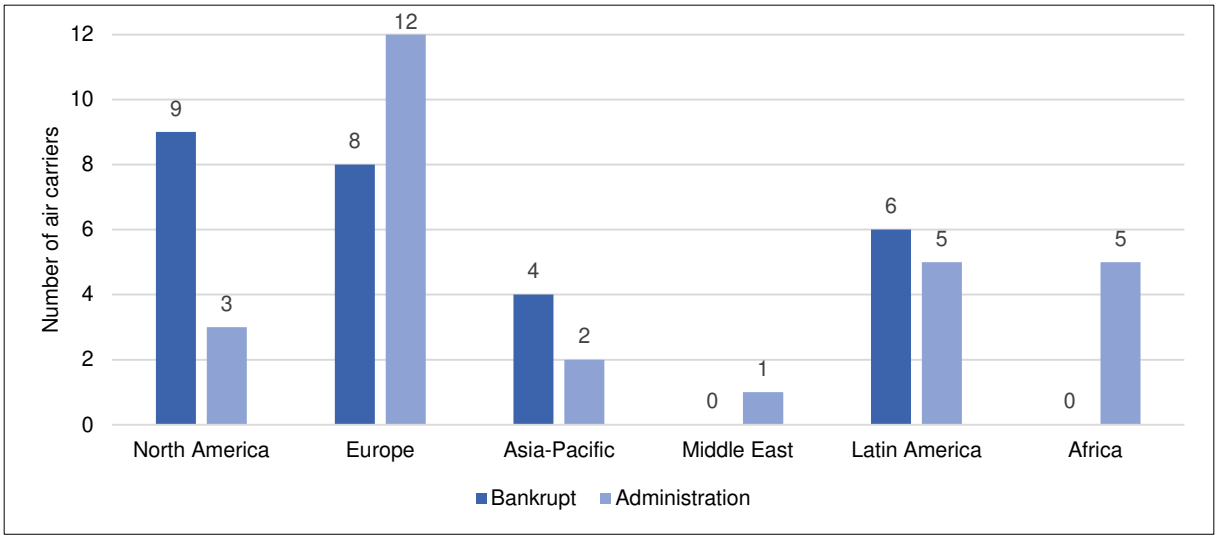
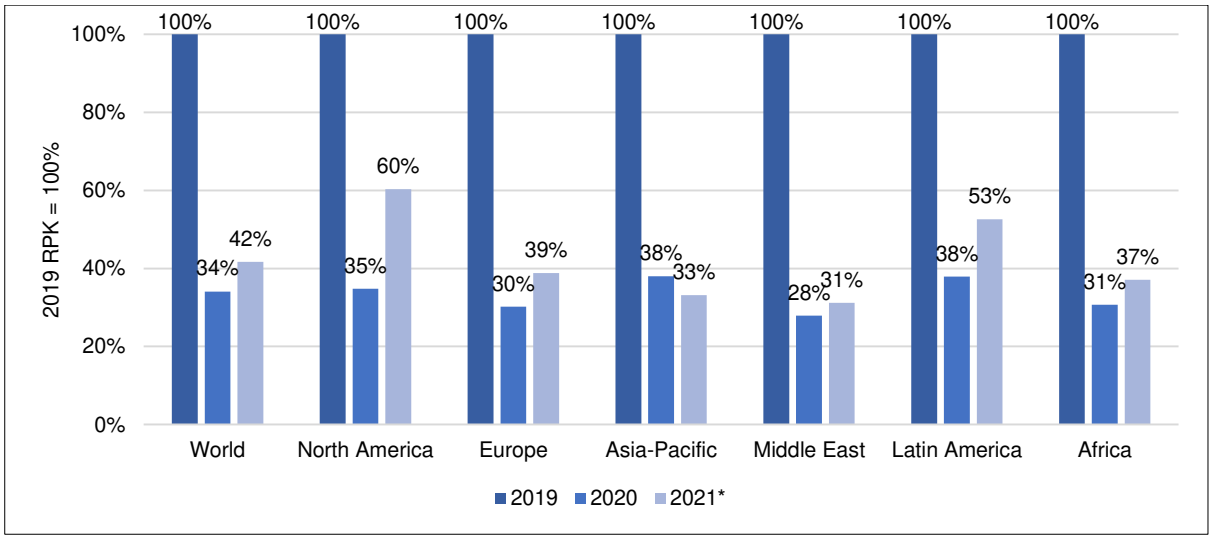


Figure 2. Number of bankrupt and administrated air carriers as a result of the COVID-19 pandemic, broken down by geographic regions.

Source: Own elaboration based on data: *IATA Annual Review 2021*. Retrieved from: https://www.iata.org/contentassets/c81222d96c9a4e0bb4ff6ced0126f0bb/iata-annual-review-2021.pdf, 30.11.2022.



* Preliminary data.

Figure 3. Number of passenger kilometres (RPK) performed in 2020-2021 in relation to the value for 2019 (2019 = 100%), broken down by geographic regions.

Source: Own elaboration based on data: Industry Statistics. Retrieved from: https://www.iata.org/en/iata-repository/publications/economic-reports/airline-industry-economic-performance---june-2022---data-tables/, 30.11.2022.

Operational data do not show a significant correlation of the pace of traffic recovery with the level of financial assistance granted, especially with regard to the number of passengers served in individual regions of the world in 2020-2021 compared to 2019. North America is the leader in both terms, yet the operational data for the European and Asia-Pacific markets (which were the 2nd and 3rd in terms of the level of state aid) are below the global average (as shown in Figure 3) and therefore the issue of granting aid can no longer explain the pace of the traffic comeback. It is also not possible to use this factor to explain the above-average pace of market recovery in Latin America. The right reasons should therefore be sought elsewhere, such as in the local conditions and geography of the regions.

3.2. Situation in the European Union

In accordance with Article 107(1) of the Treaty on the Functioning of the European Union (hereinafter as 'TFEU'), aid granted to individual entities by Member States is unacceptable if it affects the situation on the internal market, yet there are some exceptions to this rule. European Commission has treated the crisis caused by the outbreak of the COVID-19 pandemic as a *natural disaster or other exceptional occurrence* (Article 107(2)(b) TFEU). European Commission has issued decisions to the Member States enabling the granting of state aid to aviation market entities on this legal basis and on the basis of developed temporary framework. The provided aid should, according to the legal documents, repair damages caused by the COVID-19 pandemic. The rules and conditions for granting state aid have been changed and extended many times, yet their essential part has ended in June 2022.

Table 1 presents the amount of state aid granted by the Member States which was approved and published by the European Commission. The list includes only the aid that was addressed directly to individual enterprises, without taking into account the aid granted to broader groups of air carriers, which is presented in subsequent Table 2. Moreover, it should be taken into account that air carriers also could have been supported through aid addressed to all entities or through other forms of support that did not require notification and consent of the European Commission. Yet, these types of aid would result in a relatively smaller individual support, as it would have to be spread over a significantly larger range of enterprises. The provided list also omitted aid granted to enterprises which core activities are significantly broader than just the provision of air transport (e.g. TUI, which was subsidized by Germany), as well as aid granted directly to airports or other entities of the aviation market, of which air carriers could become indirect beneficiaries.

The analysis of the presented data shows that the vast majority of funds collected from taxpayers and furtherly distributed by individual governments was directed to specific companies considered as 'national carriers' in these countries. The largest aid in nominal terms was provided to Alitalia (by the Italian government), Air France (by the French government), Lufthansa (by the German government), KLM (by the Dutch government) and TAP (by the Portuguese government) – each of these supports contained at least one tranche exceeding

1 billion EUR. In terms of forms of support, recapitalization and granting loans on preferential terms dominated, which is consistent with IATA data. The practice of supporting the same company multiple times is also visible (Alitalia – 5 times by Italy; Finnair – 4 times by Finland; TAP and its affiliates – 4 times by Portugal; SAS – 3 times by Sweden and Denmark combined; airBaltic – 3 times by Latvia). In particular, the case of Alitalia is worth additional insight, as this air carrier, despite receiving the largest aid, has ceased operations on 15th October 2021. Nevertheless, Alitalia was replaced by the newly established carrier ITA Airways as part of a hybrid reorganization (ITA takes off…).

Much fewer Member States decided to provide aid to a wider group of air carriers, and the total amount of aid provided by all countries for this purpose was significantly lower and did not exceed 700 million EUR. Among the additional and non-standard aid solutions, France was indicated, which decided to defer the payment of certain taxes for air carriers licensed in that country. Romania also opted for unconventional assistance, supporting air carriers resuming operations from specific airports located in this country – in cities of Sibiu, Maramureș, Oradea and Arad.

Table 1.
List of public aid addressed by Member States directly to individual carriers in order to counteract the effects of the COVID-19 outbreak

Date of publication	Subsidising country	Subsidised air carrier	Amount (million EUR)	Legal basis
2020-04-15	Denmark	SAS	137,0	107(2)b TFEU
2020-04-24	Sweden	SAS	137,0	107(2)b TFEU
2020-04-27	Germany	Condor	550,0	107(2)b TFEU
2020-05-04	France	Air France	7000,0	Temporary framework
2020-05-18	Finland	Finnair	600,0	Temporary framework
2020-06-06	Austria	Austrian Airlines	150,0	107(2)b TFEU
2020-06-09	Finland	Finnair	286,0	Temporary framework
2020-06-10	Portugal	TAP	1200,0	107(3)c TFEU
2020-06-13	Netherlands	KLM	3400,0	Temporary framework
2020-06-25	Germany	Lufthansa	6000,0	Temporary framework
2020-08-11	Estonia	Nordica	30,0	Temporary framework
2020-08-17	Sweden	SAS	583,0	Temporary framework
2020-08-17	Denmark	SAS	486,0	Temporary framework
2020-08-20	Romania	Blue Air	62,0	Temporary framework
2020-08-21	Belgium	Brussels Airlines	290,0	Temporary framework
2020-09-04	Italy	Alitalia	199,5	107(2)b TFEU
2020-10-02	Romania	TAROM	19,3	Temporary framework
2020-12-01	Croatia	Croatia Airlines	11,7	107(2)b TFEU
2020-12-11	France	Corsair	106,7	107(2)b TFEU
2020-12-22	Poland	LOT	650,0	Temporary framework
2020-12-23	Greece	Aegan Airlines	120,0	107(2)b TFEU
2020-12-29	Italy	Alitalia	73,0	107(2)b TFEU
2021-03-17	Finland	Finavia	350,0	Temporary framework
2021-03-19	Finland	Finnair	350,0	107(2)b TFEU
2021-03-26	Italy	Alitalia	24,7	Temporary framework
2021-04-06	France	Air France	4000,0	Temporary framework
2021-04-23	Portugal	TAP	462,0	107(2)b TFEU

Cont. table 1.

2021-04-30	Portugal	SATA Air Açores /Azores Airlines	267,5	107(2)b TFEU
2021-05-12	Italy	Alitalia	12835,0	107(2)b TFEU
2021-06-02	Italy	Alitalia	39,7	107(2)b TFEU
2021-06-09	Sweden	SAS	150,0	Temporary framework
2021-06-09	Denmark	SAS	150,0	Temporary framework
2021-06-22	Spain	Air Nostrum	9,0	107(2)b TFEU
2021-06-24	Belgium	Air Belgium	4,8	107(2)b TFEU
2021-06-27	Germany	Condor	525,3	107(2)b TFEU
2021-12-21	Latvia	airBaltic	45,0	107(2)b TFEU
2021-12-22	Portugal	TAP Group	2657,0	107(2)b TFEU
2021-12-22	Portugal	TAP Air Portugal	71,4	107(2)b TFEU
2022-02-10	Finland	Finnair	48,6	107(2)b TFEU
2022-04-30	Romania	TAROM	1,9	107(2)b TFEU
2022-05-02	Greece	Ellinair	6,8	107(2)b TFEU
2022-05-23	Latvia	airBaltic	33,4	Temporary framework
2022-05-23	Latvia	airBaltic	11,6	107(2)b TFEU

Source: Own elaboration based on data: *Factsheet – List of Member State Measures approved under Articles 107(2)b, 107(3)b and 107(3)c TFEU and under the State Aid Temporary Framework*. Retrieved from: https://competition-policy.ec.europa.eu/state-aid/coronavirus_en, 30.11.2022.

Table 2.

List of public aid addressed by Member States to all carriers in order to counteract the effects of the COVID-19 outbreak

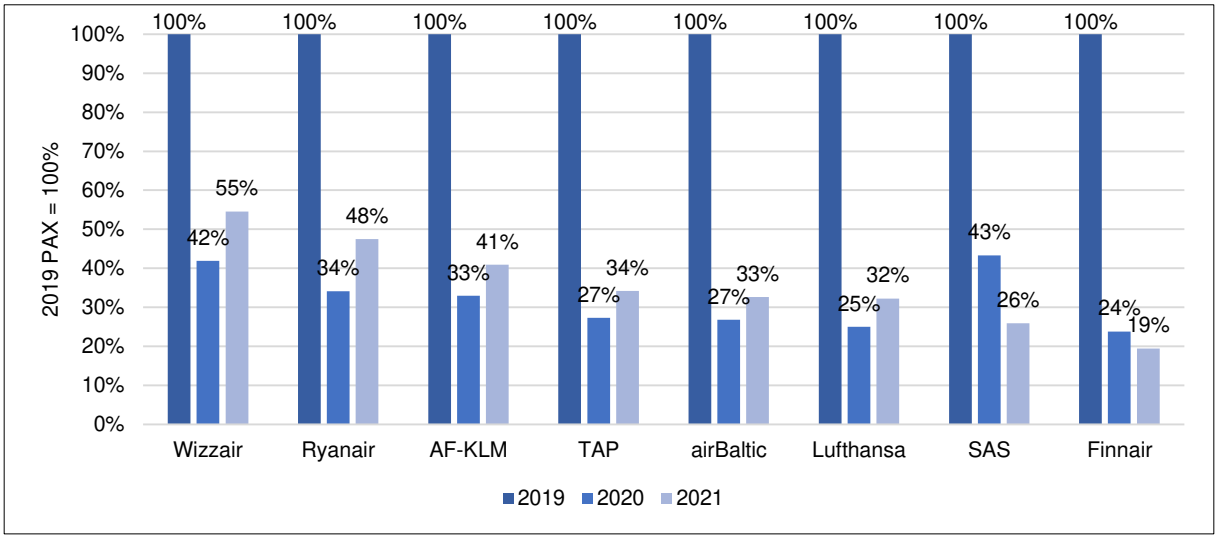
Date of publication	Subsidising country	Subsidised group of air carriers	Amount (million EUR)	Legal basis
2020-04-11	Sweden	All air carriers	455,0	Temporary framework
2020-06-01	Cyprus	All air carriers	6,3	Temporary framework
2020-06-27	Romania	Air carriers at Oradea airport	1,0	Temporary framework
2020-09-02	Denmark	All air carriers	24,0	Temporary framework
2020-11-27	Denmark	All air carriers	6,0	Temporary framework
2020-12-22	Italy	All air carriers	130,0	107(2)b TFEU
2021-06-06	Romania	Air carriers at Maramureş airport	1,2	Temporary framework
2021-09-29	Romania	All air carriers	1,2	Temporary framework
2021-11-19	Romania	Air carriers at Sibiu airport	1,7	Temporary framework
2021-12-10	Romania	All air carriers	10,3	Temporary framework
2022-02-17	Cyprus	All air carriers	6,1	Temporary framework
2022-03-02	Slovenia	All air carriers	7,0	Temporary framework
2022-03-17	Bulgaria	All air carriers	30,7	Temporary framework
2022-03-23	Slovakia	All air carriers	3,0	Temporary framework
2022-03-31	France	All air carriers	Deferral of certain taxes	107(2)b TFEU
2022-04-04	Romania	Air carriers at Arad airport	1,0	Temporary framework
2022-11-17	Slovenia	All air carriers	5,0	Temporary framework

Source: Own elaboration based on data: *Factsheet – List of Member State Measures approved under Articles 107(2)b, 107(3)b and 107(3)c TFEU and under the State Aid Temporary Framework*. Retrieved from: https://competition-policy.ec.europa.eu/state-aid/coronavirus_en, 30.11.2022.

As indicated above, the summaries do not take into account the total aid granted to all air carriers. For example, Poland, apart from supporting its national carrier LOT with an amount of 650 million EUR (State aid: Commission approves €650 million…), consisting of a subsidized loan of 400 million EUR and a recapitalization of 250 million EUR in the form of subscriptions for newly issued shares taken up by the State Treasury, also has granted a liquidity

loan through the state-owned entity Polski Fundusz Rozwoju to the private carrier Enter Air, but its amount, equal to 287 million PLN (Powzięcie informacji dotyczącej podjęcia decyzji…), was significantly lower than the aid granted to LOT.

The state aid activities met with the opposition from private carriers (especially Ryanair and Wizzair), who did not receive direct support from their home countries (i.e. the governments of Ireland and Hungary, respectively). They sued the state aid granted to other air carriers, accusing them of destroying competition on the air transport market and have won some of the disputes (Ryanair gets rare wins in EU court…). Figure 4 presents a comparative summary of operational data in terms of the number of passengers served in 2019-2021. What is important, the ability of air carriers not supported by public support to rebuild their operations in 2020-2021 was significantly greater than in the case of those entities that have received the highest levels of public aid. In addition to that, the preliminary operating results of Ryanair and Wizzair for third quarter of 2022 indicate that the number of passengers carried by these air carriers was higher than in the corresponding period of 2019, by 5% and 12%, respectively, which can be considered as another step in the process of emerging from the crisis.



Data for Alitalia/ITA Airways unavailable.

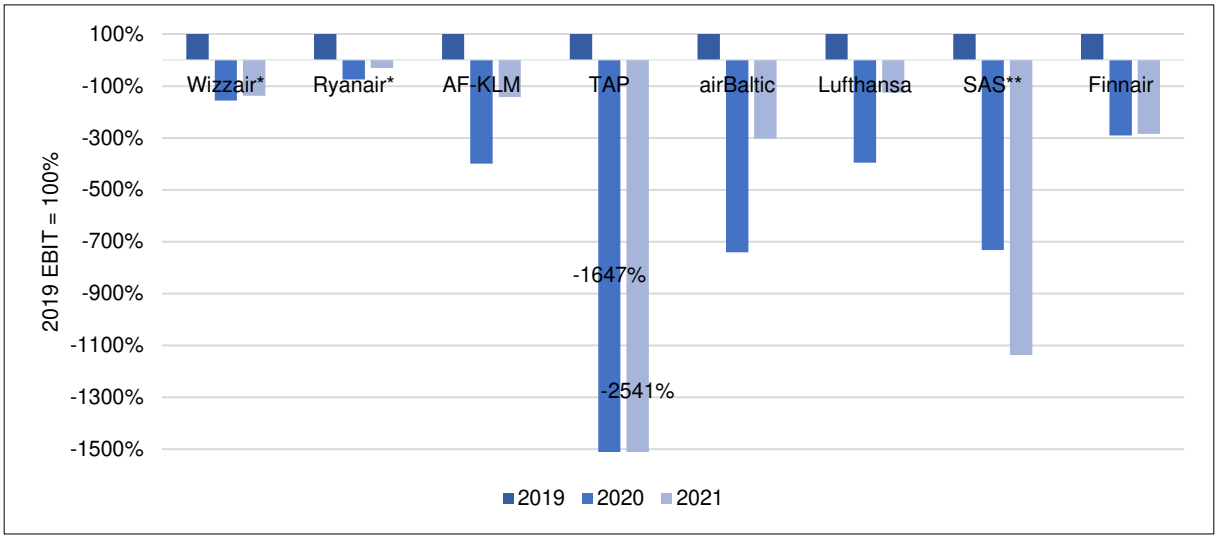
Figure 4. List of the number of passengers served (PAX) by selected air carriers in 2020-2021 in relation to the value for 2019 (2019 = 100%).

Source: Own elaboration based on operational data of air carriers.

Similar results come from the analysis of financial data. Figure 5 presents a comparison of the operating result (EBIT) of air carriers in 2020-2021 with the earnings achieved by them in 2019. Data analysis shows that the non-subsidized private carriers Wizzair and Ryanair were able to minimize losses caused by the COVID-19 pandemic in a significantly more optimal way[1]. The ability of these entities to achieve such results cannot be explained solely by the low-

[1] Comparative analysis of data is burdened with the problem of their incomparability due to the variety of reporting periods adopted by individual carriers. Nevertheless, based on the determination of the size of the difference between individual entities, the legitimacy of such a statement was recognized.

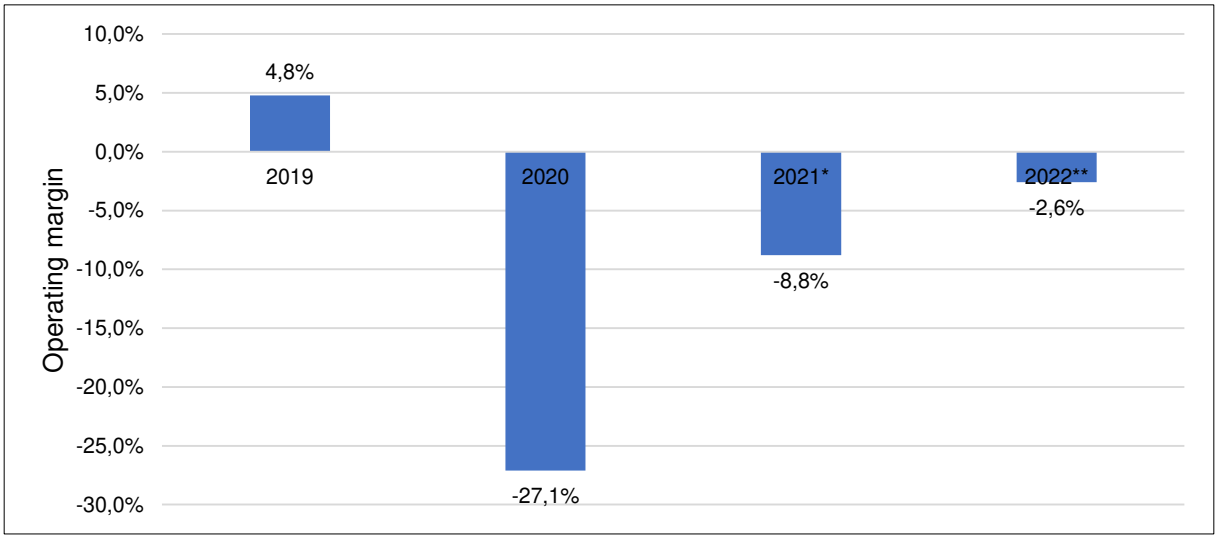
cost nature of their operations (LCC), as Latvian airBaltic, which is on also on the presented list, also uses such business model.



* *Fiscal year from April to March*
* *Fiscal year from November to October*

Figure 5. Operating result (EBIT) in 2020-2021, in relation to the value for 2019 (2019 = 100%).

Source: Own elaboration based on financial data of air carriers.



* Preliminary data
** Forecasted data

Figure 6. Operating margin of European carriers, 2019-2022.

Source: Own elaboration based on data: *Industry Statistics*. Retrieved from: https://www.iata.org/en/iata-repository/publications/economic-reports/airline-industry-economic-performance---june-2022---data-tables/, 30.11.2022.

Figure 6 shows the historical and projected operating margins generated by European carriers. According to IATA forecasts, in 2022 European carriers will still fail to generate a positive operating result on a regional basis. At the same time, taking into account the need to service relatively high levels of debt at high interest rates, it may turn out that carriers who have survived only due to the received aid, will require further funding.

4. Summary

The analyses carried out indicate that the amount and form of state aid were not unified among the geographic regions of the world. A positive correlation between the granting of public aid and the ability to quickly return air traffic to pre-crisis levels caused by the outbreak of the COVID-19 pandemic cannot be demonstrated at the regional level.

Research has shown that in the European market, the concerns presented by some researchers were partially confirmed. The European Union countries focused on providing assistance to their national carriers, rather than to the air transport market as a whole. Aid granted to all market participants provided on a relatively equal basis was marginal comparing to all of the granted support. Western European countries opted for the greatest state aid, while other Member States provided less support, resigned from such activities or did not have an air carrier of such 'national' nature. The largest enterprises were supported several times by the governments of their home countries. No evidence was found that this aid was granted primarily in order to provide sustainable development. However, in the times when air carriers are unable to achieve a positive operating result for several periods, expectation of implementing costly 'green investments' should be considered as irrational.

What is more, the high level of state aid granted cannot be considered as a factor that improved the value of operational indicators. Europe as a region (in the geographical division used by IATA) has recorded the world's largest total number of bankrupt or administrated enterprises, despite being the second in the world ranking in terms of the level of support provided to air carriers. The analysis of operational indicators showed that the level of passengers transported in 2020-2021 in comparison to 2019 values was below the global average. As the analysis ended on 2021 data, the difference between Europe and other regions of the world cannot be explained by the armed conflict in Ukraine as the new stage of it has begun in February 2022. Among the analysed enterprises and indicators attributable to them, the best results were recorded by private LCC entities, which had no grounds to expect receival of public aid and had to take immediate and rational actions from the point of view of the faced market situation. Similar conclusions were drawn from the analysis of financial data based on the generated EBIT margin.

The research was based on limited number of entities and on limited number of operational and financial indicators. Some data comparisons are burdened with error due to inconsistency between reporting (fiscal) periods.

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DO BONDS INDEXED TO INFLATION PROTECT AGAINST ITS NEGATIVE EFFECTS? ANALYSIS OF RATES OF RETURN IN REAL TERMS FOR TREASURY BONDS ISSUED BY POLAND

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Purpose: The aim of the article is to examine whether inflation-indexed treasury bonds issued by the Polish Minister of Finance protect investors' capital against the negative consequences of an increase in the price level.
Design/methodology/approach: The condition which has to be met in order to achieve a positive net rate of return in real terms has been established. The historical and current rates of return on investment in the inflation-indexed treasury bonds issued by the Polish Minister of Finance were analysed to check whether they meet this condition.
Findings: Own research has shown that in general, operation principle of bonds indexed to inflation should allow the investor to gain protection from negative effects of price changes. Yet, the example of Polish treasury bonds shows that systematic reduction of interest premiums for the subsequent series of issued instruments, changes in the operation principles, negative effect of taxation and materialisation of the defined in article time-shift mismatch risk – in the high-inflation environment results in significantly negative values of the current net rates of return in real terms of the latest series of COI and EDO bonds. This means that these bonds have not protected investors from the negative effects of price increases and loss of purchase power of invested capital.
Research limitations/implications: The levels of real rates of return calculated in the way presented in the article, i.e. based on official data of the Statistics Poland, are representative for the entire economy, yet do not have to translate into the same value for the individuals – real rates of return calculated appropriately for the individual investor may vary in both ways and therefore be more or less favourable than presented in the article.
Originality/value: The demand for these investment products is increasing, which is surprising in the light of the article's findings. That may, result from investors' expectations regarding a decrease in inflation in the coming periods, as well as the fact that, despite the negative profitability in real terms, these instruments can more effectively minimize the real-term losses stemming from inflation than other types of investments of a similar risk level (deposits, savings accounts) what can be furtherly reviewed in the next research.

Keywords: inflation, inflation-indexed bonds, real rates of return, treasury bonds.

Category of the paper: Research paper.

1. Introduction

Relatively high levels of inflation bring attention of the economists, politicians and the whole societies. Inflation has a negative impact on the economy by reducing the real value of the capital. It also generates uncertainty in the markets and discourage from saving. Investors who eager to protect their capital against the loss of purchasing power, look for opportunities to allocate capital in assets that allow to counteract negative effects of inflation. One of the type of assets that should meet this objective are inflation-indexed bonds, which interest rates refer to the levels of price changes in the economy.

The aim of the article is to examine whether inflation-indexed treasury bonds issued by the Polish Minister of Finance protect invested funds against the negative consequences of a decrease in the purchasing power of capital due to increase in the price level. It has been hypothesized that these instruments do not grant full protection against this risk for the investor.

As part of this objective, author has established the condition which has to be met in order to achieve a positive net rate of return in real terms. The operation principles of the most popular inflation-indexed treasury bonds (four-year COI series and ten-year EDO series) were also examined and the historical and current rates of return on investment in the above-mentioned bonds were analysed in order to check whether they met the established condition.

In terms of methodology, the study consists of the financial analysis of historical and current rates of return on investment in inflation-indexed treasury bonds. The data was based on the content of the letters of issue and interest tables of issued bonds published by the Polish Minister of Finance. The inflation data were taken from the Statistics Poland (Polish central statistical office) databases. The period of 2010-2022 was adopted for the analysis.

2. Literature review

Although in the history of the development of financial markets there were many examples of initiatives aimed at counteracting the loss of the purchasing power of capital, the first bonds formally linked to the inflation index were those issued in Massachusetts in the 18th century during the American Revolutionary War (Shiller, 2003). They were created in connection with the recorded high levels of inflation resulting from the ongoing military actions and, in consequence, the anger of American soldiers referred to the rapid decrease in purchasing power of their pay. For example, a certain bond from 1780 represented liability which settlement referred to a price index linked to a basket of goods composed of a fixed number of measurement units of corn, beef, sheep's wool and leather products, what guaranteed that the real value of the received gratification will be kept.

The key date for the development of the inflation-indexed treasury bond market is considered to be 1981, when the UK government has issued a financial instrument which operational principles have resembled bonds that are being issued nowadays. In Poland, the first series of such instruments was issued in August 2004 (Bembenik, 2007).

Recent research (Gomez-Gonzales, 2019) indicates that issuing inflation-linked treasury bonds is quite popular among governments in developing countries. In the group of countries analysed by the researcher, the 23% (on average) of total debt incurred in their local currencies was linked to the inflation rates. It also accounted for the 13% of total debt issued in all currencies. It was indicated that the nature of inflation-indexed bonds is considered as counter-cyclical, which means that these instruments should protect the investor against fluctuations in the GDP growth rate. It has been noted that in times of crises, developing countries decide to substitute the foreign currency debt by the inflation-indexed one as it is relatively cheaper to issue. In more than half of the developing countries analysed by the researcher, the cost of issuing inflation-linked bonds was 1.2 to 5.0 percentage points lower than in the case of standard debt in local currency.

The analysis of the current situation on the Polish treasury bond market (Kulpaka, 2023) showed that since 2016, the popularity of treasury bonds issued by Poland has significantly increased, which also applies to the inflation-indexed instruments. Nevertheless, the share of treasury bonds in the sum of all financial assets owned by a statistical Pole still remains at a low level, yet it grows dynamically. In 2010, they amounted to 0.64% of all financial assets, while in 2021 this value was equal to 2.03%, which means that the share of these instruments rose more than three times over the reviewed period.

The literature review has shown that the operational principle of inflation-indexed treasury bonds issued by Polish Minister of Finance, especially in terms of its ability to protect the investor against the inflation – has not been analysed.

3. Own research

High levels of inflation in Poland encourage investors to become more interested in instruments which, in its assumption, should protect them against the negative consequences of the increase in the price level. According to data published by the Polish Ministry of Finance, total sales of various series of treasury bonds issued in 2022 was equal to 57.1 billion PLN and was the highest in history. Among them, there are two series of publicly available inflation bonds[1]:

[1] The analysis does not include so called ‘family bonds’: six-year ROS and twelve-year ROD series, which are also indexed to inflation and which combined accounted for 0.9% of the total sales value in 2022 (57.1 billion PLN). Such narrowing of analysis only to COI and EDO series bonds was made as ‘family bonds’ can be only purchased by the beneficiaries of the government social programme ‘Rodzina 500 plus’ and thus they are not available for every investor.

- four-year COI series (abbreviation stands for pol. *Czteroletnie Oszczędnościowe Indeksowane*, ten-year indexed [bonds designed for] savings), which accounted for 42.3% of total sales in 2022, and
- ten-year EDO series (abbreviation stands for pol. *Emerytalne Dziesięcioletnie Oszczędnościowe*, ten-year retirement [bonds designed for] savings), which accounted for 10.3% of total sales in 2022.

This means that, in total, publicly available inflation bonds accounted for the majority in terms of value (52.6%) of all issued treasury bonds in Poland in 2022.

3.1. Operation principles of inflation bonds offered by the Polish Minister of Finance and its level of sales

The operation principles of different kinds of inflation-indexed treasury bonds (i.e. four-year COI and ten-year EDO) are similar, yet there are several differences that have to be furtherly analysed.

The name of individual series consists of three letters and four digits – the letters are indicating the type (series) of bonds, while the first two digits inform about the month in which the bond will be redeemed, and the last two indicate the year in which the redemption will take place – in line with the letter of issue. For example, the COI0127 bond is a four-year inflation-indexed instrument that will be redeemed in January 2027. The interest rate for each period is set in the letter of issue. It is defined as the sum of the recorded level of inflation and the interest premium. Two interest premiums are being set – one for the first year of saving and the second, constant, for the subsequent years of investment. In the vast majority of COI and EDO series in the analysed period the interest premiums for the first years of saving have been set at a different level than for the other years (both lower or higher). In case of deflation, the inflation factor is assumed to be equal to 0.00% for the purpose of interest rate calculation.

After the end of deflation period in Poland (2014-2016), the process of reducing the interest premium for the first year of saving has begun. As it has been constantly heading towards the 0.00% in subsequent series, the issuer has decided that starting from May 2017, COI and EDO series bonds will be issued with a fixed interest rate for the first interest period that is independent of inflation. This approach was maintained until the end of the analysed period (December 2022). It means that the series of COI and EDO bonds issued since May 2017 are *de facto* hybrids of a fixed-coupon bond (in the first period) and an inflation-indexed bond (from the second to the last interest period).

Among the differences between COI and EDO, interest capitalization should be pointed out, which for COI series bonds (*Obligacje 4-letnie…*) is annual and interest are also paid annually, with the deduction of capital gains tax, in accordance with art. 30b sec. 1 of the Polish act of 26th July 1991 on personal income tax 19,00% (*Ustawa z dnia 26 lipca 1991 r. o podatku dochodowym…*). On the other hand, the EDO series bonds (*Obligacje 10-letnie…*) differ in this respect from the COI series. The main difference is that annual capitalization of interest is not

being followed by its payment – the interest is cumulated and reinvested. The tax is charged only once, at the end of the whole investing period, when the bond is redeemed. What is more, the interest premiums on EDO series bonds, both in the first year of investment and in subsequent years, were historically higher than on COI series bonds, in order to reward the investor for a longer lack of access to the capital. The above means that investment in EDO bonds should be theoretically characterized by the higher rates of return than in COI series.

It should also be noted that there is a time shift between the inflation values, which are being taken into account to determine the interest rate, and the actual values for a given period. The interest rate in a given period depends on the past (last year's) inflation levels, not the current ones – thus, an investment in a COI or EDO bonds in each interest period protects against inflation that was reported for the previous period – not for the current one. This means that during the entire duration of the bonds, the capital is not hedged against price changes in the last period, yet it is enriched with appropriate interest for the period before its issuing.

In addition to that, the interest rate for the next interest period is determined in the month preceding the start of it. During this month, the latest available inflation data are those related to the month that precedes it (as an example, for the December series, the inflation reported for the October is used for interest rate settlement). The above means that there is a fourteen months long time-shift that can cause a significant decrease (or increase, respectively) in the full-period real-term profitability of the instrument. This phenomenon will be furtherly referred to as a time-shift mismatch risk. A satisfactory solution for investor to this problem could be a permanent bond rollover, i.e. replacing old bonds with the new ones, yet due to the change in operation principles and implementation of a hybrid structure of COI and EDO series bonds since May 2017, this action will no longer bring the intended benefits.

Figure 1 shows the levels of inflation to which COI and EDO bonds interest rates refer to, as well as the volume of their sales. Two peaks of interest should be pointed out – the first one in April 2020, which was related to the outbreak of the COVID-19 pandemic, the cycle of interest rate cuts performed by the Monetary Policy Council (body of National Bank of Poland) and the announcement of planned further lowering of the interest premium for the bonds issued from the subsequent month – May 2020. The second occurred in June-July 2022 and happened as a result of interest rate hikes, raising the interest premiums for the next series and introduction of the new types of bonds followed by an extensive marketing campaign conducted by the Minister of Finance. All of that has happened in the environment of still relatively low interest rates available on other forms of investment considered as alternatively safe – deposits and savings accounts.

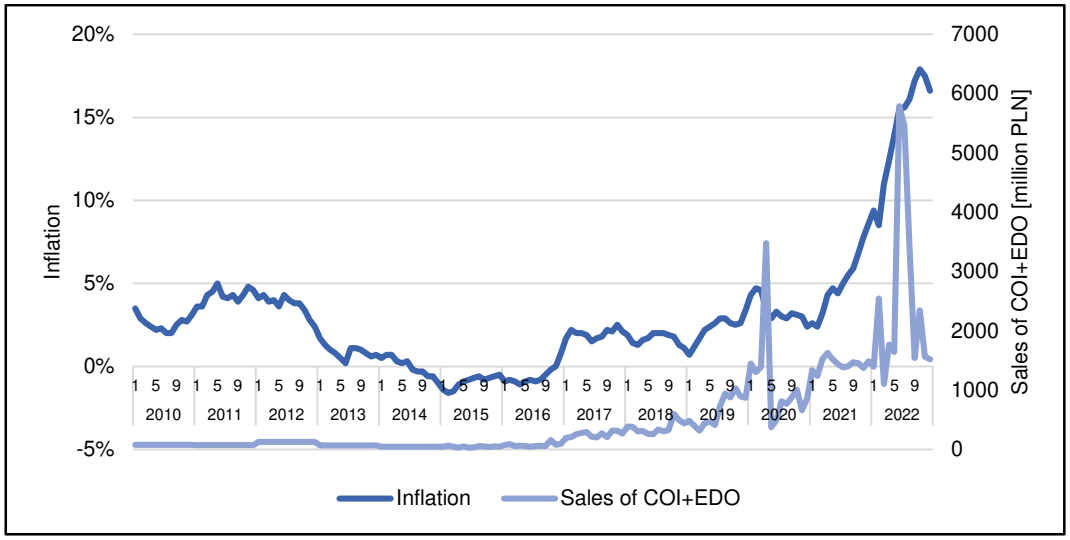

Figure 1. Inflation levels and sales of inflation-indexed treasury bonds, 2010-2022.

Source: Own elaboration based on data: *Miesięczne wskaźniki cen towarów i usług konsumpcyjnych od 1982 roku*. Retrieved from: https://stat.gov.pl/obszary-tematyczne/ceny-handel/wskazniki-cen/wskazniki-cen-towarow-i-uslug-konsumpcyjnych-pot-inflacja-/miesieczne-wskazniki-cen-towarow-i-uslug-konsumpcyjnych-od-1982-roku/#, 30.06.2023; *Wyniki sprzedaży obligacji oszczędnościowych w grudniu*. Retrieved from: https://www.gov.pl/web/finanse/wyniki-sprzedazy-obligacji-oszczednosciowych-w-grudniu3, 30.06.2023.

As indicated in the earlier part of the analysis, bonds in 2022 reached a record high level in terms of sales. Figure 2 presents a visible but gradual increase in the share of inflation-linked treasury bonds in total of treasury bonds issued, which shows that the increased interest of investors in government debt was not focused solely on inflation-linked type of bonds.

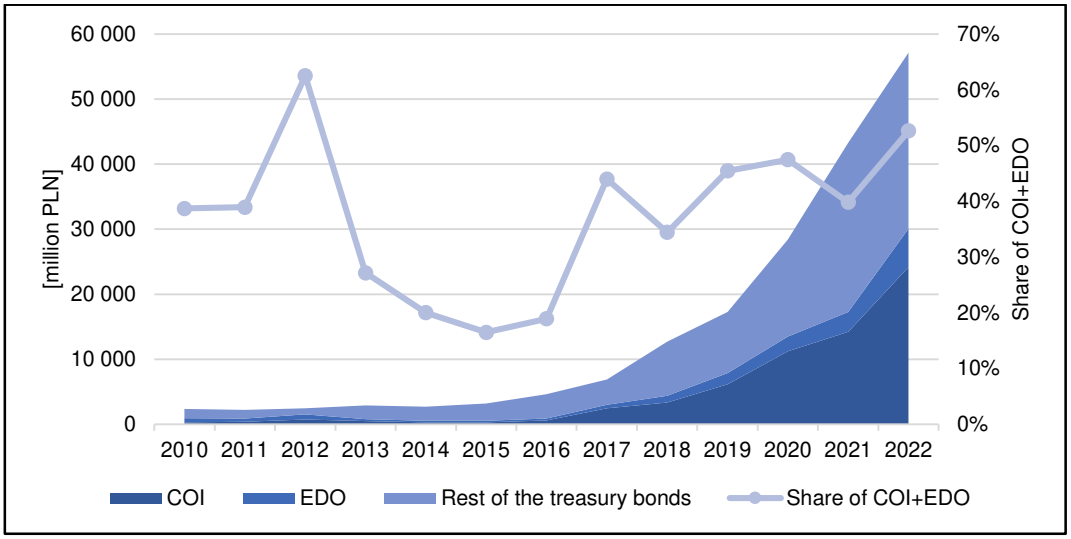

Figure 2. Sales volume of COI, EDO and other treasury bond series, 2010-2022.

Source: Own elaboration based on data: *Wyniki sprzedaży obligacji oszczędnościowych w grudniu*. Retrieved from: https://www.gov.pl/web/finanse/wyniki-sprzedazy-obligacji-oszczednosciowych-w-grudniu3, 30.06.2023.

The structure of inflation-indexed treasury bonds held by investors, broken down by COI and EDO, is presented in Figure 3. It should be noted that there is a clear trend of increasing sales of four-year bonds compared to ten-year ones. The above should be explained by the fact that the difference in interest rates and bonuses offered by the Polish Minister of Finance between EDO and COI series is, in the opinion of investors, not sufficient to compensate for the 2.5 times longer period of lack of access to funds. In addition, the operation principle of EDO series bonds which is based on the non-payment of yearly interest, significantly hinders the use of this instrument to cover the current expenses of an investor by the regular inflows, which is significantly easier to achieve with COI series.

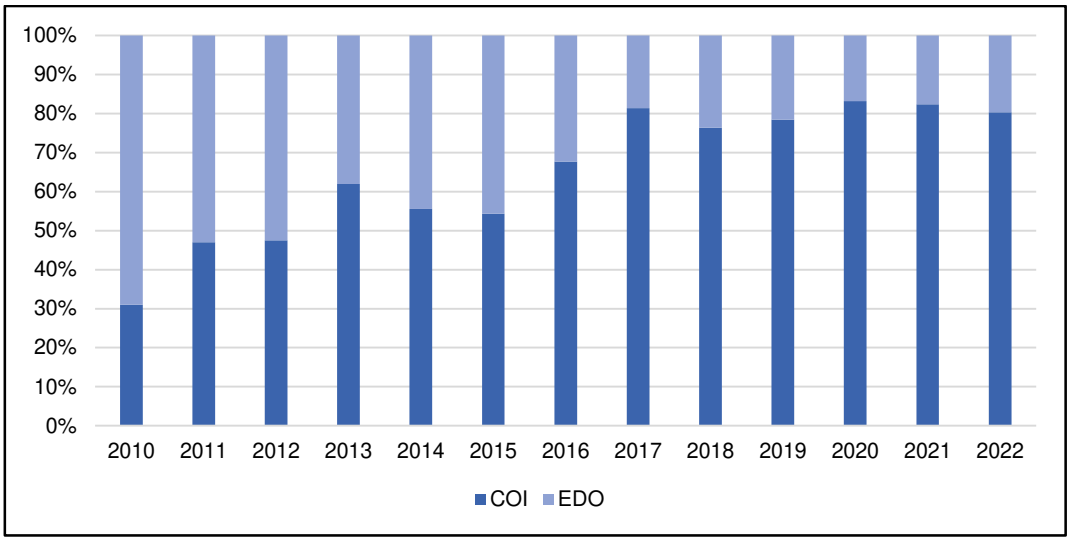

Figure 3. Share of COI and EDO series bonds in total purchased inflation-indexed treasury bonds, 2010-2022.

Source: Own elaboration based on data: *Wyniki sprzedaży obligacji oszczędnościowych w grudniu*. Retrieved from: https://www.gov.pl/web/finanse/wyniki-sprzedazy-obligacji-oszczednosciowych-w-grudniu3, 30.06.2023.

3.2. Analysis of the yield on inflation-indexed treasury bonds offered by the Polish Minister of Finance

Leaving aside the issue of time mismatch between actual inflation rate in the given period and the one used as a basis for the interest rate calculation, theoretically a bond, which interest rate is equal to inflation and furtherly enlarged by a premium of a positive value, should in each case be characterized by a positive rate of return in real terms. However, the existence of a capital gains tax (at 19.00%) reduces the profitability of such instrument. As a result of the above, with sufficiently high inflation levels, the situation may occur where the surplus of the interest rate over the inflation level (resulting from the interest premium), will not be able to cover the negative effect resulting from the taxation. Thus, the requirement of profitability was established and presented in formula (1).

$$(Inflation\ rate + Interest\ premium) \times (1 - Tax\ rate) > Inflation\ rate \quad (1)$$

After mathematical transformations, it occurs that the net rate of return on investment in real terms for an inflation bond will be positive when inflation is lower than the quotient of

- the product of the interest premium and one less the tax rate, and
- the tax rate,

as shown in formula (2).

$$Inflation\ rate < \frac{Interest\ premium \times (1 - Tax\ rate)}{Tax\ rate} \quad (2)$$

It can be noted that an increase in inflation causes a decrease in the rate of return in real terms, due to the fact that the negative effect of the taxation increases together with the interest rate growth (which grows together with inflation) and cannot be offset by an interest premium that remains constant. Table 1 shows the one-period net rates of return in real terms of inflation-indexed bonds, with relation to the level of the interest premium. The range of data refer to historical values recorder for the second and subsequent interest periods for COI and EDO series bonds offered in 2010-2022. With the lowest margin of 0.75% (present in COI bonds series issued since May 2020), the break-even point (for the bond to not generate negative yield in real terms) with regard to inflation is equal to 3.20% (and thus remain within the National Bank of Poland's inflation target, which is equal to 2.50% with acceptable deviations of ±1%). Figure 2 shows the data from Table 1 in a graphical form.

Table 1.
One-period net rates of return in real terms, depending on interest premium levels and inflation

RoR	0,0%	1,0%	2,0%	3,0%	4,0%	5,0%	6,0%	7,0%	8,0%	9,0%	BEP
0,75%	0,6%	0,4%	0,2%	0,0%	-0,1%	-0,3%	-0,5%	-0,7%	-0,8%	-1,0%	3,20%
1,00%	0,8%	0,6%	0,4%	0,2%	0,0%	-0,1%	-0,3%	-0,5%	-0,7%	-0,8%	4,26%
1,25%	1,0%	0,8%	0,6%	0,4%	0,2%	0,1%	-0,1%	-0,3%	-0,5%	-0,6%	5,33%
1,50%	1,2%	1,0%	0,8%	0,6%	0,4%	0,3%	0,1%	-0,1%	-0,3%	-0,5%	6,39%
1,75%	1,4%	1,2%	1,0%	0,8%	0,6%	0,4%	0,3%	0,1%	-0,1%	-0,3%	7,46%
2,00%	1,6%	1,4%	1,2%	1,0%	0,8%	0,6%	0,5%	0,3%	0,1%	-0,1%	8,53%
2,25%	1,8%	1,6%	1,4%	1,2%	1,0%	0,8%	0,6%	0,5%	0,3%	0,1%	9,59%
2,50%	2,0%	1,8%	1,6%	1,4%	1,2%	1,0%	0,8%	0,6%	0,5%	0,3%	10,66%
2,75%	2,2%	2,0%	1,8%	1,6%	1,4%	1,2%	1,0%	0,8%	0,7%	0,5%	11,72%
3,00%	2,4%	2,2%	2,0%	1,8%	1,6%	1,4%	1,2%	1,0%	0,8%	0,7%	12,79%
	10,0%	**11,0%**	**12,0%**	**13,0%**	**14,0%**	**15,0%**	**16,0%**	**17,0%**	**18,0%**	**19,0%**	**20,0%**
0,75%	-1,2%	-1,3%	-1,5%	-1,6%	-1,8%	-2,0%	-2,1%	-2,2%	-2,4%	-2,5%	-2,7%
1,00%	-1,0%	-1,2%	-1,3%	-1,5%	-1,6%	-1,8%	-1,9%	-2,1%	-2,2%	-2,4%	-2,5%
1,25%	-0,8%	-1,0%	-1,1%	-1,3%	-1,4%	-1,6%	-1,7%	-1,9%	-2,0%	-2,2%	-2,3%
1,50%	-0,6%	-0,8%	-1,0%	-1,1%	-1,3%	-1,4%	-1,6%	-1,7%	-1,9%	-2,0%	-2,2%
1,75%	-0,4%	-0,6%	-0,8%	-0,9%	-1,1%	-1,2%	-1,4%	-1,5%	-1,7%	-1,8%	-2,0%
2,00%	-0,3%	-0,4%	-0,6%	-0,8%	-0,9%	-1,1%	-1,2%	-1,4%	-1,5%	-1,7%	-1,8%
2,25%	-0,1%	-0,2%	-0,4%	-0,6%	-0,7%	-0,9%	-1,0%	-1,2%	-1,4%	-1,5%	-1,6%
2,50%	0,1%	-0,1%	-0,2%	-0,4%	-0,6%	-0,7%	-0,9%	-1,0%	-1,2%	-1,3%	-1,5%
2,75%	0,3%	0,1%	0,0%	-0,2%	-0,4%	-0,5%	-0,7%	-0,9%	-1,0%	-1,2%	-1,3%
3,00%	0,5%	0,3%	0,1%	0,0%	-0,2%	-0,4%	-0,5%	-0,7%	-0,8%	-1,0%	-1,1%

Source: Own elaboration.

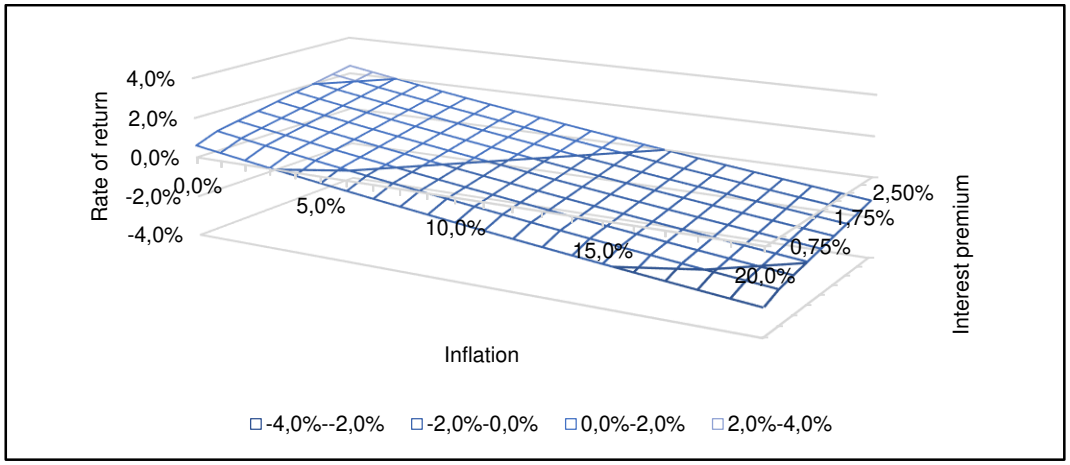

Figure 2. One-period net rates of return in real terms, depending on interest premium levels and inflation.

Source: Own elaboration.

The conclusions from the analysis so far are as follows:

- the higher the inflation levels, the lower the rate of return in real terms, which results from the fixed nature of the interest premium and the growing negative effect of the taxation,
- the higher the interest premium levels, the higher the inflation levels may be, at which the investment will be still characterized by a positive rate of return in real terms,
- the lower the capital gains tax rate – the higher the inflation levels may be, at which the investment will be still characterized by a positive rate of return in real terms.

In the following parts of the article covering the analysis of the profitability of COI and EDO bonds, the scope of the research was limited to bonds issued from January 2010 to December 2021 – so that it is possible to calculate the current net rate of return in real terms for at least one interest period for each issued series, based on actual inflation data for 2022.

Analysis of the yield on inflation-indexed treasury bonds of the COI series

Figure 3 shows the historical interest premium for the offered series of COI bonds, with separate presentation of the premiums applicable to the first annual saving period and the ones assigned to subsequent periods (i.e. from the second to the fourth period). Starting from the period in which the COI series bonds became hybrid (May 2017), two lines were drawn – a dotted one, showing a specific fixed interest rate for the first period, and a dark blue one, representing self-calculated values that show the hypothetical level of interest premium for the first period, if the COI operation principle was not changed in May 2017. The values of this theoretically assumed interest premium were calculated as the difference between the actual interest rate set for the first period and the level of inflation that would have been taken into account for calculating the interest rate, with respect to the previously used methodology. Thus, the figure shows that the hypothetical interest premiums for the first year has been characterized by decreases in recent years, reaching significantly negative values for series

issued at the end of 2021. It should be noted that in terms of calculation of rate of return over the entire investment period, the interest premium set for subsequent periods is three times more important than the one for the first period, because it will be used to generate interest three times (in periods from the second to the fourth), while the interest rate for the first period will be used only once (in the first period). This means that the seemingly equivalent actions taken in 2012-2013 which consist of roughly equal increase of the interest premium in the first period at the expense of values set for the subsequent periods, were in fact unprofitable from the investors' point of view.

Figure 4 presents the rates of return in real terms for COI series bonds issued in 2010-2021. In the case of bonds that have been redeemed by the end of 2022 (series from COI0114 to COI1222) these values should be considered as final, while in the case of the rest (series from COI0123 to COI1225) the values represent the current levels of investment yield, based on ended and settled interest periods by the end of 2022. A comparative analysis of the data presented in Figures 3 and 4 shows that the reduction of the interest premiums for subsequent periods significantly reduced the rates of return compared to the values recorded for series issued in the previous years. In the case of the latest series, the previously described time-shift mismatch risk has also materialized. Among the already redeemed 108 series, 83 of them were characterized by a positive net rate of return in real terms, while 25 series did not protect the investor from an increase in the price level. Among the latest 36 series that were not redeemed by the end of 2022, none of them represent a positive net rate of return in real terms.

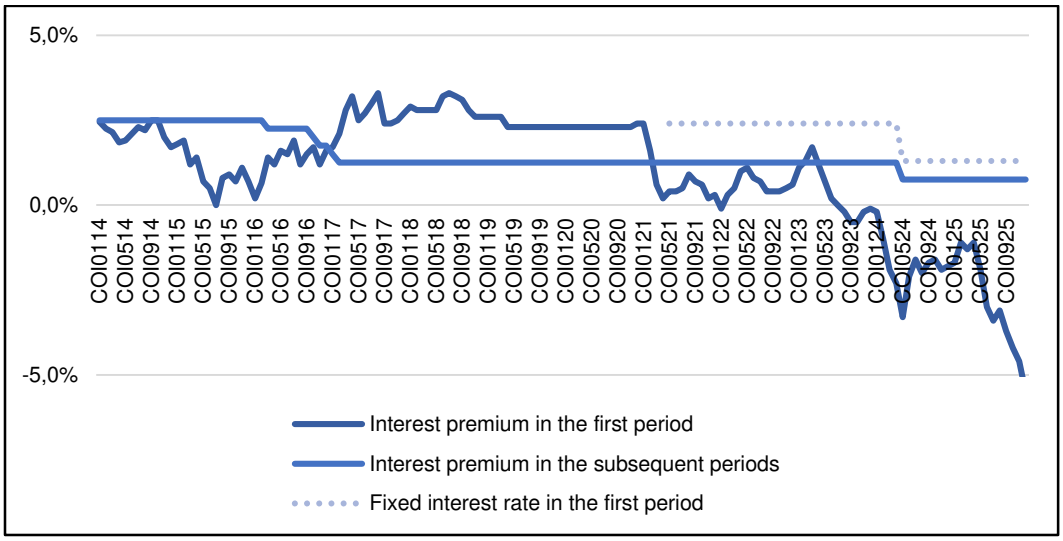

Figure 3. List of interest premiums for the first and subsequent periods set for COI bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

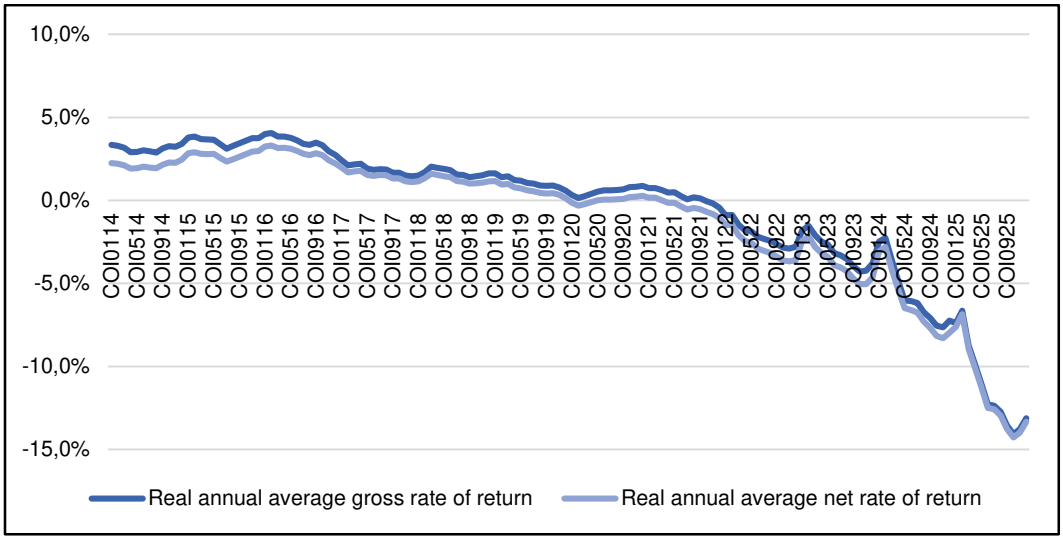

Figure 4. Final/current (in the case of not yet redeemed bonds) rates of return in real terms for COI series bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

Analysis of the yield on inflation-indexed treasury bonds of the EDO series

Conclusions drawn from the analysis of EDO series bonds are similar to those regarding COI series. The actions taken by the individual Polish Ministers of Finance in the scope of changes to the COI and EDO series bonds offers were made roughly in the same pattern.

As in the case of COI series, Figure 5 shows the historical data of interest premiums offered for the EDO bond series, with separate presentation of the premiums for the first periods and the subsequent ones (i.e. from the second to the tenth period). Also in this figure, the third line has been drawn, starting from the period in which the EDO series bonds became hybrid (May 2017), presenting a fixed interest rate for the first period and parallelly calculated values of the hypothetical interest premiums, assuming the EDO series operation principal used until April 2017 would not have been changed. Values of this hypothetical interest premium were calculated in the same way as for COI series, i.e. as the difference between the interest rate set for the first period and the value of inflation determined accordingly to the previously used methodology. The same conclusion as for COI series can also be drawn with regard to the negative impact of the operational principles changes on bonds' profitability, consisting of the increase of interest premium for the first period and in the same time decrease of the interest premium for the subsequent periods. Yet, in case of EDO series this negative effect is more significant due to the fact that the interest premium for the next periods is used for the interest rate calculation not three times, as in the case of COI series, but nine times.

Similarly to analysis of COI series, Figure 6 shows the rates of return in real terms for EDO series bonds issued in 2010-2021. However, the proportion of bonds that have already been redeemed (series from EDO0120 to EDO1222) and are not yet redeemed (series from EDO0123 to EDO1231) has changed, which obviously results from differences in the length of the investment horizon between COI and EDO series. For the newer series, the time-shift mismatch

risk has also materialized, which had a negative impact on a larger number of series due to the longer time of investment. Among the 36 series already redeemed, all were characterized by positive profitability in real terms, while out of 108 not redeemed series of bonds by the end of 2022, only 7 represent of a current positive net rate of return in real terms – these are the earliest series, issued from January to April 2013 and from January to March 2014. The 'jumping' character of the values presented in Figure 6. results from the dynamically increasing inflation levels in the following months of 2021 and 2022 – which resulted in the fact that bonds issued in the first months of the year were based on much lower inflation levels than those issued at the end of the year. The same effect could be observed in the case of COI bonds, but to a smaller extent (only for the latest series).

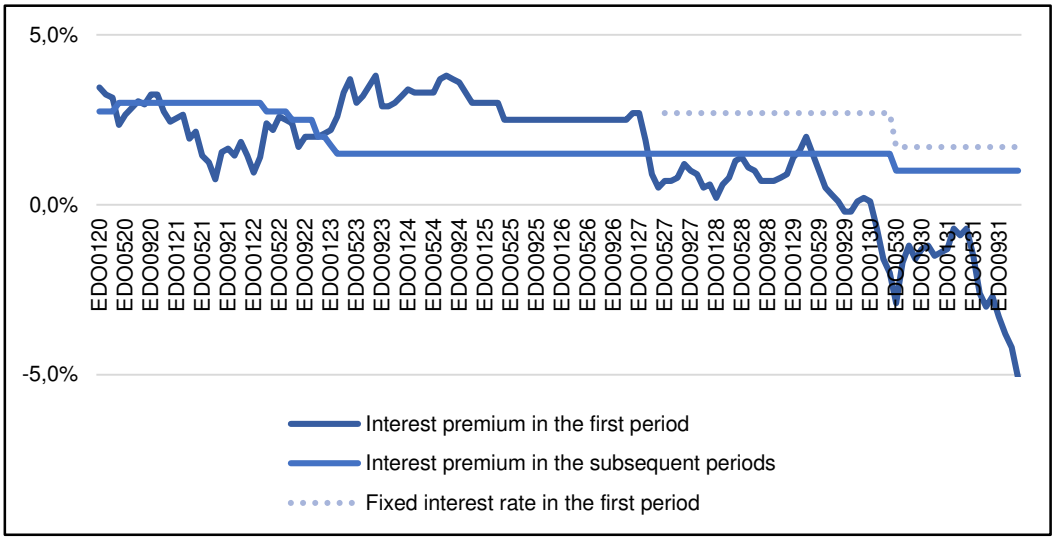

Figure 5. List of interest premiums for the first and subsequent periods set for EDO bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

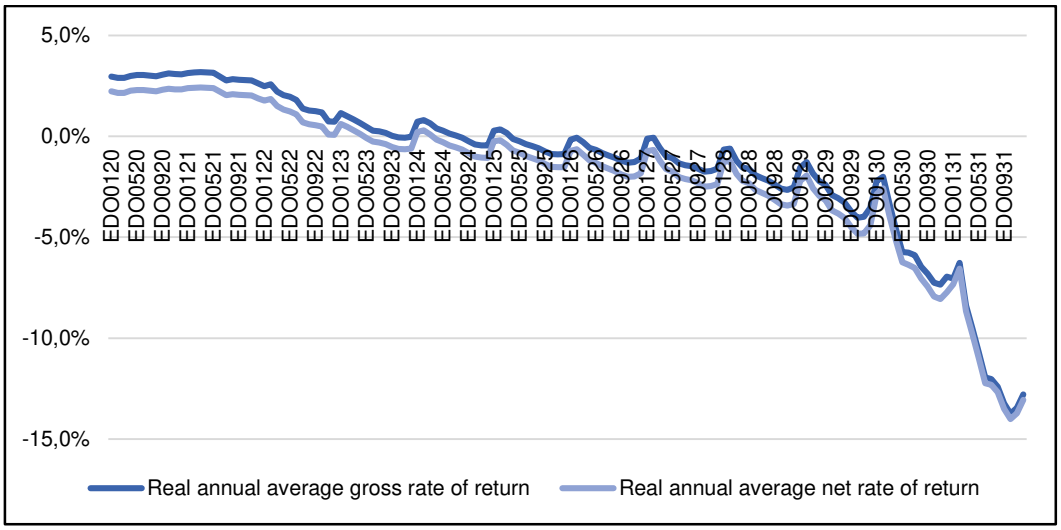

Figure 6. Final/current (in the case of not yet redeemed bonds) rates of return in real terms for EDO series bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

Comparative analysis of inflation-indexed treasury bonds of the COI and EDO series

Figure 7 presents a summary of net rates of return in real terms for the analysed 288 series of inflation-indexed bonds (144 COI and 144 EDO) broken down by the interest premium values for subsequent periods. This summary shows, above all, an obvious positive correlation of profitability of individual series depending on the interest premium level set for the subsequent periods. In addition, it also shows that despite the lower interest premiums, the rates of return for COI series issued in the analysed period were on average higher than those for EDO series, which should be considered as an unexpected conclusion.

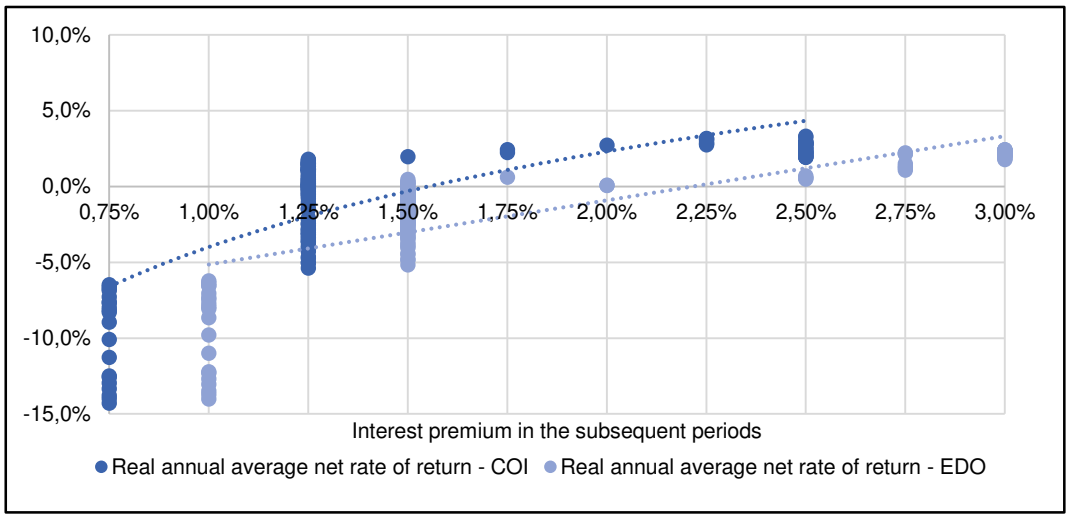

Figure 7. Comparison of average annual net rates of return in real terms for COI and EDO series bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

The explanation for this phenomenon can be found in Figure 8, which presents data of net rates of return in real terms for COI and EDO series bonds broken down by the periods of issuance. At the beginning of the analysed period, the initial expectation of a higher profitability of EDO series versus COI series founds its confirmation in the data. However, in the middle of the period, the profitability of investments in EDO series was much lower than the corresponding COI series. This was due to the fact that the longer investment horizon of EDO bonds has 'reached' the years 2021-2022, when inflation levels began to grow dramatically, negatively affecting profitability and materializing the time-shift mismatch risk. On the other hand, COI series issued in these periods were redeemed in the middle years of this decade, recording additional benefits resulting from the observed deflation. Differences in rates of return has minimized when the COI series' investment horizon also have 'reached' 2021-2022 data. As a consequence, rates of return on EDO series became once again slightly higher than COI series.

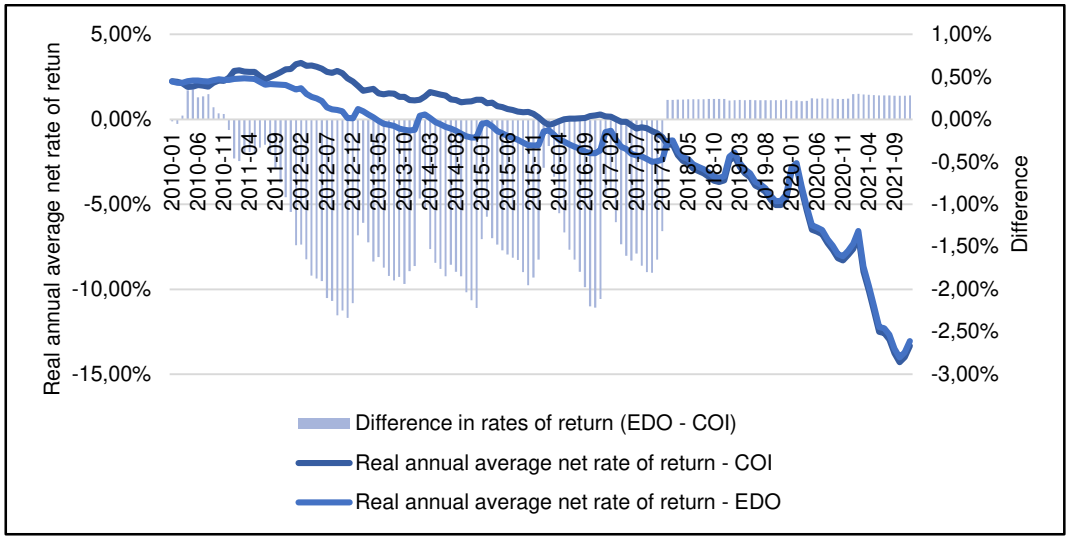

Figure 8. Comparison of average annual net rates of return in real terms for COI and EDO series bonds issued in 2010-2021.

Source: Own study based on Poland's Ministry of Finance and Statistics Poland data.

4. Summary

Own research has shown that in general, operation principle of bonds indexed to inflation should allow the investor to gain protection from negative effects of price changes. Yet, the example of Polish treasury bonds shows that systematic reduction of interest premiums for issued instruments in the following series, the change in the operation principles and the negative effect of taxation and materialization of time-shift mismatch risk – in the high-inflation environment results in significantly negative values of the current net rates of return in real terms of the latest series of COI and EDO bonds. This means that these bonds have not protected investors from the negative effects of price increases and lose of purchase power, what confirms the hypothesis formulated in the introduction. In view of the above, it is surprising that the demand for these investment products is increasing, which may, however, result from investors' expectations regarding a decrease in inflation in the forthcoming periods, as well as the fact that, despite the negative profitability in real terms, these instruments can more effectively minimise the losses stemming from inflation than other types of investments of a similar level of risk (deposits, savings accounts) what can be furtherly reviewed in the next research.

With regard to the limitations of the practical application of the conclusions from the article, it should be pointed out that each investor has his own individual inflation basket. This means that the levels of real rates of return calculated in the way presented in the article, i.e. based on official data of the Statistics Poland, are representative for the entire economy, yet do not have to translate into the same value for the individuals – real rates of return calculated appropriately for the individual investor may vary in both ways and therefore be more or less favourable than presented in the article.

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THE NON-COMPETITION CLAUSE IN LABOUR LAW- IMPLEMENTATION OF THE DIRECTIVE 2019/1152

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Purpose: Issues related to the non-competition clause are the subject of numerous publications. The stimulus for creating this article was the coming into force on 26 April 2023 of the amendment to the Labour Code, aimed at implementing into the Polish legal order two European directives: Directive (EU) 2019/1158 of the European Parliament and of the Council of 20 June 2019 on work–life balance for parents and carers and repealing Council Directive 2010/18/EU, known as the Work–Life Balance Directive; and Directive (EU) 2019/1152 of the European Parliament and of the Council of 20 June 2019 on transparent and predictable working conditions in the European Union. The Act brought a range of changes to the Labour Code, among others, with respect to the non-competition clause. The new regulations will undoubtedly be challenging for employers and bring the non-competition clause in the labour law once more to the forefront of discussion.
Design/methodology/approach: The deliberations are based on the related subject literature and an analysis of the legal provisions applicable in the area under discussion.
Findings: As a result of the implementation of Directive 2019/1152 to the Labour Code, Art. 261, under which an employer cannot prohibit an employee from having a concurrent employment relationship with another employer or a concurrent legal relationship that is a basis for providing work other than the employment relationship, nor can they subject an employee to unfavourable treatment because of this. This provision strengthens the freedom of employees in terms of accepting employment. Since the legislator did not introduce transitional measures regarding the application of said provision, it should be assumed that the ban on prohibiting of additional employment is applicable to employment relationships initiated after the changes came into force as well as those relationships initiated before 26 April 2023. If an agreement with a new employee is concluded after the date of this amendment, the employer will be obligated to conclude such an agreement in a different form to other agreements.
Violation of Art. 261 of the Labour Code by the employer results in employer's liability.
If the employee is not bound by the employer to a non-competition agreement, provision of work by the employee for another employer does not have any negative consequences, and the employer cannot terminate the employment agreement for this reason.
Practical implications: Entrepreneurs will need to implement far-reaching organisational changes in adjusting their businesses to the new legal requirements, and hence it is increasingly important that employers are knowledgeable about the non-competition clause.
Originality/value: This article raises the issue of the non-competition clause, which is important from the prospective not only of the employee but also from that of the entrepreneur employer.

Keywords: labour law, implementation, non-competition clause, entrepreneurs' obligations, employee.

Category of the paper: viewpoint, literature review.

1. Introduction

Legal regulations concerning the non-competition clause were introduced into the Act of 26 June 1974, The Labour Code in 1996 (The Act, 2022, Item 1510). These provisions are extensions of the employee's obligations to act in the best interest of the workplace, protect its property, and maintain confidentiality of information that, if disclosed, could harm the employer (The Act, 2022, Item 1510, Art. 100 § 2 Point 4), and they allow the employer to obligate the employee to additional adherence to the non-compliance clause resulting from the contractual provisions (Masłowski, 2009).

The non-competition clause concluded and agreed by the employer and the employee should be put in writing, under pain of nullity. Finalising of such an agreement can take place at the same time and within the same document as the employment agreement but can also happen in a separate document, as long as it falls during the period of the employment relationship.

The non-competition clause itself, according to Art. 101^1, § 1 of the Labour Code, can take the form of refraining from competitive activity in relation to employers, as well as not accepting employment with a different party undertaking a competitive activity (either within the employment relationship or on any other legal basis). The subject matter of the non-competition clause resulting from Art. 101^1, § 1 of the Labour Code cannot be contractually extended. Unfortunately, since this provision is formulated broadly, doubts can arise in specific situations as to whether it has been violated (Góral, 2014).

The employee can undertake to adhere to the non-competition clause during the period of the employment relationship as well as after termination of such relationship (Kārkliņa, 2021). The period within which the employee is bound by the agreement is particularly important due to the fact that it determines the way in which the agreement is terminated and the potential remuneration (Aromińska, 2014). A party to a non-competition clause during the employment can be any physical person with the status of an employee within the meaning of the Labour Code (Kryczka, 2012).

On 26 April 2023, an act amending the Labour Code act and some other acts (The Act 2023, Item 641) entered into force. This act implemented into the Polish legal order two European directives: Directive (EU) 2019/1158 of the European Parliament and of the Council of 20 June 2019 on work–life balance for parents and carers, and repealing Council Directive 2010/18/EU, known as the Work–Life Balance Directive (Directive, 2019, Item 188); and Directive (EU)

2019/1152 of the European Parliament and of the Council of 20 June 2019 on transparent and predictable working conditions in the European Union (Directive, 2019, Item 186).

The aim of the above-specified directives is to improve the employment conditions of employees on the labour market, and their implementation into Polish law required amendment, in particular of the Act of 26 June 1974, The Labour Code, (The Act, 2023, Item 641). The amendment covered four main areas: the content of an employment contract, information handed over to the employee, additional information for employees sent to work outside of Poland, and additional employment of the employee. In the last of these areas, the addition of Art. 261 of the Labour Code is particularly important as it guarantees to employees freedom to accept additional employment in their free time (except for cases specified in the Act).

Despite numerous publications on the non-competition clause, the implementation of the EU law into the Polish law that took place on 26 April 2023 brought this issue back to the fore. The goal of this article is to indicate changes in the Labour Code caused by the amendment with respect to the non-competition clause, and the challenges that employers currently face as a result of such modifications.

2. Freedom to work

The term *freedom to work* is a universal law, "common to all people (*ius commune*) universal in the sense that it is understood always and everywhere, in every country, and takes into account the natural characteristics of an individual. The freedom to work is thus one of the natural rights of humans (…) The reason for existence of such and no other content of these rights are the human beings who, by nature, are focused on their development and therefore have a relationship with the goods that are due to them. The final reference point for a legal system should thus not be laws on their own, but the wellbeing of an individual, with this being the goal of the application of such laws" (Piechowiak, 1997).

In accordance with the rule of freedom to work, expressed, among others, in Art. 65, Section 1 of the Constitution of the Republic of Poland, freedom of choice, pursuit of profession and selection of workplace (Constitution, 1997) is guaranteed for all. According to Art. 10 of the Labour Code, everyone is free to select their work (in particular with respect to selecting a profession and the place of work (The Act, 2023, Item 641). "Freedom to work means unrestricted selection of employer, freedom to resign from employment, and freedom to accept additional employment. It is unacceptable to force one into performing work. The motivational aspect of the actions of an employee who terminates an employment contract does not affect their freedom to resign from employment" (II PK141/17). This right is complemented by the freedom of the parties to the employment relationship in terms of establishing and shaping the content of this relationship (The Act, 2023, Item 641, Art. 11).

Although the principle of freedom is not absolute, limitations to it can only be introduced under statutory law (K 32/00). Restrictions on the freedom to work will always interfere with the sphere of relations between private entities, and thus with the constitutionally guaranteed freedom of contract. At the same time, when introducing such restrictions, the legislator should be aware of the obligation to protect the weaker party to the employment relationship while respecting the rights and freedoms of the stronger party (Florczak-Wątor, 2021).

The principle of freedom to work is complemented by the principle of freedom to establish an employment relationship, expressed in Art. 11 of the Labour Code (Sobczyk, 2023). This principle guarantees the employee's freedom to take up work, as well as the employer's freedom to select candidates for work, subject to restrictions resulting from the prohibition of discrimination. It also includes the parties' freedom to shape conditions of work and pay (Nałęcz, 2023).

This principle applies not only to the very fact of the creation of this relationship, but also to the formation of its content at the time of its creation. Under Article 11 of the Labour Code, it should not be assumed that a change to the content of an existing employment relationship within the scope of changing the terms of employee remuneration requires, for it to be valid in each case, a joint statement of consent from both parties. "Its content refers directly and unambiguously only to the phase of creating a work relationship and not to changes (modifications, reshaping) to the content of already existing (created earlier) work relationships" (II PK 330/07). It should be assumed that a change to conditions during the work relationship can be made while maintaining the norms adequate for the work relationship.

The rule of freedom to work, as well as the rule of freedom to accept an employment relationship, are basic rules of labour law (Holland, Burnett, Millington, 2016). It is worth emphasising that despite some differences in the content of the provision in Art. 65, Section 1 of the Constitution and Art. 10 of the Labour Law, the doctrine of law accepts that both regulations are a guarantee of free choice of profession and work, meant as the place of work. In both cases, it comes down to civil liberty, and in particular, employee liberty. "This position is justified in particular by the placement of this rule among constitutional freedoms, rights and obligations of human beings and citizens in the section on freedoms and economic, social and cultural rights" (Wieleba, 2018).

3. Additional employment

The provision of Art. 9 Section 1 of the Directive 2019/1152 imposes on the Member States the obligation to ensure that an employer does not prohibit a worker from taking up employment with other employers. Moreover, Member States can introduce additional regulations with regard to employers applying limitations in combining job positions, if such limitations result from objective causes (health and safety, protection of trade secrets, conflict of interest).

As mentioned above, freedom to work is one of the basic rules of labour law. It could be thus assumed that before the amendment there had already been grounds for the employee to accept work (including additional work) freely.

The admissibility of introducing limitations to the freedom of undertaking additional employment by the parties in a work relationship under an employment contract raises a range of doubts in the doctrine of law as well as the judicature (Jaśkowska, Maniewski, 2023). Until now, the Labour Code did not refer directly to the matter of general prohibition of undertaking additional employment. Labour laws only included regulations concerning contractual non-competition clauses, and that could in the future bring accusations from the European Commission regarding the lack of adequate implementation of the Directive (EU) 2019/1152 of the European Parliament and of the Council. The problematic issue was whether the employer could prohibit the employee from undertaking other employment outside of the non-competition clause; e.g., within the same employment agreement (Jaskulska, 2023). In the decision of 2 April 2008, the Supreme Court shared an opinion that "the provisions of an employment contract envisaging a prohibition from undertaking additional employment within the scope of non-competitive activity with respect to the employer is not valid (Art. 58, § 1 of the Labour Code in conjunction with Art. 300 of the Labour Code), as it constitutes a bypass of the prohibition resulting from Art. 101^1, § 1 of the Labour Code" (II PK 268/07). While in the decision of 14 April 2009, the Supreme Code took the position that "crystallization of the obligation of caring about the condition of the workplace can take the form of contractual limitation to the employee undertaking additional employment through an appropriate prohibition of necessity to obtain the employer's approval to undertake such employment (activity). Such limitation cannot be introduced if there are no grounds for it in the real interest of the workplace" (III PK 60/08). In the decision of 6 December 2018, the Supreme Court emphasized that in the Polish situation, employees' search for additional employment is often determined by their economic situation, and the application by an employer of a ban on additional employment without guaranteed fair remuneration, if such employment does not affect the economic situation of the employer and its position among its competition, violates the principle of freedom to work (II PK 231/17).

Finally, Art. 261 was added to the Labour Code, in accordance with which an employer cannot prohibit an employee from concurrently having a work relationship with a different employer or concurrently having a legal relationship that is the basis for providing work, other than the work relationship; nor can the employer subject an employee to unfavourable treatment for this reason. The legislator decided to introduce the above provision, thus following the instructions of Directive 2019/1152 and at the same time strengthening the freedom of the employee with respect to accepting employment.

Since the legislator did not introduce transitional provisions concerning the application of the said provision, it should be assumed that the ban on additional employment applies to work relationships created after the changes came into force as well as those created before 26 April

2023. If an agreement with a new employee is be concluded after the amendment, the employer will be obligated to conclude it in a different form than for other agreements.

The fact that the wording of Art. 9 Section 1 of the Directive 2019/1152 ("Member States shall ensure that an employer neither prohibits a worker from taking up employment with other employers…"), was adopted by the Polish legislator almost verbatim, can cause serious problems with its interpretation. The use of the word "prohibits" can mistakenly suggest that a contractual exclusion of the right of the employee to undertake employment with a different employer is permissible under Art. 261 of the Labour Code.

It seems correct to take the position according to which the provision of Art. 261 of the Labour Code should be considered as a ban on an employers' interference in the private matters of employees, and the additional employment itself should be undertaken solely in the employee's free time. The undertaking of additional work (by an employee or non-employee) cannot lead to poor quality of provided work by such employee (Sobczyk, 2023). It is without doubt that in the event that an employee undertakes additional employment with a different employer, it is possible to terminate a work agreement with such an employee if such additional employment results in non-performance or inadequate performance of that employee's work obligations.

What is important is that Art. 261 of the Labour Code refers to any kind of provision of work; i.e., providing work under an employment relationship as well as under civil law contracts (contracts of mandate for providing work, contracts for specific work), volunteering contracts, contracts for providing work by an employee as a sole trader, partnership or corporation, if the employee has the status of a partner.

In view of Art. 29 § 1 of the Labour Code, the reason for justifying termination of an employment agreement or its dissolution without notice of termination or a reason for conducting an activity having the same effect as termination of an employment agreement cannot be the concurrent employment relationship with another employer or a concurrent legal relationship that is a basis for providing work other than the employment relationship, unless limitations in this extent result from separate provisions, or an event specified in Art. 101^1, § 1 of the Labour Code (The Act, 2022) has occurred.

The Act also transferred onto the employer the burden of proof that the termination of an employment agreement or undertaking of an action having the same effect as termination of the employment agreement is not based on inadmissible premises. In other words, the employer, in the event of a dispute, has to demonstrate that the decision made by the employer to lay off an employee was based on objective criteria and was not solely a result of the additional employment.

If the employee thinks that the reason for terminating a trial-period employment agreement by notice or for an action having the same effect as termination of the employment agreement was the concurrent employment relationship with another employer or a concurrent legal relationship other than the employment relationship, the employee can, within 7 days from the

submission of the statement of intent by the employer concerning the termination of an employment agreement or undertaking an action having the same effect as termination of an employment agreement, submit to the employer, on paper or online, a request to present duly justified reasons for such termination or such action (The Act, 2022, 29, § 3). On the side of the employer, this will create an obligation to provide the employee with an answer to the request to present duly justified reasons for termination of an employment agreement or undertaking of an action having the same effect as termination of an employment agreement, on paper or online, within 7 days from the submission of the request by the employee.

The provision of Art. 261 of the Labour Code is excluded in a situation in which the employer applies Art. 101^1, § 1 of the Labour Code or if separate provisions stipulate otherwise.

The first exception refers to a non-competition agreement for the duration of the employment. The employee and the employer can be bound by a non-competition agreement that introduces a ban on undertaking additional employment, but only within the scope of the work provided for an entity with competitive business activity with respect to the original employer.

The second exception concerns statutory provisions limiting additional activity for certain groups of employees, e.g., employees of government offices, academic staff, or civil service workers.

The Directive allows Member States to introduce further limitations to the provision, as long as they are justified. The Polish legislator assumed quite a strict approach to this EU ban, forgoing the possibility of listing exceptions to such an extent as suggested by the Directive 2019/1152 (Makar, 2023).

According to Art. 101^1, § 1 of the Labour Code, it is possible to draw up with an employee a separate non-competition agreement during the employment relationship, which, in order for it to be valid, has to be made in writing. Under the provisions of such agreement, the employee undertakes to refrain from additional work or performing work for another employer (if stipulated so by separate provisions). The latter is applied, for example, to local government employees, who are not allowed by law to undertake employment that would infringe their professional obligations.

It is worth emphasising that "by concluding a non-competition agreement during the employment relationship (Art. 101^1 of the Labour Code), an employee obligation arises, covered by the content of the employment relationship, to refrain from conducting competitive activity with regard to the employer or to provide work within the employment relationship or on a different basis to the entity conducting such activity. The employee is liable for a breach of such obligation under the rules specified in the Labour Code" (I PK528/02). In accordance with the judicature, the Supreme Court accepts that "competitive activity is an activity shown in the same or identical subject matter and addressed to the same audience, covering, even partly, the scope of the main or additional activity of the employer. As a result, activity that infringes on the interests of the employer or threatens the employer can be prohibited.

Competition means rivarlry between entities or persons interested in achieving the same goal. Undertaking competitive activity is thus synonymous with actions taken for economic purposes or with participation in commercial ventures or transactions the results of which are directed (or could be potentially directed), even partly, at the same audience" (II PK 39/06).

Summing up, except for the situations specified in Art. 261, § 2 of the Labour Code, the employer cannot impose on an employee a ban on concurrent employment relationships by a way of an order, nor enter with an employee into an agreement that would introduce such a ban, and this contractual reservation will be invalid under Art. 18, § 1 of the Labour Code (Sobczyk, 2023). This also concerns provisions introducing such a ban that are included in the content of an employment agreement.

Problems can arise in a situation in which employer and employee, before implementing Directive 2019/1152, were not bound by a non-competition clause. The introduction of such limitation will depend on the employee's will, and the employer no longer has the possibility of laying off the employee because the employee remains concurrently in an employment relationship with another employer or concurrently provides services on a different legal basis to what was permissible under the regulations binding at an earlier time.

4. Conclusion

Implementation of the Directive (EU) 2019/1152 of the European Parliament and of the Council of 20 June 2019 on transparent and predictable work conditions in the European Union strengthened the protection of employee rights in Poland. Although before the amendment to the permissibility, the Supreme Court took the opinion that the provisions of an employment agreement providing for the prohibition of undertaking additional employment in the non-competition area are invalid, adding Art. 261 into the Labour Code undoubtedly strengthened the position of employees and gave them the freedom to undertake additional employment. In view of the above-mentioned provision, the employer cannot prohibit the employee from remaining concurrently in an employment relationship with another employer or remaining concurrently in a legal relationship being a basis for providing work other than the employment relationship, i.e., a relationship based on any civil law agreement, although such provision will be excluded in the event that the employer applies the provisions of Art. 101^1, § 1 of the Labour Code or other separate provisions so stipulate.

An employer can enter into a non-competition agreement with an employee, but it should be remembered that it cannot prohibit the employee from undertaking any work; such a ban can only concern competitive work. It is also worth emphasising that non-competition clauses included in employment agreements concluded before 26 April 2023 are invalid.

It should be emphasised that the sole fact of performing other work by the employee, in accordance with the meaning of Art. 29 of the Labour Code, cannot serve as a basis for unfair treatment of the employee, and in particular cannot cause negative consequences for the employee, i.e., cannot serve as the basis for justifying termination of an employment agreement or its dissolution without notice by the employer.

Due to the short period within which the discussed regulations have become binding, it is difficult to assess their functioning in practice. Only time will tell whether and to what extent they require further amendments and improvement.

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SUPPLY CHAIN RISK MANAGEMENT OF LOGISTICS COMPANIES THROUGH MERGERS AND ACQUISITIONS

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Purpose: The paper aims is to determine the factors determining the development of mergers and acquisitions in the logistics sector, but also the resulting dependencies related to difficulties in managing the risk of a combined enterprise under the influence of adverse economic events, such as the COVID-19 pandemic or the conflict in Ukraine.
Design/methodology/approach: The paper was divided into two parts, consisting of a source literature of mergers and acquisitions, logistics, risk management and global supply chain, and a part devoted to the analysis of trends in the logistics sector in 2018-2022. The research took into account data from the reports of recognized audit firms.
Findings: Based on the trends, the authors observed a connection between the risk resulting from adverse economic events, e.g. the COVID-19 pandemic and the conflict in Ukraine, on the degree of merger decision-making, in particular in the context of supply chain management, which is important for the functioning of a logistics company.
Practical implications: The experience of logistics companies in recent years shows that the issue of supply chain risk management is an important criterion when making decisions about merging with another company. Moreover, unfavorable economic events that affect supply chain management also determine mergers and acquisitions.
Originality: The paper is an interdisciplinary analysis of the M&A market in the field of supply chain risk management in logistics companies during COVID-19 and the conflict in Ukraine, which has not been subject to in-depth verification in the studies of other authors. The paper is a result of the authors' research that was partially presented at the 3rd International Conference "Logistics challenges in the modern world" organized by the Warsaw University of Life Sciences on January 19, 2023.

Keywords: risk management, logistics, mergers and acquisitions, COVID-19, conflict in Ukraine, supply chain.

Category of the paper: case study.

1. Introduction

One of the fundamental elements of the global economy is the global supply chain in which three basic entities participate: supplier, recipient and enterprise. Its purpose is to meet the demand for specific goods and products, so any disruptions in its functioning affect both the global economic situation and individual entities. The outbreak of COVID-19 pandemic and the conflict in Ukraine significantly remodeled the current way of managing the supply chain. The greatest effects of these events include change in consumer habits through the development of e-commerce, volatility of raw material prices and uncertainties related to the timeliness of orders, or the search for alternative sources of supplies and communication with contractors. All these changes can be treated as both a potential opportunity and a threat.

Since supply chain is a system of flow of raw materials, materials, subassemblies or finished products, its efficiency depends on the degree of integrity of individual links, which are often other companies, as well as the customer himself (logistics customer services). Enterprises striving to improve efficiency and reduce operating costs must look for new solutions that, on the one hand, will ensure development and, on the other hand, will be a reaction to adverse economic events. One of the ways to respond to these expectations is long-term investment through mergers and acquisitions.

The paper aim is to determine the factors affecting decision-making in logistics in the area of mergers and acquisitions in the face of the effects of COVID-19 pandemic and the conflict in Ukraine, and also to indicate the impact of these events on risk management in selected enterprises that have merged in recent years. The authors reviewed the theoretical foundations explaining the phenomena occurring on the mergers and acquisitions market in the context of the logistics. Additionally, they conducted an analysis of the entity structure of logistics, taking into account the directions of its development and strategy formulation, as well as assessing the impact of risk management in the supply chain of the merging enterprises.

2. Literature review and research in the field of mergers and acquisitions

Logistics companies become participants in the control market through mergers and acquisitions. It is a result of increasing benefits that the M&A deals may bring to the companies. They include e.g. diversification of the production range, entering new markets, acquiring a unique production and manufacturing technology. If these objectives are considered as benefits of the merger or acquisition, their reverse will potentially threaten them. It involves risk because it is the probability of a hazard occurring. If it is assumed that the inverse of the typical benefits of a merger or acquisition is the lack of diversification of products or services,

a reduction in production capacity, sales and market share, decrease in cost optimization and, consequently, a lack of synergy, it means that the effects expected from the transaction have not been obtained. Failure to achieve them determines failure to meet the goals set in the strategy and merger plan, and thus constitutes a failure for a company.

The purpose of business combinations is long-term development, when entities are unable or unwilling to use other means of external development. However, due to the time horizon, legal implications and organizational consequences, planned mergers and acquisitions entail a number of potential risk areas that should be diagnosed in advanced.

It is worth emphasizing that risk is an indispensable element of a market economy. As an objective and at the same time common phenomenon, it is taken into account in every type of activity, constituting its integral part (Kulińska, 2011). This is due to the fact that each activity is undertaken under conditions of uncertainty, in the absence of all information and predictable variables. Among the potential risk areas, the theory and practice of management point to problems related to the diversity of the workforce, social responsibility and issues of ownership and ethics, but also to areas related to globalization, ensuring the expected level of quality and production efficiency, and difficulties in adjusting production volumes to expectations and abilities of the employed staff (Drucker, 2009). Factors shaping the phenomenon of risk in an enterprise may come from the competitiveness of domestic companies, instability of regulations, volatility of customer preferences, management system inadequate to current challenges, lack of employee competence, unpredictability in terms of exchange rates and behavior of the stock exchange as well as forces and natural phenomena, as well as unreliability of technology and social and financial system (Ciekanowski, Wyrębek, 2016).

The multiplicity of various reasons for the occurrence of risk in an enterprise translates into its existence and financial condition (Kwiecień, Wójcik-Jurkiewicz, 2022). This phrase is important in the perspective of supply chain management in enterprises covered by mergers and acquisitions, where risk identification at a relatively early stage allows you to avoid threats to its further functioning. In order to understand the essence of merger processes, it should be noted that although both forms of mergers - mergers and acquisitions - are of a long-term nature, their purpose, and therefore the degree of risk can be different.

The merger is carried out by way of consolidation or incorporation. Consolidation is defined as a merger of at least two enterprises, as a result of which a new enterprise is created (Korpus, 2014, p. 30). As a result of this process, the merging entities lose their legal personality. Incorporation occurs when, as a result of a merger, one of the enterprises retains its legal personality, and the enterprise incorporated (incorporated) into the buyer loses its legal personality.

A takeover process is different, it entails the loss of control to the acquiring company (acquired company to the acquiring company), which does not lead to the loss of legal personality, and thus does not lead to the cessation of the acquired legal entity. A special

relationship arises which is used by the buyer (acquiring company). Acquisition most often takes place as a result of the direct acquisition of such a number of shares (shares) of a given enterprise that allows it to be controlled. It may also occur as a result of the purchase of assets, obtaining a power of attorney with majority voting rights at the general meeting, privatization of an enterprise, joint venture or lease with the right to exercise voting rights at the general meeting. Figure 1 presents the forms of business combinations.

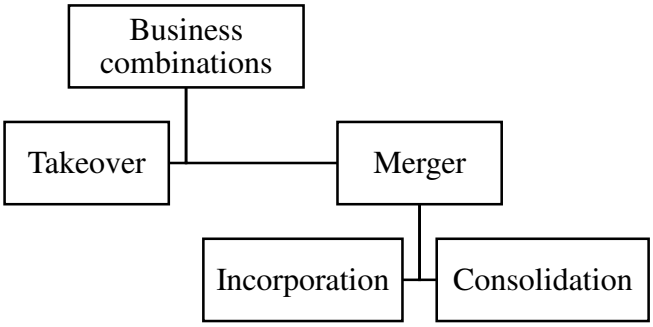

Figure 1. Business combinations scheme.

Source: author's own studies.

Takeovers can be done by both purchasing an entire enterprise and its separated part or even selected assets. It is most often due to the acquisition of intangible resources, e.g. production technology, licenses or know-how, which will allow it to achieve a better position on the market. In practice, it happens that it is a stage preceding a merger, which is a tighter form of cooperation.

The pressure of development in the face of market constraints, in particular in hermetic sectors where there are high barriers to entering the market, result in a high level of activity in the field of business combinations. As a result, the findings of the merged enterprise after the integration period are lower than expected. It increases with growing business dependencies between entities and in such organizational structures where transaction costs (due to technological conditions) are high, e.g. in tech industry.

Nevertheless, it is also visible in logistics companies that base their operations on the supply chain in which various entities participate - suppliers, recipients, secondary or incidental contractors, and even competitors. A simplified model of the supply chain, taking into account three entities: supplier, intermediary company and recipient is presented in Figure 2.

Figure 2. Simplified model of supply chain.

Source: author's own studies.

Among the three basic features that characterize the supply chain, source literature indicates: subjective structure, understood as separate entities that cooperate with each other. In turn, the object structure is a set of products, goods and materials that are transferred through subsequent links of the supply chain to the final recipient and additional intermediary elements.

The last group mainly includes goals, scope of activities and areas of cooperation between the participating entities (Zbroja, Marel, 2020). As indicated by M. Romanowska: "Striving to reduce transaction costs and improve the competitive position in relation to other entities, rationally operating enterprises will limit competition, developing cooperation with both suppliers and customers. And in justified cases, with its competitors" (Romanowska, 1997, p. 16). According to the authors, this thesis is consistent with the transaction costs theory and, apart from the contractual theory or the network approach, it indicates the dependencies that arise between the company and its environment. They highlight the links in the supplier-recipient relationship, as well as between competing entities. This is due to the fact that logistics service operators create the supply side, which, thanks to appropriate connections, enables the functioning of the communication channel in market conditions.

The creation of global supply chains is the result of the impact of connection processes, but also other processes related to the need to reduce risk in global logistics management by taking actions aimed at:

1. expanding the links between the degree of product service at individual stages, combined with continuous analysis of the demand for products and services,
2. improving the means of monitoring the handling of products or services for the development of world trade,
3. developing theoretical concepts of logistics, production and marketing management (Dyczkowska, 2012, p. 422).

Mergers and acquisitions in logistics companies may additionally require an analysis of the profitability of investments and ways of organizing management in the combined company, e.g. integration of positions or division of tasks (Jeszka, 2013, p. 30).

3. Risk areas of companies merging in the logistics during COVID-19 and the conflict in Ukraine

Large enterprises striving to develop their activities to mergers. This is also visible in the logistics sector, in which entities involved in various activities in the supply chain participate. The structure of the logistics services market is mainly changed by network, transnational connections, the purpose of which is to concentrate technical and organizational solutions, in which, together with the development of IT systems, they create new development opportunities. The COVID-19 pandemic and the conflict in Ukraine, as well as the resulting consequences in the form of high inflation in many countries, restrictions on energy supplies from Russia, changes in adopted climate policies and instability of consumer demand, forced an urgent revision of the current direction of logistics risk management. At that time, the demand for transport services collapsed, and the pandemic weakened the flexibility of

transport and the timeliness of orders (Ziółkowska, 2021). The dependence of the global industry on suppliers located in Asia has led to many problems that the COVID-19 pandemic has highlighted. Delays in deliveries, increasing costs of transport and storage of goods, congestion in transshipment ports, difficulties in timely execution of orders have shown how excessive reliance on foreign production can be a threat to the entire supply system. The supplier-entrepreneur-recipient model was shaken, because a supplier who was unable to accept an order for product supply could not transfer it to an intermediate entrepreneur, who could not transfer it to the final recipient.

The supply chain before the COVID-19 pandemic was based on sourcing raw materials at the lowest possible cost, regardless of the country of origin, while applying the JIT (Just-In-Time) strategy. It is based on the delivery of materials and goods before the very moment of reporting the demand for them, which did not contribute to the creation of high stock levels, and thus did not generate high storage costs. The COVID-19 pandemic, followed by the outbreak of the conflict in Ukraine, forced a revision of this direction. It should be mentioned that globalization, which has been progressing for many years, has begun to give way to partial deglobalization. Recently, friendshoring or mutual trade with friendly countries has become popular (especially after the outbreak of the US-China trade war in 2018). The determinant of the choice, taking into account this approach, is not only the need to reduce costs, but also the emphasis on interdependence with trading partners. This action has consequences both internationally and nationally. An insufficiently diversified supplier base has a negative impact on the production capacity of enterprises, and thus on the flow of goods in the supply chain. Before the pandemic, many enterprises, especially smaller ones, used only a few suppliers and service providers, who in turn based their activities on selected customers. For both sides of the supplier and the recipient, this solution was beneficial, as it did not generate expenditures, and as a result of serial production and certainty of business relations, it ensured a relatively predictable profit.

During the COVID-19 pandemic and after the outbreak of the conflict in Ukraine, such an approach began to involve risks. The risk of the global supply chain in logistics companies has an internal basis (within a given distribution channel) and external (resulting from macroeconomic dependencies). In a Deloitte report The Ripple Effect. How manufacturing and retail executives view the growing challenge of supply chain risk the authors classified the risk into four related categories:

1. operations carried out within the distribution channel - from the production design process, through transport, distribution and return logistics,
2. extending the standard supply chain with cooperation with business partners in the field of supplying logistics services and distribution,
3. macro-environment, i.e. based on phenomena resulting from unforeseen economic, political, social and economic events that will force a revision of the directions of

distribution channels and their preferences among interested parties (suppliers, recipients), e.g. in connection with the COVID-19 pandemic or the conflict in Ukraine,

4. the scope of functional support, covering areas of the company not directly related to logistics, forwarding and distribution, e.g. finances, human resources, payroll, legal and IT departments, the limitations of which may lead to problems with the flow of key operational data, e.g. waybills, accounting documentation, lists orders, etc.

Figure 3 shows the most important risk areas in mergers and acquisitions, taking into account the protection of the interests of the buyer and seller.

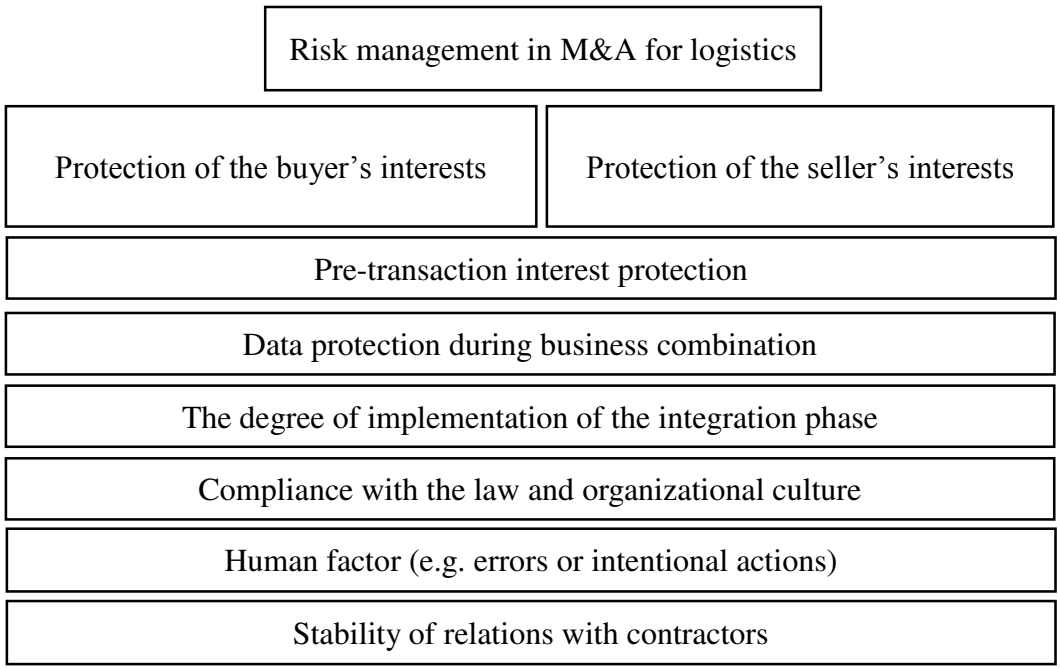

Figure 3. Risk areas in mergers and acquisitions in the logistics

Source: author's own studies.

The correctness of the merger depends on both the phases preceding the merger (preparation and planning), in which analyzes and studies of investment profitability and potential effects on the financial condition are carried out, and the integration phase, in which the adopted solutions are implemented (but also to capture anticipated value and moderate risk). Due diligence plays a key role in the risk analysis of mergers and acquisitions. Its role is to identify and eliminate risk. A successful transaction depends to a large extent on the proper preparation of both parties for the merger

Identification of risk areas that may arise during the merger of entities relates in particular to differences of a financial, organizational, legal and cultural nature (organizational culture). Risks may relate to irregularities (mistakes made at the integration stage), fraud, criminal acts (corruption), trade restrictions (export and import), conflict of interest or loss of credibility (both on the part of the buyer and the seller), both as a result of intentional and and unintentional activity (human factor). Therefore, attention is drawn to the need to secure the interests of the merging enterprises before the transaction is made. This applies in particular to the protection

of digital data, including accounting and employee documentation. A common problem faced by enterprises before a merger is the risk of incurring excessive expenditures that will not be compensated by a transaction premium. It results from the limited access to reliable financial data before the merger (Partacz, 2022).

4. Challenges resulting from the COVID-19 pandemic and the conflict in Ukraine for the logistics sector

The development of logistics services is the result of the growing demand for them, which is met by logistics operators. The logistics services sector brings together a group of enterprises diversified in terms of services offered, but also the range and scale of operations. In the logistics sector, there are both small, local and large, international enterprises, offering logistics services at various levels of execution, from logistics management, through transport, storage, packaging, forwarding services, to reverse logistics or comprehensive supply chain service. The development of this sector is supported by modern technical and organizational solutions supported by ICT systems (Janczewska, Janczewski, 2021).

The most important benefits of mergers and acquisitions for the logistics sector in 2018-2023 include: increasing market share and access to new markets (mainly for international enterprises); increase in competitive position; concentration of capital, which is conducive to the use of solutions using IT systems based on optimization; expansion of the portfolio and diversification (extending the range of services offered); synergy and technological exchange (Toborek-Mazur, Wójcik-Jurkiewicz, 2022).

Table 1 contains a summary of the number and value of mergers and acquisitions in 2019-2021 and in the first half of 2022, based on the PwC Transport & Logistics Barometer report.

Table 1.
M&A transactions before, during and in the post-pandemic time

	2018	**2019**		**2020**		**2021**		**2022**	
Time	**Before pandemic**			**Pandemic times**				**Conflict in Ukraine**	
Period of the year (half-year)	I + II	I	II	I	II	I	II	I	II
Number of deals	223	138	123	103	150	148	175	144	117
Total transaction value (in $bn)	113,8	68,4	74,3	37,1	62,8	94,5	119,7	131,3	50
Average transaction value (in $mln)	510,8	495,9	604,1	359,7	418,4	638,3	683,8	911,7	427,5

Source: author's own studies based on (PwC, 2022).

Table 1 contains the number and value of M&A transactions broken down by the period before the pandemic (2018 and 2019), the pandemic (2020-2021) and the year 2022, when the conflict in Ukraine broke out. The data shows that the pandemic period did not significantly

affect the trends in the merger and acquisition market in the logistics sector. The data from 2020 are different. They result from the then sanitary restrictions and restrictions on mobility introduced in many countries around the world. The visible decrease in the value and number of transactions in 2020 compared to the previous year is not significant. Although the time of the pandemic influenced the merger decisions and thus the development of the global economy. In 2021, 323 transactions with a total value of over USD 214 billion were carried out, which is the highest result among all the years surveyed. In 2022, the number of mergers and acquisitions in the logistics sector decreased by about 19% compared to the previous year, which is due to the disruption of the global supply chain as a result of the conflict in Ukraine (Toborek-Mazur, Partacz, Surówka, 2022). Figure 4 contains a graphical presentation of the presented analysis.

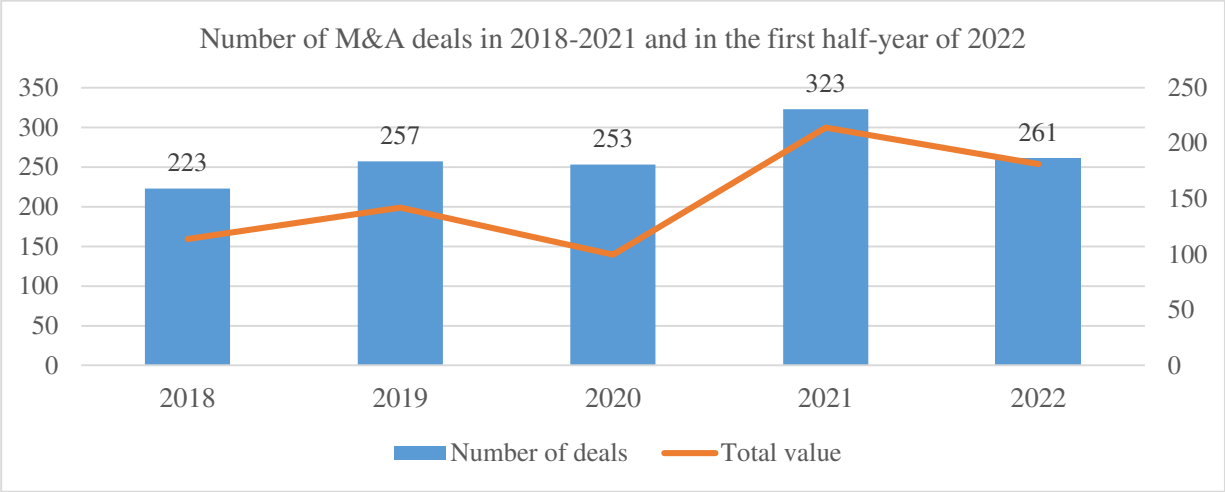

Figure 4. M&A transactions before, during and in the post-pandemic time.

Source: author's own studies based on Table 1.

Figure 5 presents a graphical structure of M&A transactions in the logistics sector.

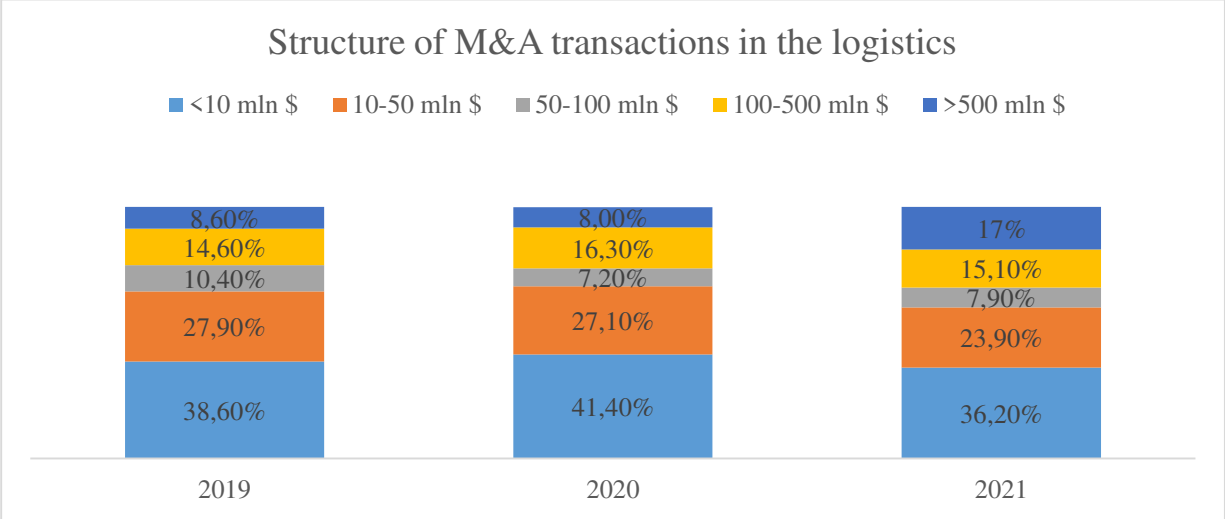

Figure 5. Structure of M&A transactions in the logistics sector in 2019-2021.

Source: author's own studies based on table 1.

Analyzing figure 5, it can be seen that the structure of M&A transactions in the logistics sector is similar. The largest share in the analyzed years was attributed to transactions not exceeding USD 10 million, values between 36.2% in 2021 and 41.40% in 2020. Transactions between USD 10-50 million were followed in terms of the size of M&A transactions. Transactions above USD 500 million and between USD 50-100 million participated the least. The indicated data suggest that mergers and acquisitions in the logistics sector are not among the most expensive, which may result from the high degree of diversification of logistics activities, but also from the high costs incurred by enterprises for operating activities. The year 2021 was exceptional in this respect, as a 17% share of transactions exceeding USD 500 million was recorded, with a relatively low (compared to previous years) transaction volume of up to USD 10 million.

Initially, the outbreak of the COVID-19 pandemic disrupted the global supply chain (Toborek-Mazur, 2022). This problem was particularly visible in manufacturing companies, which, due to the nature of work involving many processes, starting from the acquisition of the necessary elements and components, through production, transport, loading and distribution, led to temporary shortages on the market. An example of the problems that logistics companies had to face at that time were the difficulties in accepting goods at the warehouse on the basis of notifications (the value of delays in the second quarter of 2020 ranged from 37-40% (Marel, Zbroja, 2022)). The notification is based on a declaration made by the owner as to the quantity of goods that will be delivered to the warehouse and the time of arrival to the destination. The declared value of the goods is not verified and the goods are not additionally recalculated. The advantage of such a solution is speed and low cost, and the disadvantage - the lack of information on potential discrepancies between the declared and actually delivered to the warehouse. This also applies to discrepancies between the actual arrival at the destination and the time of notification, which affects the formation of queues of transport waiting for unloading. Advice is therefore important in manufacturing companies because it can ensure smooth operation, which allows you to generate higher profits.

Logistics companies either opted for long-term contracts with partners or looked for alternative suppliers who would be able to fill stock shortages if necessary. The conclusions contained in the report of the American investment bank Houlihan Lokey can be presented as confirmation of the analyzed data. The authors found that the trend resulting from the first years of the pandemic continues. It is additionally updated with other macroeconomic phenomena, e.g. the increase in the US Federal Reserve rates, inflation and the volatility of M&A development in Europe. In addition, it results from the adaptation of the global economy to the distribution trends of nearshoring, i.e. a variant of outsourcing focused on the development of local partnership, without the need to adapt to differences, e.g. cultural ones. Finally, the authors of the report point to the potentially negative effects of the conflict in Ukraine (decrease in exports to the Ukrainian market). Table 2 contains data of the Houlihan Lokey in 2020-2022 divided into quarters.

Table 2.
M&A transactions before, during and in the post-pandemic time

	2020				2021				2022		
	Pandemic								Conflict in Ukraine		
Period of the year (quarter)	I	II	III	IV	I	II	III	IV	I	II	III
Number of deals	117	80	113	149	138	146	155	161	151	124	106

Source: author's own studies based on (Houlihan Lokey, 2022).

Although the data presented by PwC and Houlihan Lokey differ from each other in terms of the recorded number of mergers and acquisitions, they indicate a trend in which the COVID-19 pandemic and the conflict in Ukraine influenced the development of the logistics sector in terms of management decisions connection decisions. This is partly related to the presented factors shaping the M&A market, but also to the directions of development of logistics companies in recent years. These studies confirm the trend for 2022, in which a slight decrease, by approximately 20%, in the global volume of mergers and acquisitions is noticeable. The period following the COVID-19 pandemic and the events resulting from the conflict in Ukraine trigger the lipstick effect. In times of economic downturn and increased uncertainty in business judgment, buyers are more likely to focus on smaller deals that are more affordable than opting for spectacular call costs. In Q3 2022, for the first time in three years, no transactions exceeding USD 10 billion were made (WTW, 2023).

A significant merger and acquisition transaction in the logistics sector in 2021 was the signing by the CMA CGM Group (a global logistics operator in the field of contract logistics and air and sea freight) a share purchase agreement with Ingram Micro Commerce & Lifecycle Services (CLS). The acquisition was based on the acquisition of a significant portion of Ingram Micro's North America, Europe, Latin America and Asia-Pacific businesses. This allowed CMA CGM to strengthen its position in the segment of services for contract logistics and e-commerce, in particular in the management of reverse logistics and same-day delivery services. The transaction was finalized, making the subsidiary (CEVA Logistics) the fourth largest contract logistics provider in the world. The value of the transaction was estimated at USD 3 billion. In addition, in 2022, CMA CGM acquired 100% of GEFCO's capital. GEFCO is the European leader in contract logistics in the automotive segment. It plays an important role in maintaining the continuity of European production lines.

The causes and effects of the development of the M&A market in the logistics sector in recent years should be divided into those resulting from the COVID-19 pandemic and the conflict in Ukraine. The effects of the COVID-19 pandemic include an increase in consumer demand, which has accelerated the development of e-commerce. There are at least two reasons for this event. First of all, it results from the change in consumer habits - the growing importance of online shopping, the development of the e-commerce market and electronic payments, a process that began years before the pandemic, and the direction of which the pandemic only exacerbated. Secondly, from the limitation of mobility during the COVID-19 pandemic.

Sanitary restrictions and restrictions introduced by the governments of many countries, including Poland, have reduced the migration of people and goods. In March 2020 (at the time of the significant spread of the virus), car traffic decreased by 50% compared to the averages from previous months (Paprocki, 2020). In addition, the effects also include disruptions in the supply chain - the search for alternative sources of supply and the increase in raw material prices in the world.

The outbreak of the conflict in Ukraine, which intensified in early 2022, affected the global supply chain. Ukraine is one of the world's largest grain exporters, mainly corn, wheat and barley. According to data published by APK-Inform, in 2021, 86 million tons of cereals were exported from Ukraine. Forecasts for 2022 indicated a decrease oscillating around 54.1 million to 55.7 million tonnes due to harvest reduction. According to research, the greatest fears related to the conflict in Ukraine are recorded by the TSL sector (transport, forwarding, logistics) - (54% of respondents), of which as many as 72% of respondents consider it to be at least moderate (PIE, 2022).

In enterprises (not only logistics) it can be seen that the risks arising from the initial and final phases are interrelated. They result from the ambiguity of the goals formulated at the stage of developing the strategy, which is implemented in the integration phase (after the actual merger). Most often, it manifests itself in the desire to achieve too high a level of synergy, which is associated with the involvement of funds in transactions of inadequate value or lack of understanding of the prospects of the acquired party, but also the issues of cultural assimilation and communication and organizational policy, e.g. in the field of changing positions.

5. Summary

In the conditions of high product competition, both in terms of quality, prices or access to the market, logistics is one of the most important spheres of activity of production and commercial enterprises. Achieving efficiency in service is possible thanks to integrated logistics activities within the supply chain. Integration of processes is possible both thanks to cooperation with various logistics operators, as well as thanks to the acquisitions carried out within the company's own communication and distribution channel.

Supply chain management of logistics companies that have decided to merge is associated with a number of changes of a strategic nature. Demand for individual goods and services decreased or changed during COVID-19 and the conflict in Ukraine, which forced many logistics companies to change their strategy and verify their current supply channels. These events have an impact on determining the directions of development of logistics companies, also in the context of making decisions about the connection process. Based on the

observations, it was noticed that both the COVID-19 pandemic and the conflict in Ukraine affected the number of mergers and acquisitions. Although these values do not differ significantly from data from other periods, the results suggest that, in order to protect the capital, assessments of the economic feasibility of the merger should be made. In the analyzed period, buyers in the logistics sector focused more often on making smaller transactions than they decided on costly transactions with large entities on the market. While it may be an element of a defensive strategy in an unstable competitive environment, in the future it may turn into an offensive strategy that will use new communication and distribution channels to win new markets.

A changed structure of trade, which was undermined by the pandemic and then the conflict in Ukraine, will most likely not lead to the end of the globalization trend, but at most, according to the authors, to its partial transformation, which will be based on a revision of the current direction of supply chain development through local mergers and acquisitions, mainly of a vertical nature. An additional variable that should be taken into account is the progressing process of automation and digitization, which will only intensify in the coming years. Enterprises interested in long-term growth must skillfully adapt to market expectations so that the effort put into merging enterprises for diversification in the supply chain is not wasted. This is also important so that in the future economic operators can react to similar threats in a no less decisive way. The faster the adaptation to changing market conditions, the more effective the protection of assets.

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UTILITY OF THE GENDER MANAGEMENT SYSTEM IN THE PROCESS OF SOCIAL DEVELOPMENT AND MODERNIZATION – IN SEARCH OF POLICY OF GENDER EQUALITY AND EQUAL OPPORTUNITIES FOR WOMEN AND MEN

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Purpose: to present the role and importance of the Gender Management System as a set of procedures, standards and instructions used at various stages of management (planning, implementation, motivating, steering, organizing, controlling, evaluating, improving), which are aimed at equalizing the opportunities and possibilities of both sexes and elimination of sexual differences. It is a strategic process consisting in optimizing the management of an organization by constantly striving to increase its effective functioning, multiply its resources (primarily human, but also financial, market, information, and material), and maximize the potential value for stakeholders.
Design/methodology/approach: an overview of original articles, programs and strategies on the Gender Management System. Presentation of the state of the art and possible further implications.
Findings: GMS is a tool for activating women in development processes, effective use of their personal resources, including by offering access to the management and life-shaping of organizations for women, recognizing the full impact of women on the content, pace and course of social change and modernization processes, creating an organizational culture by women that grows out of the values they recognize as key, and incorporating these values into the official management style.
Practical implications: conducting a systematic and in-depth literature review (with conclusions) will improve research on the Gender Management System. On this basis, attempts can be made to effectively implement the main assumptions of the GMS and correct previous mistakes in the field of gender equality management.
Originality/value: there are no publications dealing with this issue, especially in Polish management science.

Category of the paper: review article.

Keywords: Gender Management System, resources, social development, modernization, women.

Gender equality is the goal that will help abolish poverty that will create more equal economies, fairer societies, and happier men, women, and children, Graça Machel

Introduction: Gender Management System - theory and practice

Gender equality is one of the fundamental principles of the adopted legal system (expressed in legal norms and interpretations) and of the organizational system (used by bodies or organizations that implement and enforce the above-mentioned rights). This means that there are institutionalized procedures, measures, and instruments that can bring real changes in the functioning of an organization - both in its structure (with particular emphasis on hierarchical systems, access to the highest positions, and promotion opportunities) and in the organizational culture related to values, foundations programming, assumptions and goals, behavioral, cognitive and linguistic artifacts (Schein, 1995). Achieving and implementing the principle of gender equality is a complex and broad process - it covers various segments of the organization, takes place at all management levels (top management, middle management, lower management) - in the operational, coordination, and strategic fields. It must also be a continuous, constantly renewed procedure, monitored by specially appointed agencies. As long as the postulate of gender equality will not be fully incorporated into the areas of organizational activities and practices, as long as management is ineffective, flawed, or worse, it causes a leadership crisis, obstruction of decision-making processes, professional burnout, and accumulating conflicts. Therefore, it seems necessary to introduce innovative solutions and progressive models focused on equality, democratization, and human rights, the acceptance of which is achieved through formal and official management activities and external evaluation. This is complemented by support networks, building community resources, increasing socio-cultural capital, shaping human resources, and increasing human potential.

One of the paths of change towards gender equality is the Gender Management System (GMS). This is a set of procedures, standards, and instructions used at various stages of management (planning, implementation, motivating, steering, organizing, controlling, evaluating, and improving) aimed at equalizing the opportunities and possibilities of both genders and eliminating gender differences. It is a strategic process consisting in optimizing the management of an organization by constantly striving to increase its effective functioning, multiply its resources (primarily human, but also financial, market, information, and material), and maximize the potential value for stakeholders. The concept of GMS was created in the 1990s in Great Britain as part of the gender mainstreaming policy, becoming not only an important theoretical recommendation but also an indispensable action bringing real profits for the organization - for its internal and external environment. This concept was presented by the Commonwealth Secretariat - the intergovernmental, supreme institution of the Commonwealth of Nations, responsible for the process of policy formulation and consulting, dissemination of innovative solutions and good practices, implementation of effective strategies and programs for sustainable development, democracy, and fair governance. Although the implementation of this concept may differ from country to country (in different geopolitical and

socio-cultural areas), the main axis around which sub-strategies and actions are designed is the recognition that the interests, aspirations, and talents of both genders are equivalent. The distribution of goods, setting priorities, creating policies should be made based on clearly and precisely indicated criteria of equal opportunities and non-discrimination - when women and men are provided with identical conditions for personal and professional development. It is also about transforming knowledge and power systems in such a way as to be able to identify instruments that effectively eliminate all gender inequalities and obstacles to full equality. The pursuit of full equality is seen as a condition of sustainable development, intergenerational solidarity, modern democracy, and civil society. According to the proposed program, all efforts should be focused on creating the following vision of the world:

"a world in which women and men have equal rights and opportunities, and in which women are respected and valued as equal and able partners in establishing values of social justice, equity, democracy and respect for human rights. Within such a framework in collaboration and partnership to ensure people-centred sustainable development for all nation" (Commonwealth Plan…, 1995).

Adopting such an approach requires the use of mechanisms, processes, and applications that guarantee and maintain gender equality in various areas of the public sphere (politics, banking, finance, education, healthcare, cultural sectors). GMS is based on gender differentiation, which should be taken into account in the management process and the system of social relations. Gender plays a fundamental role in the structuring of reality - it defines socially generated characteristics and attributes assigned to gender, creating the social identity of women and men. This, in turn, determines the place of the individual in society - it affects the access to goods and services, mobility in the social structure, and the realization of interests and values. Gender is processual in nature - it is constructed and reconstructed in action, in the course of interaction, as well as through social and political institutions such as family, labor market, and the welfare state. Therefore, the category of gender should permanently enter the mainstream of politics, economics, and management, as it is a necessary condition for maintaining the horizontal principle of gender equality. This is accompanied by the belief that it is impossible to effectively and reliably manage and build the potential of an organization without treating both sexes equally and subjectively, without fully involving women in decision-making processes, without taking into account gender differences in creating the organizational environment. GMS is therefore not only an opportunity, but even a necessity - it is of key importance when strengthening the resources and potential of an organization, promoting diversity, maintaining integration and organizational cohesion, and meeting the requirements of the equality directives proposed by the European Union.

Including gender in the areas and methods of management requires taking steps to build the organization as an environment free from all forms of discrimination, especially in the field of budget planning and implementation, benchmarking, and strategic analysis. These activities should be undertaken by all actors that are within the organization, have an impact on it, or care

for the well-being and flourishing of the organization. Affirmation of gender equality is also done by expanding the partnerships of stakeholders in cooperation with civil society, the business sector, and the government (Kurebwa, 2016). It is a project activity, thanks to which it is possible to prevent depreciation, marginalization, or exclusion of any gender, and women and men can participate in the decision-making, information, and executive processes on an equal footing. The overarching goal is to transform masculinistic models of management, to sensitize to gender differences, and to include women in the mode of creating conditions, arrangements, and rules according to which the organization lives and develops. If this process is successful, then there is a change in the management paradigm - towards an egalitarian model that implements and consolidates the principle of equality and realizes the right to equal treatment regardless of sex, age, degree of disability, ethnic or national origin, class affiliation, etc. this is how the Gender Management System is created, under which regulations, directives and procedures are created that are obligatory and universally applicable, and entities are appointed to guard them. The administration of gender equality requires standardization, so there should be a set of institutionalized principles as a basis of reference - guaranteeing equal, broad, and cost-effective participation and access for all sexes to goods and profits. The Gender Management System should be treated as a fruitful investment - it is an integral element of the organizational culture that serves to achieve goals, promote value, create an image, attract talents, raise financial indicators. This system should work at all levels of organizational culture - that is, in terms of artifacts (language, objects, technologies), the system of norms and values (mission, valued and desired properties, management style, hierarchical systems, image, and brand), interpersonal relations within the organization, and also between the organization and the environment (Nogalski, 1998). The main goal of GMS is to introduce organizational changes in all organizational structures in which gender inequalities or discrimination occur. In the opinion of Catherine Atthill, Tina Johnson, Suzanne Williams, a favorable environment for these changes is created by: an appropriate administrative and legal framework, well-selected and prepared human resources, properly calibrated financial resources, political will, active civil society, women holding decision-making positions and functions. Such a formed environment determines both the activities of organizations and markets, but also the dynamics of events and trends that form the foundation of the company's existence. In this environment, GMS structures, processes and mechanisms are also created that evoke social change and development. The structures include organizations and institutions responsible for introducing and maintaining gender equality: Gender Equality Commission or Council, Parliamentary Gender Caucus, gender focal points or inter-ministerial steering committee, lead agency, gender management team. On the other hand, the processes that take place within these structures relate to: designing GMS instruments, developing and implementing a strategy of actions supporting gender equality, highlighting the issue of gender equality in individual ministries and economic sectors. All this can take place through special educational and psychosocial mechanisms, including: diagnosis and gender training (aimed at

raising awareness), management information system (aimed at transparency and effectiveness of communication), performance evaluation system (http://oasis.col.org). GMS is therefore a tool for deep changes in contemporary management processes, organizing policies within the organization, eliminating distribution conflicts, and relations with the environment. The institutional policy created in this way, shaping gender relations and systems of gender hierarchies, directly influences the economic system as a whole. This is because the existence of special socio-economic programs; building social agreements through consensus, dialogue, or deliberation between employers' organizations, trade unions, and the government decides about macroeconomic stabilization and leads to strengthening the position of the state thanks to building a social base, protection from the welfare state, properly planned and distributed public expenditure, increasing the purchasing power of the underprivileged population (Tridico, 2007, p. 112).

At the same time, it should be emphasized that the changes evoked by GMS require not only deep structural transformations, but above all the identification and revision of the norms of thinking, perception, action, or even social identity and personality. The main aspirations are the realization of gender equality as well as fair distribution and access to goods, services, and their control. It is also about promoting values such as equality, consensus, dialogue, understanding, fair treatment, proportional division, and distribution of goods or capital (not only financial but also cultural and social). These programs include a series of institutionalized instructions and recommendations designed to improve the social, political, and economic situation of all citizens, with a particular focus on women. The focus on women results from the fact that in management systems they are a disadvantaged group, despite the anti-discrimination legislation in force and the existence of institutions that can enforce respect for human rights. The implementation of GMS assumptions requires the strengthening of the institutional infrastructure in the field of distinguishing human, organizational and material resources, which are adequate and sufficient to shape social relations according to the newly introduced standards and rules. In this case, normative transformations are also necessary - it is about recognizing gender equality as the guiding principle of management, as well as about a new type of mentality that will reorganize the social order and initiate an egalitarian orientation. Institutions and values should be a reference point for any axionormative regulations, because "shaping a sense of justice or injustice is anchored in both values and interests, because both spheres are important to people" (Morawski, 2001, p. 23). The development process will run according to the assumed scenario only if the operation and strength of the institution are initiated in organizational values, their compliance with egalitarian aspirations, and equality distribution mechanisms.

Gender in development and gender equality as a pro-development factor

Social, political, legal, and economic equality can be considered a qualitative criterion for development and modernization. Achieving this equality, using appropriate instruments and equalization mechanisms, should be the main aspiration of institutions and organizations, regardless of their mission or specialization. It should also be implemented in the course of social activities - because these activities create and recreate institutions; while the institutions regulate the actions. Inequality disturbs the functioning of the community, causing their polarization, moreover, it slows down economic growth, inhibits progress, and generates conflicts and tensions. As Richard Wilkinson and Kate Pickett argue, "it is known that inequality affects so many dimensions of life and on such a broad spectrum of society. The transformation of society is in the interest of all its members. Greater equality is the gateway to a society capable of making everyone's life better and a significant step forward in building a sustainable economic system" (2011, p. 250). Socio-economic development is accelerated not only by new technologies and products but also (perhaps primarily) by an axionormative system that should be integrated with the system of knowledge, innovation, design, and creative solutions. Thus, while the old theories of social development oscillated mainly around the economic axis (employment growth, enrichment, economic recovery, GDP growth, prosperity, finding outlets, improving competitiveness), the modern approach to development assumes compatibility of development with other areas of life, such as health, family, education, the justice system, politics, culture. Civil rights and freedoms began to be recognized as an important element of development, and gender equality became an important pro-development factor. It is about equality of women and men in terms of rights, duties, realization of needs and interests; as well as for equal opportunities to be present and participate in the public sphere, to derive benefits and profit, and to build status. At the same time, gender equality is the lack of any discrimination achieved through equal treatment, abandoning stereotypical social roles ascribed to the sexes, and negating attitudes that create or perpetuate inequalities.

Gender equality is not only an attribute of every organization, but also an inalienable and unchanging component of its functioning, despite the constant evolution and flexibility of both the organization and its environment. All social actors should be involved in the design, promotion and promotion of gender equality. It is "the indispensable foundation of a peaceful, prosperous and sustainable world", the importance and importance of which is signaled in the documents regulating the directions and aspects of development (including: the Lisbon Strategy, the Millennium Development Goals, the Europe 2020 Development Strategy). Gender equality should therefore become a new paradigm for managing an organization that aims at increasing the quality of services provided and goods produced, creating new policies, awakening related values, and respecting and guaranteeing human rights. To highlight and

estimate the importance and impact of this equality on development processes, the Gender Inequality Index (GII) was introduced - as one of the most important elements of the Human Development Report (2010). The GII reports to what extent global gender inequalities result in losses in terms of achievement, gains, and benefits in the following three areas (taken together). The first area is labor market participation (measured through the participation of women in the labor force, taking into account paid and unpaid work as well as active job search). The second is empowerment (level of education, percentage of women in parliament). The third is reproductive health (maternal mortality rate, number of teenage mothers). GII allows to determine the position of women in a given society, shows the source and scope of gender inequalities - on this basis, it becomes possible to create intervention and preventive programs that will minimize or eliminate the indicated problem. According to Pasquale Tridico, in order for social development to follow a set pattern and result in the achievement of social equality, apart from GDP growth, the following conditions seem necessary: effective conflict resolution mechanisms, fighting inequalities, stimulating economic activity (2007, pp. 96-98). The implementation of these assumptions is fostered by the efficient and effective operation of institutions that have adequate personal, organizational, and material resources to recognize and meet social needs, with particular emphasis on the fight against discrimination and unequal treatment.

Due to feminist criticism, gender has become a central component of development theories - on the premise that full economic development can only be achieved through equal division and distribution, global justice and gender egalitarianism. To achieve this, radical restructuring and re-planning of development processes in terms of policies and practices that create them seem to be necessary (Momsen, 2019). Gender equality turned out to be a necessary condition for modernization, and at the same time its desired effect - it is a component of a great cultural change, the consequence of which is the decline of industrial societies (Alexander, 2007; Inglehart, Norris, 2003) and the diffusion of roles typical of these societies (Apter, 1965). The influence of modernization is visible - as Ronald Inglehart and Pipa Norris write - on two levels of cultural transformations. Firstly, modernization made women work professionally, became a paid workforce, and gained economic independence, which at the same time changed the hierarchical structure of the family and reduced the birth rates. Moreover, the literacy rate of women decreased - they learned to read and write, began to educate themselves, acquired electoral rights, entered the path of political participation. Secondly, women, having appropriate education and competencies, gained managerial positions and significant political influence, perform freelance professions, and strive for equality. The two levels described above are closely related to further social changes (transitions): from traditional and religious values to rational and secular values; from values conditioning survival to free expression (which was manifested in gender equality). The resulting reforms and women's rights have brought about significant changes in culture, while the change itself is not sufficient to make gender equality universal and pervasive (2003,

p. 20). It seems necessary to constantly strive for equality and emancipation, pointing to their constitutive nature, and loud and emphatic cry for them. In his book Freedom Rising, Christian Welzer points to the rapid expansion of rights and freedoms because people clearly demand them - regardless of whether they live in a democratic system or outside of it. Although Western civilization is the cradle of these values, the demand for these values arises in authoritarian regimes. People want universal "emancipatory values" and "existence free from domination" because this desire has the driving force - it is the basic motivation for human empowerment and autonomy (Welzer, 2013, p. 2). Therefore, a social change is necessary - that is, "broadly understood non-cyclical transformation of institutions, norms, culture or social structure" (Sztompka, 2005, p. 437). Changes in thinking and valuation (especially a reevaluation of the ideological assumptions of the social order) evoke structural changes, favor the emergence of institutions and procedures that uphold these values, and the accompanying systemic organizational solutions.

Changes leading to modernity, towards an optimal model of society, must be successively carried out in various areas because modernization is a multi-faceted and complex process, stimulated by factors of various origins and steered by various agendas. Firstly, it is about changes in the economic sphere - especially in the field of the market economy (existing economic entities, production method, rational management), changes in contemporary labor markets, technological and scientific development, knowledge, and information transfer. Secondly, these are changes in the political sphere, including political changes, the shape of foreign policy, democratization, and direct state investments. Thirdly, they relate to the socio-cultural sphere - with particular emphasis on cultural patterns and cultural rules (norms and values, discourses, and the language of reality description). Affirming gender equality in society and continuing activities for egalitarian sexual relations is the current and relatively new ideological and axiological foundation of all progressive processes oriented towards modernity and progress. This is because the theories of modernization actually until the 1970s ignored the importance of gender in creating a modern society, assuming that development is not determined by gender or the gender of the entities that initiate this development, lead it, or are its architects. Modernization was seen as a cycle of change or a series of stages designed and supervised by men. Women had a limited influence on the direction and dynamics of development processes that took place beyond their participation, control, and knowledge, usually without taking into account women's needs, aspirations, and interests. Regardless of the framework in which modernization is understood, it can be concluded that morphogenesis (Archer, 1988), structuring (Giddens, 2003), and becoming a society (Sztompka, 2005) are thoroughly androcentric - defined by the male vision and interpretation of reality; shaped by knowledge and power systems belonging to men. Modernization was mainly based on male models and patterns that could not be applied to the world of women in a 1:1 ratio - so it did not guarantee an equal distribution of goods, benefits, and social benefits. Therefore, an alternative development and modernization program should be created, which should be

based on a conscious policy conducted by reformed institutions operating according to equality standards and procedures. This policy should focus on reducing deviations from the originally assumed version of sustainable development, as well as allowing interventions by the state, business, and non-governmental organizations. So that the effect of development is a planned change in the sectors in which it was approved and assumed (Pepe Roberts, 1979, pp. 60-66). Subsequently, complementary measures should be taken, focused on the strengthening and full implementation of the newly established normative practices that will create lasting relationships and interpersonal systems.

Feminist criticism, questioning the theory of modernization adopted so far, began to emphasize the gender factor in the theories of development, pointing out that the achievement of measurable and perspective benefits is possible only through "gender sensitization", i.e. redirecting the development process to such paths that will take into account the interests and aspirations of women and strive for their autonomy and empowerment. It is about "radical restructuring of the development process" in terms of policies and practices (Momsen, 2019). In this way, as early as the 1970s, the Gender in Development approach was born, aimed at including women in the processes of sustainable development, integrating gender with current global trends, implementing equality programs into the ongoing economic processes, and creating new types of behavior of economic system entities. Elliot describes this integration strategy as the Revised Development Model (1977, p. 4). The inclusion process involves taking into account gender relations in planning, management, the anticipation of modernization directions, shaping public policies, and long-term strategic thinking. As Duflo points out, "gender empowerment can favor development if women make decisions that are better for long term growth" (Duflo, 2012, p. 3), which largely depends on the behavior and decisions made within households run mainly by women. Development is the result of individual and rational decisions of producers and consumers made in basic management units, which focus on meeting the needs of members. Household activities take place in a specific cultural context. It is therefore also about examining this context and indicating its impact on the labor market, medical care and public health, the education system, housing, ecology, low crime rate, and improvement of the quality of life.

In view of the above, it is worth asking the question: what place do women occupy in social and economic development? As noted by Ester Boserup in the pioneering work Woman's Role in Economic Development (1970), the role of women in development was initially ignored or treated superficially - especially when it comes to the negative impact of development on the situation and place of women in society, about which she writes from the perspective of an economist (Beneira, Sen, p. 279). Boserup points out that economic development and macroeconomic policy are sexually determined - both men and women exert a different kind of influence on them, participate in them differently, and to varying degrees are their beneficiaries. Boserup emphasizes the role and importance of women in the structural transformations characteristic of modernization in industry and agriculture. She emphasizes that women and

men played different roles in development processes and shaping developing economies, and therefore their contribution to development should be differently qualified and assessed. The domination of capitalism was not as beneficial for women as it was supposed to be, because capitalism neglected the need to equalize access and relatively equal opportunities to meet needs. Based on empirical data, Boserup highlighted the main (previously known and still valid) problems and pathological mechanisms: women were used as "cheap labor" - receiving low wages, working excessively in very difficult conditions, coping with the use of blunt tools and non-specialized techniques and thus significantly contributed to the accumulation of capital and land, which then became the property of men. Although women achieved tangible profits as farmers and systematically increased the productivity of farms, the successive stages of development meant that women lost access to land, which lowered their status and position in the community. Boserup says: “When sales of land increase women are at a disadvantage, because they usually cultivate subsistence crops for the family, while men cultivate cash crops or work for a wage. Therefore, it is the men who have money and can purchase land. Thus the possession of land is likely to pass gradually from women to men, even in tribes where women have the right to inherit land” (1970, p. 47). The increased participation of women in the labor market and the feminization of professions have led to a widening of the scope of female paid labor. However, at the same time, it has had numerous negative consequences for women - such as: employing them in unskilled jobs, in less prestigious, underpaid, and secondary sectors, often deprived of social security and other benefits. The creeping job insecurity additionally weakened the subjectivity and agency of women as social actors who could shape development processes. There is a vicious circle in this situation. For when jobs in the profitable and dynamically developing industry, trade, and administration are occupied in the absolute majority by men, diametric differences arise between the male and female perception of the world and their everyday functioning. As at the time when self-catering was replaced by commercial farming, men then had modern tools while women operated with old, primitive methods. As the mentioned economist writes, "two successive steps in economic development can be seen; in the first step, subsistence activities for family use are replaced by commercial production for sale, and small scale market trade and services. In the second step, this type of activity is replaced by employment in modern factories, offices, modern shops and modern service industries” (1970, p. 166). Progress has proved beneficial and fruitful for men, while for women it has been neutral, and at times disadvantageous and disruptive, due to the increased competitiveness that results from the fact that modernized male enterprises have an advantage over traditional ones run by women. As a result, the income gap widens even more, and gender inequalities have further negative effects (Tan, Toulmin, 2007, pp. 4-7). Gender is the first and fundamental factor in the division of labor, regardless of the degree of development and organization of a given community or society: „Even at the most primitive stages of family autarky, there is some division of labor within the family, the main criteria for the division being that of age and sex... Both in primitive and in more developed communities, the traditional

division of labor within the family is usually considered 'natural' in the sense of being obviously and originally imposed by the sex difference itself" (Boserup, p. 15). Thus, the division of labor, as an economic category, sustained the developmental diversities in the world economy.

Ester Boserup, as an "interdisciplinary visionary of sustainable development" (Turner, Fisher-Kowalski, 2010, p. 1), created a new framework for the theory of development and modernization. Describing the models and stages of modernization (also in the context of historical changes), she also gave instructions on actions that would accelerate this modernization. The main thesis of Boserup was the call to rebuild and strengthen the status and potential of women, which was weakened by development processes initiated by the West (Turner, Fisher-Kowalski, 2010, p. 3). The developmental change was long-lasting and extended in time, it was of an endogenous nature, and therefore it depended on internal resources and potentials. In the course of change, social structures that "change under the influence of other structures are of great importance, although they may be resistant to such changes for a shorter time or longer periods, and they only change when the pressure is strong or persistent" (Boserup, 1995, p. 508). In this case, class affiliation, divisions, and classifications resulting from gender stratification, which - according to the socioeconomic assumption - regulate the articulation and realization of interests as well as access to goods, are of significant importance. Thus, women, but also poor men deprived of power and tools of domination, are in a similar, disadvantageous situation (Turner, Fisher-Kowalski, 2010, p. 6). For the change to become possible, new configurations and reconfigurations of structural connections within social roles and positions should be allowed, which will lead to the emergence of new (previously unknown or not practiced) hierarchy and power systems. Boserup's position laid the foundation for the so-called "Women in Development" (WID) approach, which then evolved into "Women and Development" (WAD) and finally into the aforementioned advanced analytical "Gender and Development" (GAD) approach. It is worth emphasizing that in these three approaches, the change was exogenous, determined by external factors and influences - especially those resulting from globalization and geopolitics.

WID, WAD, and especially GAD, perceive women in subjective categories - as social actors capable of carrying out a social change and setting the direction of social development, actively participating in the course of modernization. Gender - treated as a framework for interaction and institutionalization of social relations - defines the mode and dynamics of change in two aspects. First, the individual represents gender, is "entangled" in a set of roles, statuses, attitudes, functions, or dispositions assigned to that gender. On the other hand, gender is a modified social construct, the existence, and image of which are constructed by society and culture – based on myths, beliefs, attitudes, collective imagination, norms, and values prevailing in the community. It is a processual construct that can be transformed and reorganized in time and space. Gender determines the roles, positions, and statuses of all genders in society. Consequently, "the organization of women in changing their roles is a central issue in development. Modernization inequalities must be solved through structural changes, especially

political ones, because institutions that discriminate against women may be insensitive or highly resistant to economic development" (Turner, Fisher-Kowalski, 2010, p. 8). A necessary condition for the change is therefore the introduction of institutionalized instruments and activities and the design of complete institutional systems that will be a stimulus or accelerator of this change, and they will also coordinate and promote this change. In this context, it is possible to indicate a positive dependence of this process with economic growth, as "development is growth achieved thanks to institutional changes" (Fadda, 2003, p. 15). Development is going beyond or going beyond the previously considered natural and commonly practiced rules and introducing innovative approaches in their place; it is overcoming the obstacles and "resistance of the whole complex of established interests and values" (Kuznets, 1965, p. 30) that block or maintain this development in the old framework. The reformed institutional structure should be oriented in such a way as to maintain adaptive efficiency - perceived as the central component of economic growth, which assumes flexibility of the course of this growth in the long term (Boehlke, 2009, p. 96). Thanks to adaptive efficiency, a new management system is created based on innovation and creativity, in which the way of reacting and responding to the growing demands of the environment and the speed of adjusting the offer to the changing needs of customers are maintained at a high level of effectiveness. In addition to institutional transformations (taking place within state or business sector institutions), the WID, WAD and GAD approaches require the initiation of informal processes, understood as development support, in the field of care, guidance, counseling, psychotherapy, coaching - all those aimed at strengthening and expanding the network of contacts and interactions, building partnerships and support groups, facilitating access to qualified and helpful tutors or mentors who will show you how to plan a professional career, how to fight stereotypes, how to protect yourself from discrimination, how to solve gender-related problems (e.g. violence), harassment, feminization of poverty), how to shape your (female) model of work, organization, and management.

As Caroline Moser points out, the most important GAD tools include 1) gender role recognition, 2) diagnosis of the needs of each gender; 3) abandoning the stereotypical division of resources in the household; 4) balancing the rights and obligations. All this requires gender planning in development processes and placing women in positions adequate to their education, experience, and commitment, giving them their rightful places and a voice in the public sphere (Moser, p. 1993). Although at the conceptual level this approach seems to be overall beneficial, it raises some doubts in terms of specific social practices. Firstly, the assumption of achieving holistic well-being and universal (available to all) benefits becomes impossible, because it is impossible to satisfy everyone due to the limitations of certain goods and due to individual differences in terms of psychological, social, and biological characteristics (Roberts, 1979). Secondly, there is an ambiguity in the concept of integrating women in the development process which has made it difficult to achieve this goal from the very beginning. Women are rightful participants in all processes of social change" (Papanek, 1977, p. 15). This lack of uniformity

or conceptual consistency stems from an overly generalizing approach to the vision of including women in development processes and deciding on their behalf about issues that should be the subject of their autonomous choice. Moreover, modernization is not an egalitarian process - contrary to the hope placed in it, it will not cause the modernization of enterprises to translate into benefits for all participants in this process and that all will benefit similar or identical.

Including women in the development process requires a rational state policy through reformed and egalitarian-oriented institutions and organizations that remain in constant dialogue, understanding, and cooperation with the social side and business circles. Feminization of development and modernization also requires the successive involvement of donors in the creation of social policies aimed at ensuring and maintaining gender equality. Thanks to the dissemination of equality programs and projects, they can strengthen the position and status of women in society, which is especially important and useful in poor countries or masculinized sectors. These activities are totally transformative because by reducing gender inequalities in strategic domains, they lead to women's empowerment and overall social progress (Grown, Addison, Tarp, 2016, p. 312). Most often, these activities are carried out in two ways - in parallel, they include direct investments and affirmative actions for girls and women, and the implementation of specific elements of gender mainstreaming in donor plans, strategies, and initiatives (Brouwers, 2013). While the programmatic assumption of this approach seems to be right and effective, it can also show shortcomings or weaknesses. Internationally recognized experts in the field of gender in development indicate that the accusation against the donors was the failure to undertake advanced activities or the failure to apply innovative solutions in the field of capital and human resources multiplication. In addition, the points indicated were inadequate to the needs of financing or subsidies, and the lack of systematic monitoring and evaluation that could contribute to introducing improvements. These allegations stem from the fact that gender equality has many dimensions and meanings that cannot be included in a uniform and universal system of equalization. In addition, identifying gender differences requires specialist knowledge as well as competencies and tools to effectively counteract unequal treatment and discrimination. Monitoring and evaluation also seem problematic, thanks to which it becomes possible to track the course and importance of procedures helpful in reducing gender inequalities in particular areas of development - also those that are stereotypically considered masculinized (most often donors offered their help in the field of health and education, excluding business, banking, energy, communications, mining, and industry). The multidimensionality of gender also causes numerous difficulties in the daily allocation of resources. Therefore, donors do not know to what extent their involvement is needed and sufficient to achieve equality goals; it is also not known whether the donor's contribution is embedded in the current political rhetoric and has a chance to be constituted in this rhetoric (Grown, Addison, Torp, 2016, p. 312). The problems and inaccuracies specified in this way become an argument for GMS to be understood in the broadest possible way, which will take into account the heterogeneity of the organization and become an open application formula.

Gender Management System in social development - so that unnoticed women become visible

Feminist critique of liberal modernization theory clearly emphasizes the need to replace or supplement androcentric approaches and theories - treated as paradigmatic implications for public policies. In the feminized approach, economic growth is conditioned by an increase in gender equality. Modernization is a successful and complete process only if it takes into account the equality of participation, decision-making, and governance in the public sphere for both sexes. This is especially important because for a long time the position and role of women in management seemed to be secondary or latent. The visibility and visibility of women were weakened by many factors - not only those of institutional importance, resulting from legal legality, but also non-institutional ones shaped by assimilated cultural patterns, environmentally established habits, habits, symbols, customs, and other informal significant elements that become a permanent element of an individual's social personality that they define the type and scope of activities undertaken by him.

As Caroline Moser points out, there has been a gradual change in the place of women in management processes and the structures of the organization. This change is the result of new rules: planning, creating concepts, implementing intentional solutions that are aimed at equalizing opportunities and opportunities. It is about "proposing a new planning framework that can effectively help achieve the goal of women's emancipation through strategies to challenge and overcome oppressive roles and relationships" (Moser, 2019, p. 67). Such targeted actions should become a permanent strategy of organization and evaluation, through which women can build their image as autonomous entities capable of influencing development to the same extent and scope as men. Even though women are key actors in the economic system, their long-term neglect in development processes has failed to exploit their potential and disregard for the contributions they have made to social development (see Overholt et al., 1984, p. 3). The waste of female talents, capital, knowledge, and competencies is a consequence of not only planning or organizing inability but also of entrenched institutional barriers, for example, "glass ceiling," "sticky floor," "leaky pipeline." The influence of women on the economic sphere is limited or treated as secondary, and the gender gap is deepening. Therefore, the formation of a GMS requires a thorough knowledge of the entire organization (environment, structure, culture, power systems, and dependencies), and in particular, it is about the precise identification and naming of the main problems of the organization (their etiology and their effects), while designing projects pilot and comprehensive strategies to eliminate these problems, taking into account possible specific characteristics of the organization. It seems advisable to use the help and support of external experts (social scientists, economists, financial analysts, and others). Only a multilateral view of this matter will enable the adaptation of the organization's environment to the implementation of GMS operating rules and procedures and their subsequent enforcement. Stephen A. Matlin defines the GMS as an interconnected and interdependent network of procedures and structures that have been put into the institutional

framework to monitor and guide the process of gender and mainstream cultural integration, as well as aligning policies to achieve the goal of gender equality and equity in division and distribution in the process of sustainable development (www.un.org). By adopting the GMS perspective and treating it as a strategy and management style, you can orient and reorient the directions of changes, development, and modernization, the course of which is stimulated both by internal factors of the organization (intellectual, capital), but also by external factors resulting from the environment, depending on the factor human, environmental stimuli.

Depending on the economic sector, GMS has different assumptions and rules against which the management process runs, including: planning, organizing, motivating, and controlling. However, in each domain there are numerous barriers that must be identified and named on an ongoing basis in order to be able to eliminate them through specially designed tools and programs optimizing the management process. They are presented in the table below.

Table 1.
Characteristic of GMS in selected sectors (finance, public service, trade and industry)

SECTORS	PRELIMINARY ASSUMPTIONS	BARRIERS
FINANCE	- Macroeconomic management and coordination of fiscal policies. - Investment analysis and balance of payments. - Liberalization of credit policy, open access to microcredit. - SWAP contracts and transactions.	- Lack of permanent guidelines for creating financial policies in the context of globalization changes and economic liberalization. - Lack of understanding of the importance of gender in shaping financial policies. - Lack of favorable institutional structures. - Lack of opportunities for women's organizations to engage in macroeconomic policy debates.
PUBLIC SERVICE	- Management of public service personnel by introducing clear criteria (in terms of: employment conditions, promotions and nominations, improvement of professional qualifications). - Eliminating problems in the work environment, such as: discrimination, sexism, harassment, gender gap. - Equal treatment in employment of employees, balanced participation of women and men in decision-making processes.	- Institutional and bureaucratic resistance. - The belief that gender equalization mechanisms collide with the rules of meritocracy. - Gender stereotypes and prejudices that generate discriminatory attitudes.
TRADE AND INDUSTRY	- The constant pursuit of gender balance in staffing. - The use of incentives and benefits so that the private enterprise sector applies the principles of gender equality. - Equal access to resources and goods. - Introducing administrative and legal solutions aimed at maintaining the principle of gender equality. - Granting loans, grants and additional financing.	- Gender stereotypes and the maintenance of traditional gender roles, which makes it difficult to access specialized training in management, trade and business development. - Limited technical competences of women, lack of experience and resources necessary to perform managerial functions and create business environments. - Limited qualified staff of women to manage the enterprise. - Women working in the household and fulfilling family responsibilities. - Stakeholder activity to eliminate gender inequalities.

Source: Created by the author based on: http://oasis.col.org.

GMS seems to be an effective tool for visualizing and activating women in development processes, and for the effective use of their personal resources. In view of gender differences, the task of the organization is to develop concepts of diversity management, productive use of resources in the process of designing solutions, and creating development and modernization perspectives. There are at least six specific objectives for this system. First, offering access to the management and life-creation of organizations for women, which is made possible by developing their leadership and leadership opportunities. Second, recognizing the full influence of women on the content, pace, and course of social change and modernization processes, with particular emphasis on women's discourses, interests, and needs. Third, for women to create an organizational culture that grows out of the values they recognize as key, and to integrate these values into their official management style. Fourth, continuing flexible forms of responding to change so that they can adequately respond to the needs of each gender, and then creating instruments for eliminating gender differences and fields of discrimination. Fifth, maintaining a gender balance in access to lucrative goods and services, as well as a balance in the political, educational, scientific, and business system - wherever women are a marginalized minority. Sixth, create partnerships and networks that foster cooperation and increase opportunities for influence and influence. The aforementioned goals should guide all social institutions: family, community, market, state, employment institutions, etc. The task of these institutions is to establish and enforce laws concerning the equal treatment and fair distribution, and to ensure equal rules of the social game for the sexes.

Gender inequalities, which result in the underrepresentation of women in the public sphere, impede social life in the sense that institutions or organizations supervised by men do not take into account women's needs and ambitions in their activities, which in turn results in apathy, discouragement, and lower productivity. The Gender Management System is used to enable women to participate in decision-making processes, increase their visibility in key organizational areas, make their voice heard, important, and socially valued.

Conclusions

The article presents the theoretical assumptions and paths of practical implementation of the Gender Management System - a set of concepts, mechanisms and procedures that enable the incorporation of gender into the mainstream of politics, culture, social organization - in effect, it is about gendering strategic sectors (e.g. finance, public services, market and industry). The adoption of the GMS is a condition for gender equality achieved by equal opportunities, capabilities, choices, knowledge and power for all sexes. The GMS is essential to: 1) enable women to participate equally and equitably in planning, designing, and managing social and political change; 2) strengthen women's leadership, subjectivity, influence and

decision-making in various institutional fields; 3) create an organizational culture that values gender equality and is based on lateral thinking and inclusive management styles. GMS covers the following activities: consulting and support, effective communication, building motivation and managerial competences (in particular: planning and division of work, human resources management, eliminating conflicts), multiplying intellectual capital, knowledge transfer, professional socialization and shaping employee attitudes.

The usefulness of GMS is wide and brings real benefits in social development and modernization transformations. GMS optimizes operational, financial and investment activities of enterprises – it is a key factor in increasing creativity, innovation and efficiency. In the process of GMS implementation, organizational, communication, financial and ideological barriers may appear, which result from the lack of knowledge about the role of GMS in organization and management, as well as the lack of conviction about its necessity in development processes. GMS is an element of the social responsibility of the organization, so the implementation of this system must be coordinated and monitored by competent and specialized entities. GMS is a dynamic concept, which means that it should react flexibly to changes in the environment and harmoniously adapt to the requirements of the community.

GMS guarantees the effectiveness of introducing emancipatory changes, which may often require radical changes in the structure and culture of the organization. Therefore, the GMS needs courageous and decisive leadership, openness to new ideas and process of reform. Historical experience shows that GMS is a type of strategic management without which a contemporary and modern organization cannot exist.

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UNIVERSITY BUSINESS INCUBATORS AND THEIR IMPORTANCE FOR BEGINNERS

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Purpose: The article aims to assess the knowledge and interest in the offer of university business incubators by students of faculties offering theoretical and practical knowledge about starting and running a business.
Design/methodology/approach: A questionnaire plus the Pearson correlation coefficient and the T-Czuprow dependence coefficient were used to examine the relationship between the study variables.
Findings: Students are well acquainted with the offer of university business incubators, while not sufficiently aware that these entities can provide them with support at the stage of setting up or developing their business activity.
Practical implications: Intensifying activities promoting the activities of the surveyed institutions at universities could activate entrepreneurial thinking and the involvement of academic youth.
Originality/value: The article highlights the important role of university business incubators in supporting young entrepreneurs, which makes it a valuable source of information for those interested in starting their own businesses.

Keywords: university business incubators, entrepreneurship, business, students, academic entrepreneurship, technology transfer.

Category of the paper: research paper.

1. Introduction

In the conditions of the Polish economy, the concept of incubation has many meanings, but in relation to business, we can treat it as a support in the process of setting up and developing a business by ambitious people who are entering the business world. An incubator is a place where these people can receive support. The creation of incubators is aimed at developing new, high-potential enterprises so that they can successfully face the competition. Therefore, it would be necessary to verify how popular the services of these institutions are among young people who will soon start their own businesses.

2. Literature review

There are various categories of incubators: academic, technological, social and research. These institutions' main objectives include assisting in starting a new business, eliminating local and regional differences, creating entrepreneurial behaviour, supporting socially excluded people and bridging technological gaps (Aernoudt, 2004). Given the functions performed by incubators, two scopes of the incubation process should be indicated: pre-incubation (at this stage, an idea for a business is born, and then it is improved) and incubation (this stage begins with the establishment of a business) (Marszałek, 2009).

The term "university business incubator" (UBI) has been adopted to refer to a separate type of business incubation path, the main purpose of which is to prepare for the creation of a business entity in the vicinity of a scientific institution (Szopik-Depczyńska, Depczyński, 2013). As the name suggests, these institutions are located within or near academic centres. Thanks to this, students, graduates, PhD students and university employees can initiate the process of establishing a business, thus enriching the didactic process with a chance to start practical operations in market conditions. The operation of incubators at universities leads to the activation of students in entrepreneurship (Jankiewicz, Lis, 2006). Therefore, university business incubators fill the gap in support of knowledge and technology transfer processes because their offer is addressed to the academic community. Thus, Universities participate in building a knowledge-based economy and generating economic growth in the regions where the discussed entities are located.

Some selected definitions of university business incubators are presented in the following table.

Table 1.
Definitions of the university business incubator

Author	Definitions of the academic business incubator
Xu, 2009	An institution that provides physical space within the university to promote the development of university spin-offs.
Brezdeń et al., 2010	An institution whose task is to provide broadly understood support for start-ups. Its purpose is to market and protect (incubate) newly established enterprises. The effect of this institution's activity is the development of small and medium-sized enterprises, the creation of new jobs, and thus the improvement of the region's economic situation and its inhabitants.
Barbero et al., 2012	A university institution that supports young start-up businesses through tangible and intangible services.
Ładyga, 2012	An institution that supports entrepreneurship in the broad sense of the word among young people, facilitating the implementation of business ideas. Through financial, technical, organisational and advisory support, it helps young people start their own businesses and motivates them to continue their activities.
Jamil et al., 2015	Institutions that provide the right environment that facilitates revenue generation by providing financial, legal and technical support for mutually beneficial interaction between universities, business representatives, government and community.

Cont. table 1.

Robles, 2017	Non-profit organisations operate in order to increase economic development by initiating many projects and creating jobs. They help in the early stages of development of start-up companies.
Siemieniuk, 2017	Institutions that focus mainly on the pre-incubation phase. They are created in the vicinity of universities, and their goal is to shape a place for the development of enterprises and gain experience so that they can later function independently on the market.
Narayanan, Shin, 2019	An organisational form which aims to facilitate entrepreneurship.
Dániel, Porkoláb, 2021	Dedicated business incubators create a link between universities, businesses and government, generating a significant impact on the local economy.

Source: Own elaboration based on the subject literature.

Based on the definitions provided in the table above, the characteristics of university business incubators can be distinguished, such as assistance for start-ups, promoting the development of entrepreneurship, leading to marketisation of activity, legal protection, technical and organisational support, striving for regional development and reducing local unemployment. To conclude, university business incubators can be defined as non-profit institutions that support academic entrepreneurship at the pre-incubation stage by providing appropriate conditions for conducting business activity initiated by students, graduates or researchers.

There are two forms of operation of university business incubators (Marszałek, 2009):

- As a university-wide unit - the university can exercise direct control and supervision over the incubator's activities; it operates based on the regulations approved by the university senate;
- As a commercial company or foundation, appropriate legal documents regulate functioning.

University business incubators are most often university-wide units focused primarily on the pre-incubation process, i.e. the stage in which substantive and financial support is the most important until market stability is achieved. The market success of the companies supported by the incubator is the primary goal of their operation. The incubation period lasts about 3 years, although in reality, this time is determined by the achievement of the enterprise's independence. Of course, the discussed institutions collect fees from incubated companies, although this is done gradually, and the start of covering the costs usually takes place after a few months of operation.

The most important functions of university business incubators include the following: (Matusiak et al., 2005; Lockett et al., 2002):

- Promoting and supporting academic entrepreneurship (information and promotional campaigns);
- Supporting young entrepreneurs in their quest for rapid growth in their business;
- Seeking to commercialise ideas for new products and technologies;
- Making office space, university laboratories and research equipment available on preferential terms, along with other tangible and intangible facilities;

- Providing advisory services (e.g. technological and patent consulting) and training services;
- Legal and accounting services;
- Intermediation in financial support (e.g. help in obtaining seed capital necessary to start a business, as well as grants, subsidies or loans);
- Providing databases on researchers and inventors, ideas, patents and technologies.

As emphasised by N.A. Hassan (2020), the role of university business incubators is not limited to the provision of services for companies starting their own business. First of all, incubators strengthen the culture of entrepreneurship because their functioning consists not only in educating students and developing research but also in building tools that increase innovation, entrepreneurial thinking, organisation development and raising people's living standards.

Thanks to the operation of university business incubators, scientific institutions and entrepreneurs benefit. The table below contains exemplary arguments for the involvement of both parties in UBI activities.

Table 2.
Benefits resulting from the functioning of university business incubators

Benefits for universities	Benefits for entrepreneurs
• Improving the image of the university. • Making the educational offer more attractive. • Improving relations with the community. • Opportunities to increase income (students and researchers) from cooperation with local business and transfer of technological solutions. • Possibility of obtaining funds from entrepreneurship support programmes. • Increasing the demand for R&D results. • Strengthening links between the university and business communities by transferring technological achievements and research results to the market.	• Opportunity to test business ideas in a market reality, • Using the legal personality of the incubator. • No need to register the company physically. • Consulting services are available. • Possibility to study the market in order to achieve positive economic results. • Possibility of using well-prepared laboratories with computer systems made available by universities. • Saving time and significantly reducing the costs associated with setting up a company. • Conducive environment to conduct business and take the risk of being in business. • The possibility of taking advantage of various forms of support for enterprises (in particular those that enter the market).

Source: Matusiak, 2001; Hassan, 2020; Ładyga, 2012.

In Poland, business incubators began to be established, similarly to other innovation centres, in the early 1990's. Together with the changes taking place at universities, their number has significantly increased. The functions performed and the services provided by incubators include common space with technical equipment, management support, networking, access to knowledge and financial capital, which encourage starting the business activity. In connection with the above, the development of these institutions should be in the interest of the state, regions and universities.

3. Methods

The survey was conducted among students of the Faculty of Economics, Finance and Management of the University of Szczecin. 335 students from two fields of study took part in the study, i.e. management (285) and entrepreneurship and investments (50 students), of which as many as 62.4% of respondents are considering starting their own business. These fields of study were selected for the study because of their profile partly related to setting up and running a business.

Entrepreneurship and investments is a practical field of study. The content of education in the field of study includes issues in the management discipline and quality science, economics and finance, as well as related disciplines. The students have an opportunity to learn practical skills with regard to starting and running their own business, developing a family business or pursuing the career of a local leader - a creator of economic ventures and initiatives undertaken within the local community. The practical profile enables education in line with the expectations of employers and with the participation of practitioners - entrepreneurs, managers and specialists. Graduates of the field of study are prepared to establish and develop their own enterprise, take over a family business, work in managerial and specialist positions in small and medium-sized enterprises, in consulting companies and other organisations such as institutions supporting entrepreneurship, acting as a leader of local entrepreneurship, e.g. in the countryside, in a small village. The field of study is implemented in cooperation with entrepreneurs and local business support institutions. Students have the opportunity to learn about the functioning of business in practice, including thanks to numerous visits by students to small and medium-sized companies, innovative forms of teaching are also implemented: theory combined with practice, meetings with entrepreneurs, decision-making games, case studies, work in small teams, creating original projects and many others.

Studies in the management field of study aim to acquire specialist knowledge in the discipline of management sciences, economics and related disciplines, shaping a critical understanding of economic and organisational processes, as well as developing the ability to use methods and techniques necessary to solve problems and make decisions within the organisation. In addition, the studies are aimed at preparing graduates for the implementation of their own entrepreneurship, career development of specialists and managers in management structures. In the area of social competencies, the studies are aimed at shaping ethical and social sensitivity, commitment and a sense of responsibility in the work environment and beyond, awareness of the need and development of personal development and lifelong learning skills. The study programme includes general managerial education (useful for running own business and managing teams of people) and specialist management education. The knowledge acquired in the management discipline is of an applied nature and includes primarily theories and concepts describing and explaining the formation, functioning, transformation, development

and cooperation of organisations, primarily business entities but also public and non-governmental sector organisations. The graduate is prepared to work as an analyst and specialist, manage a small team of people in business and other organisations, and run their own business.

The degree of studies is the criterion that divided the research group into two groups, which are almost equal in terms of quantity - 52.5% were first-cycle students, and 47.5% were second-cycle students. In addition, 72.5% of the respondents are full-time students, and the remaining 27.5% are part-time students. 69.3% of respondents were female, while 30.7% were male. The research aimed to assess the knowledge and interest in the offer of university business incubators. It was also verified which areas of activity of business support institutions were indicated by students interested in using the services of the surveyed institutions. Students could choose from the areas of support most often offered by business environment institutions, namely: training and workshops, consulting and individual consultations, promotion and advertising, obtaining grants for starting a business, assistance in applying for EU funds, access to current economic information, as well as various meetings and business and integration trips.

The questionnaire was sent to students by e-mail (students received a link that took them to the questionnaire). In addition to the key substantive part, the questionnaire contained significant additional elements, such as the study's title, the purpose of the study and other explanations for the respondents. The questionnaire form used mainly closed and semi-closed questions, as it limited the percentage of people who resigned from answering the question. In addition, these types of questions made it easier to classify and analyse the data. A part of the survey form was also a metric, thanks to which it was possible to obtain the necessary information about the individual characteristics of the respondent, such as: gender, field of study, year of study. Collecting this data made it possible to analyse them in terms of selected characteristics of the surveyed students.

Pearson's correlation coefficient and T-Czuprow dependence coefficient were used to examine the relationships between the data being processed. Pearson's coefficient (rxy) is a linear correlation coefficient that determines the level of linear dependence between random variables. Its value falls within the closed interval [-1, 1]. The greater the absolute value of this coefficient, the stronger the linear relationship between the variables. The numeral one (1) indicates a positive relationship, while the negative one (- 1) indicates a negative relationship between the characteristics. 0 indicates the absence of a linear relationship (Zelias, 2002). The T-Cuprow coefficient (Txy) is, in turn, a dependency coefficient that is used to measure the strength of the relationship between two nominal variables. It assumes values from the closed range [0, 1]. The closer the value of this coefficient is to unity, the stronger the relationship between the examined characteristics (Domański, 2001).

4. Results

The surveyed group of students was asked to answer the question of whether, in the case of planning or conducting business activity, students would like to take advantage of the offer of university business incubators. Students had the opportunity to indicate interest (or disinterest). As many as 70.75% of students are familiar with the offer of UBI, and 45.67% of respondents are interested in taking advantage of it. Students (in particular students of economics) should be familiar with the offer of entities that at some point, may become one of the strategic partners facilitating the start or continuation of their own business.

The survey also asked which areas of activity of business support institutions students would most like to use when planning to run a business. The figure below lists the percentage share of business support areas among students who expressed interest in using university business incubators' services.

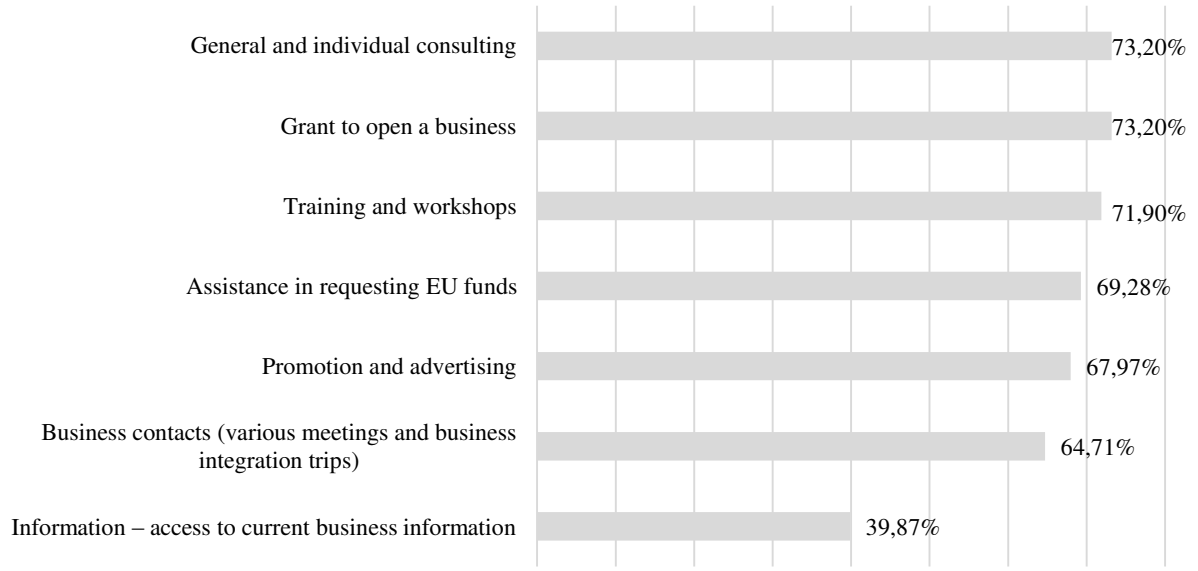

Figure 1. Areas of activity of business support institutions in the opinion of students who are interested in using the services of university business incubators.

Source: Own study based on own research.

The areas of activity that were of the greatest importance among students interested in using the services of university business incubators were counselling and individual consultations, as well as obtaining financial resources, including grants, which were indicated by 73.20% of the respondents. Receiving non-returnable cash at the beginning of the business, i.e. at the time of its greatest capital intensity, is a great advantage of this type of financing. The next important area for the respondents are training and workshops (71.90% of responses), which should be an integral part of the functioning of any company that wants to develop and constantly raise its prestige on the market. Other areas of business support institutions indicated as important are assistance in applying for EU funds (69.28% of responses) and promotion and advertising

(67.97% of students). It is worth noting that every company starting its activity should conduct appropriate promotion in order to appear on the market. Assistance in obtaining business contacts was important for 64.71% of students. Access to information turned out to be the least important area of functioning of business support institutions for the surveyed group of students (39.87% of answers).

In the study conducted on a group of students of the Faculty of Economics, Finance and Management, it was also decided to verify whether the independent variables (gender, field of study, degree and mode of study) have an impact on the dependent variable (desirable areas of support for people who are interested in using the services of university business incubators). The table below shows the percentage of students' answers to the question about the dependent variable. The following four criteria were taken into account: gender, field of study, degree of study, and mode of study. In addition, the following table presents the values of correlation coefficients between the independent variables and between the independent and dependent variables.

Table 3.
Percentage of students who answered the question regarding the desired areas of support by gender, field of study, degree of study and mode of study

Criterion		Desirable areas of activity of business support institutions by students who are interested in using the services of university business incubators [in%]						
		Training and workshops	**General and individual consultations**	**Promotion and advertising of the company**	**Subsidy for starting a business activity**	**Assistance in applying for EU funds**	**Information - access to up-to-date business information**	**Various business and integration meetings and trips**
Gender	Female	75,63	73,95	66,38	75,63	69,75	39,50	63,87
	Male	52,94	73,53	73,53	58,82	67,65	41,18	67,65
Field of study	Management	73,44	71,09	66,41	73,44	71,09	35,94	62,50
	Entrepreneurship and investments	56,00	84,00	76,00	64,00	60,00	60,00	76,00
Degree of study	I	77,78	71,60	70,37	76,54	70,37	40,74	70,37
	II	62,50	75,00	65,30	66,67	68,06	38,89	58,33
Mode of study	Full-time	70,25	70,25	72,73	74,38	71,07	42,98	67,77
	Part-time studies	71,87	84,37	50,00	62,50	62,50	28,12	59,37

Source: Own study based on own research.

Table 4.
Values of Pearson's correlation coefficients between independent variables and values of T-Czuprow dependence coefficients between independent variables and the dependent variable

Criterion		The value of the Pearson correlation coefficient rxy between the individual variants of the criteria (independent variables) when answering the question regarding the indication of the desired areas of business environment institutions by students who are interested in using the services of university business incubators	The value of the T-Czuprow Txy relationship between the criteria (independent variable) and the indications of desired areas of activity of business environment institutions by students who are interested in using the services of university business incubators (dependent variable)
Gender	Female	0,5917	0,0508
	Male		
Field of study	Management	0,1621	0,0740
	Entrepreneurship and investments		
Degree of study	I	0,8544	0,0284
	II		
Mode of study	Full-time	0,7467	0,0602
	Part-time studies		

Source: Own study based on own research.

5. Discussion

The above lists show that in the case of the "degree" and "mode of study" criteria, there is a strong linear relationship, and in the case of the "gender" criterion, a moderate relationship between independent variables in response to questions regarding the indication of areas of business environment institutions desired by students among students interested in using the services of university business incubators. This means that first- and second-cycle students and full-time and part-time students answered very similarly. There were no significant differences between the answers of men and women. At the same time, very low values of the T-Czuprow index indicate that gender, field of study, degree and mode of study do not affect the answers provided by students. However, it can be observed that the values of the Pearson correlation coefficient for the "field of study" criterion are not as high as for the other criteria. Such areas of activity of business environment entities as general and individual consultations, promotion and advertising, assistance in access to current information, as well as the organisation of meetings and business and integration trips are more desirable by students of the Entrepreneurship and investments field of study. This may result from the practical profile of studies in this field. Students very often have the opportunity to learn about the offer of the discussed institutions thanks to field classes (e.g. as part of the following subjects: basics of business economics, entrepreneurship, setting up and functioning of a small company, business problems in practice, financing small companies, small business support system), during which visits of students to enterprises and business environment entities take place.

The results of the conducted research indicate that students are well acquainted with the offer of university business incubators, and at the same time they are not sufficiently aware that these entities can provide them with support at the stage of setting up or developing their business activity. Intensifying activities promoting the activities of the surveyed institutions at universities could activate entrepreneurial thinking and the involvement of academic youth. Regardless of the field of study, profile or degree, students should be provided with the opportunity to acquire the knowledge and skills necessary to run a business on their own account. Practical information in this regard can be provided to them, for example, during training conducted by representatives of such entities as, e.g. university business incubators, especially since training and workshops are one of the most preferred areas of support by students who are interested in using the services of these institutions. The academic staff should also intensify activities aimed at increasing the interest of students in the offer of university business incubators to a greater extent.

6. Summary

Business incubators help the smallest entities survive, especially in the initial phase of functioning on the market. This is done by providing production space or various types of technical and office services. With the increase in market stabilisation, young enterprises operating under the name of an university business incubator may seek further support from business environment institutions, including in the technology transfer discipline. One of the basic goals of business incubators is to support small and medium-sized businesses, regardless of the sector of the economy. Thanks to this, they can be treated as an element of the labour market policy because they contribute to counteracting unemployment. Due to the wide offer of support for novice entrepreneurs, university business incubators should be treated as one of the key factors for the growth of entrepreneurial spirit, as well as an important element of the state's innovation policy.

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SMART MOBILITY IN SMART CITY – SINGAPORE AND TOKYO COMPARISON

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Purpose: The goal of the paper is to analyze the main differences between the smart mobility idea implementation in Singapore and Tokyo.
Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.
Findings: This paper analyzes the smart mobility solutions implemented in Singapore and Tokyo to improve urban transportation. Singapore and Tokyo have taken proactive measures to address transportation challenges and enhance the overall mobility experience in their respective cities. Singapore has emerged as a global leader in smart mobility, employing initiatives such as a well-connected MRT system, dedicated bus lanes, electronic road pricing, and intelligent transport systems. These measures have significantly improved transportation efficiency, reduced congestion, and promoted the use of public transport. Singapore has also embraced shared mobility options like bike-sharing and e-scooter sharing services, offering sustainable and convenient alternatives to private vehicle ownership. In contrast, Tokyo has focused on developing an integrated and efficient public transportation system. The city's extensive network of trains, subways, and buses enables seamless transfers and convenient travel across the city. Real-time information systems, multimodal integration, and sustainable initiatives have further enhanced transportation efficiency and connectivity in Tokyo. Additionally, Tokyo has prioritized pedestrian-friendly infrastructure, encouraged the use of electric vehicles, and implemented smart parking systems to alleviate congestion and support sustainable mobility.
Originality/value: Detailed analysis of differences between Singapore and Tokyo in the case of smart mobility implementation.

Keywords: Smart City, smart mobility, smart biking, sustainability, cycling.

Category of the paper: research paper.

1. Introduction

Singapore is often regarded as a global leader in smart mobility. It has implemented a comprehensive Intelligent Transportation System (ITS) that includes electronic road pricing, smart parking systems, and an extensive network of autonomous vehicles for public transport.

Tokyo has made significant advancements in smart mobility, including advanced public transportation systems, intelligent traffic management, and the integration of various transportation modes. It also hosts several pilot projects involving autonomous vehicles and smart infrastructure.

The goal of the paper is to analyze the main differences between the smart mobility idea implementation in Singapore and Tokyo.

2. Smart Mobility in Asia

Smart cities and smart mobility systems aim to optimize resource usage, reduce energy consumption, and minimize environmental impact. By integrating advanced technologies and data-driven solutions, these systems can streamline transportation, optimize traffic flow, reduce congestion, and promote the use of clean and sustainable modes of transportation, such as electric vehicles or public transportation (Jonek-Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023, Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Steculа, Wolniak, 2022; Olkiewicz et al., 2021).. This leads to more efficient and environmentally friendly cities. Smart mobility solutions can greatly enhance the quality of life for residents (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021). Efficient transportation systems reduce commute times, minimize traffic congestion, and improve air quality. Smart city infrastructure can also facilitate easier access to essential services, such as healthcare, education, and public safety. By leveraging technology and data, smart cities can provide better services and amenities to their residents, making urban living more convenient and enjoyable (Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022; Wolniak, 2013, 2016; Hys, Wolniak, 2018).

Smart cities rely on vast amounts of data collected from various sources, including sensors, IoT devices, and citizen inputs. This data is analyzed to gain insights and make informed decisions about urban planning, infrastructure development, and service delivery. Data-driven decision making enables cities to identify patterns, anticipate future needs, and allocate

resources more efficiently (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023).

Smart mobility in Asia has seen significant advancements and has become a key focus for many cities and countries in the region. Asian cities have embraced ITS (Intelligent Transportation Systems) technologies to improve traffic management and enhance transportation efficiency. These systems often include traffic signal optimization, dynamic traffic routing, real-time traveler information, and smart parking solutions. Cities like Singapore, Tokyo, and Seoul have implemented comprehensive ITS frameworks to manage their urban transportation networks effectively (Su et al., 2022).

Smart mobility in Asia is driven by the region's rapid urbanization, increasing population density, and the need for sustainable transportation solutions. Governments, city planners, and technology companies are collaborating to address transportation challenges and improve the overall mobility experience for residents and visitors congestion.

Those cities are known for their well-developed public transportation systems. Many cities have integrated smart features into their transit networks, such as contactless fare payment systems, real-time arrival information, and digital ticketing options. Cities like Hong Kong, Tokyo, and Seoul have efficient metro systems with extensive coverage, while cities like Beijing and Shanghai have advanced bus rapid transit (BRT) systems. Asian cities have been at the forefront of promoting bike-sharing programs and other micro-mobility solutions. Cities like Beijing, Shanghai, and Taipei have large-scale bike-sharing networks, allowing residents and visitors to easily access bicycles for short trips (Muñoz, Bolivar, 2021). Additionally, electric scooters and shared electric vehicles are becoming increasingly popular in cities like Singapore, Taipei, and Bengaluru (Feardous et al., 2022).

Asian countries have been actively exploring and testing autonomous vehicles. Singapore, for instance, has conducted numerous pilot projects for autonomous taxis and buses on designated routes. China has also been a significant player in AV development, with companies like Baidu, Didi Chuxing, and Pony.ai conducting extensive testing and deployment of autonomous vehicles in cities like Beijing, Shanghai, and Guangzhou. Asian cities face significant challenges with parking availability and congestion. As a result, many cities have implemented smart parking systems using technologies like sensors, real-time occupancy information, and mobile applications. Cities like Seoul, Tokyo, and Singapore have introduced smart parking initiatives to help drivers find available parking spaces quickly and reduce traffic congestion caused by parking-related issues.

Several Asian cities have been exploring Mobility-as-a-Service concepts, where different transportation modes are integrated into a single platform or app. For example, cities like Singapore and Tokyo have developed platforms that provide users with access to multiple modes of transportation, including public transit, ride-sharing, bike-sharing, and even taxis, all through a single app. Asia is a significant market for electric vehicles, and many cities have

been investing in charging infrastructure to support their adoption. Countries like China and Japan have extensive networks of charging stations, and cities like Beijing, Shanghai, and Tokyo have been encouraging the use of electric vehicles through incentives and subsidies (Henriot et al., 2018).

3. Smart Mobility solutions in Singapore

Singapore is widely recognized as a global leader in smart mobility solutions. The city-state has implemented numerous initiatives to enhance transportation efficiency, reduce congestion, and promote sustainable mobility. Singapore's MRT (Mass Rapid Transit) system is a highly efficient and well-connected network of train lines that covers most parts of the city. It provides fast, reliable, and convenient transportation for commuters, reducing reliance on private cars (Sukawan, Rachmawati, 2021).

Singapore has implemented various measures to prioritize buses on the roads, including dedicated bus lanes, bus priority traffic signals, and bus priority boxes at intersections. These measures aim to improve bus speeds, enhance reliability, and encourage more people to use public transport. Singapore was also one of the first cities to introduce electronic road pricing as a means to manage traffic congestion. The ERP (Electronic Road Pricing) system charges vehicles for road usage during peak hours in congested areas, effectively controlling traffic volume and encouraging the use of public transport (Chin, 2021).

Singapore utilizes advanced ITS (Intelligent Transport Systems) technologies for efficient traffic management. These include real-time traffic monitoring, dynamic message signs, and smart traffic control systems that optimize signal timings based on traffic conditions, reducing congestion and travel time. These systems include traffic monitoring, dynamic message signs, and smartphone applications that help users plan their journeys and make informed travel decisions. ITS enables the optimization of traffic flow, reduces congestion, and enhances the overall efficiency of transportation in Singapore. By analyzing data and utilizing smart technologies, ITS contributes to a safer and more convenient travel experience for residents and visitors alike (Zhong et al., 2016).

Singapore has embraced shared mobility options, including bike-sharing and e-scooter sharing services. In Singapore, bike-sharing services provide a convenient mode of transportation for short trips. Users can easily locate available bicycles using mobile apps that show the real-time availability of bikes at various docking stations across the city. Once located, users can unlock the bikes using a mobile app or a membership card. These bikes are designed for easy riding and typically come equipped with features like adjustable seats, baskets, and built-in GPS systems (Joo, 2023).

The introduction of bike-sharing and e-scooter sharing systems has had a positive impact on Singapore's urban mobility. These services provide a practical and convenient alternative to private vehicle ownership, reducing traffic congestion and air pollution. They also promote a healthy and active lifestyle by encouraging physical activity through cycling and offer first/last-mile connectivity to public transportation nodes, making multi-modal journeys more accessible.

Furthermore, the availability of shared mobility options supports the government's vision of creating a car-lite society in Singapore. By reducing the reliance on private cars, these systems contribute to a more sustainable and efficient transportation network (Ferro-Escobar et al., 2022).

In the table 1 there is a description of realization of main factors of smart mobility concept realization in Singapore.

Table 1.
Main factors of smart mobility in Singapore

Factor	Realization
Integration and Interconnectivity	Singapore emphasizes the integration of different modes of transportation into a seamless network. The Mass Rapid Transit (MRT) system, buses, taxis, and other mobility options are interconnected, allowing passengers to switch between modes easily.
Advanced Infrastructure	The city-state has invested heavily in building a comprehensive and advanced transportation infrastructure. This includes a well-developed road network, efficient public transport systems, dedicated bus lanes, and pedestrian-friendly walkways.
Intelligent Transport Systems (ITS)	Singapore utilizes ITS technologies to enhance traffic management and provide real-time information to commuters. This includes traffic monitoring, dynamic message signs, and smartphone applications that help users plan their journeys and make informed travel decisions.
Data-Driven Planning and Optimization	The government leverages data analytics to analyze travel patterns, traffic flow, and passenger demand. This data-driven approach helps in optimizing transportation systems, identifying bottlenecks, and making informed decisions regarding infrastructure development and service improvements.
Smart Payment and Ticketing Systems	Singapore has introduced contactless payment systems and smart ticketing options across various modes of transportation. Commuters can use contactless smart cards or mobile payment methods to pay for fares, facilitating convenient and hassle-free travel.
Sustainable and Green Initiatives	Singapore promotes sustainable mobility solutions, such as electric vehicles (EVs) and bike-sharing services. The government provides incentives and infrastructure support to encourage the adoption of EVs and reduce carbon emissions.
Multi-Modal Integration	Mobility-as-a-Service (MaaS) platforms play a crucial role in Singapore's smart mobility landscape. MaaS apps integrate different transportation options, including public transport, ride-sharing services, and micro-mobility solutions, allowing users to plan, book, and pay for their entire journey seamlessly.
Smart Traffic Management	Singapore uses technologies like electronic road pricing (ERP) to manage traffic congestion. ERP dynamically adjusts toll charges based on demand, encouraging the use of public transport and reducing private vehicle usage during peak periods.
Autonomous Vehicles (AVs)	Singapore is at the forefront of testing and deploying autonomous vehicles. AVs are being trialed in various applications, such as autonomous shuttles for first/last-mile connectivity and autonomous taxis for on-demand transportation.
Proactive Government Policies	The Singaporean government plays a proactive role in implementing smart mobility solutions. It sets policies, provides funding and incentives, collaborates with industry stakeholders, and actively engages the public to ensure the successful adoption of smart mobility initiatives.

Source: Authors own work on the basis of: (Sukawan, Rachmawati, 2021; Chin, 2021; Zhong et al., 2016, Jhoo, 2023; Ferro-Escobar et al., 2022; Shamsuzzoha et al., 2021, Zhang, 2021).

In the table 2 there is an analysis of main advantages and problems in implementation of smart mobility solutions in Singapore.

Table 2.
Comparison of advantages and problems of implementing smart mobility in Singapore

Advantages	Problems
Efficient and reliable transportation	Initial high implementation costs
Reduced traffic congestion	Integration and interoperability of different systems and modes
Improved air quality and reduced carbon emissions	Technological complexities and maintenance
Enhanced connectivity and accessibility	Potential privacy and data security concerns
Seamless multi-modal integration	Public acceptance and behavior change
Promotes sustainable and eco-friendly mobility	Resistance from traditional transport industries
Optimized transportation planning and management	Potential job displacement in certain sectors
Enhances overall quality of life	Limited physical infrastructure in some areas
Economic opportunities and job creation	Ensuring equitable access and affordability
Proactive government support and collaboration	User education and awareness

Source: Authors own work on the basis of: (Sukawan, Rachmawati, 2021; Chin, 2021; Zhong et al., 2016, Jhoo, 2023; Ferro-Escobar et al., 2022; Shamsuzzoha et al., 2021, Zhang, 2021, Elm, Carvalho, 2020; Lim et al., 2020; Ng, Kim, 2020; Chang, Das, 2020).

4. Smart Mobility solutions in Tokyo

Smart mobility in Tokyo refers to the implementation of advanced technologies and innovative solutions to enhance transportation efficiency, connectivity, and sustainability in the city. Tokyo, as a bustling metropolis, faces various transportation challenges, and smart mobility initiatives aim to address these issues. One key aspect of smart mobility in Tokyo is its highly integrated public transportation system. The city boasts an extensive network of trains, subways, and buses that provide efficient and extensive coverage. This integrated system enables commuters to navigate the city seamlessly, with well-connected transportation hubs and synchronized schedules facilitating smooth transfers between different modes of transportation (Yagi, 2016).

Real-time information plays a crucial role in Tokyo's smart mobility infrastructure. Commuters have access to timely updates on train schedules, delays, and platform changes through mobile apps and announcements. This enables them to plan their journeys more effectively and make informed decisions, ultimately reducing wait times and improving overall travel experiences. Tokyo also places emphasis on multi-modal integration. The city recognizes the importance of providing a range of transportation options to cater to diverse commuter needs. This includes efficient integration of trains, buses, and bicycles, allowing commuters to choose the most convenient and suitable mode for their travel. Well-designed transportation hubs and synchronized schedules facilitate seamless transfers, ensuring a hassle-free journey (Vinod, 2022).

Sustainability is another crucial aspect of smart mobility in Tokyo. The city actively promotes the use of electric vehicles (EVs) and has been developing EV charging infrastructure to reduce carbon emissions and air pollution. By incentivizing the adoption of EVs, Tokyo aims to contribute to a cleaner and greener transportation system. Furthermore, Tokyo implements smart parking systems that utilize sensors and digital signage to guide drivers to available parking spaces. These systems optimize parking resource utilization, reduce the time spent searching for parking, and alleviate traffic congestion (Smart Tokyo, 2019).

Collaboration and innovation are key drivers of smart mobility in Tokyo. The government, transportation operators, and research institutions collaborate to foster innovation, implement advanced technologies, and improve transportation services continually. This collaborative approach ensures that Tokyo remains at the forefront of smart mobility solutions and adapts to evolving transportation needs (Manabu, 2020).

In the table 2 there is a description of realization of main factors of smart mobility concept realization in Tokyo. Smart mobility in Tokyo focuses on enhancing transportation efficiency, connectivity, and sustainability. Through the integration of advanced technologies, real-time information systems, multi-modal integration, and sustainable initiatives, Tokyo strives to provide its residents and visitors with convenient, efficient, and environmentally friendly transportation options.

Table 3.
Main factors of smart mobility in Tokyo

Factor	Realization
Integrated Public Transportation	Tokyo has a highly integrated and extensive public transportation network, which includes trains, subways, buses, and trams. The seamless integration of these modes allows for convenient and efficient travel across the city, reducing the reliance on private vehicles.
Advanced Ticketing and Fare Systems	Tokyo utilizes contactless smart cards, such as Suica and PASMO, for fare payment across multiple transportation modes. These cards enable passengers to easily access and pay for various services, promoting seamless transfers and eliminating the need for separate tickets.
Real-time Information and Updates	Tokyo provides real-time information to commuters through digital displays, mobile apps, and announcements. This includes updates on train and bus schedules, delays, and platform changes, allowing passengers to plan their journeys and make informed decisions.
Intelligent Transport Systems	Tokyo employs advanced ITS technologies to manage traffic flow and improve transportation efficiency. This includes traffic monitoring systems, dynamic message signs, and smart traffic control mechanisms, which help optimize signal timings based on real-time traffic conditions.
Bike-sharing and Micro-mobility Options	Tokyo has embraced bike-sharing services and other micro-mobility options as an eco-friendly and convenient means of transportation. Bike-sharing programs allow users to rent bicycles for short trips, promoting last-mile connectivity and reducing congestion.
Walkability and Pedestrian Infrastructure	Tokyo prioritizes the development of pedestrian-friendly infrastructure, including well-designed sidewalks, pedestrian crossings, and pedestrian-only zones. This promotes walking as a viable mode of transportation, particularly for short distances, reducing reliance on motor vehicles.
Multi-Modal Integration	Tokyo emphasizes the seamless integration of various transportation modes, including trains, buses, and bicycles. This involves well-connected transportation hubs, synchronized schedules, and clear signage, facilitating easy transfers and providing passengers with flexible travel options.

Cont. table 3.

Sustainable Initiatives	Tokyo actively promotes sustainable transportation solutions, including the adoption of electric vehicles (EVs) and the development of EV charging infrastructure. The city incentivizes the use of EVs, aiming to reduce carbon emissions and air pollution from transportation.
Smart Parking Systems	Tokyo implements smart parking systems that utilize sensors and digital signage to guide drivers to available parking spaces. These systems reduce the time spent searching for parking, alleviate traffic congestion, and optimize the utilization of parking resources.
Collaboration and Innovation	Tokyo's smart mobility initiatives are driven by collaboration between the government, transportation operators, private companies, and research institutions. This collaborative approach fosters innovation and facilitates the implementation of cutting-edge technologies and solutions.

Source: Authors own work on the basis of: (Yagi, 2016; Vinod, 2022; Smart Tokyo, 2019; Manabu, 2020; Tokyo Smart City, 2015; Adachi, 2021; Sadayuki, 2018).

In the table 4 there is an analysis of main advantages and problems in implementation of smart mobility solutions in Tokyo.

Table 4.
Comparison of advantages and problems of implementing smart mobility in Tokyo

Advantages	Problems
Improved transportation efficiency and reduced congestion	Balancing the demand for transportation services with the existing infrastructure
Enhanced accessibility and connectivity across the city	Integration of various transportation modes and systems
Reduced reliance on private vehicles, promoting sustainable transportation	Managing the increasing demand for public transportation during peak hours
Real-time information and updates for better trip planning	Ensuring reliable and accurate real-time data for commuters
Integration of multiple modes of transportation for seamless transfers	Overcoming potential resistance to change from commuters accustomed to traditional transportation methods
Promotion of eco-friendly options such as bike-sharing and micro-mobility	Addressing safety concerns and establishing regulations for new mobility solutions
Implementation of intelligent transport systems to optimize traffic flow	Managing and maintaining advanced technologies and systems for efficient operation
Emphasis on pedestrian-friendly infrastructure, promoting walking as a viable mode of transportation	Balancing the needs of pedestrians, cyclists, and motorists in shared spaces
Collaborative approach between government, operators, and technology providers	Ensuring inclusivity and accessibility for all segments of the population
Innovation and technological advancements driving continuous improvement	Balancing the costs associated with implementing and maintaining smart mobility systems

Source: Authors own work on the basis of: (Yagi, 2016; Vinod, 2022; Smart Tokyo, 2019; Manabu, 2020; Tokyo Smart City, 2015; Adachi, 2021; Sadayuki, 2018; A tale of…, 2018; Kawamura, Yai, 2019).

5. Singapore and Tokyo comparison

In Singapore, the transportation system boasts an extensive and efficient network of trains, buses, and taxis. The public transportation system is highly integrated, allowing for seamless transfers and convenient travel across the city. The use of contactless smart cards,

such as EZ-Link, enables commuters to pay for fares across multiple modes of transportation, including buses and trains, with ease. Real-time information on train and bus schedules, delays, and disruptions is readily available through mobile apps and digital displays, helping commuters plan their journeys more effectively. Singapore also promotes sustainable transportation by actively encouraging the adoption of electric vehicles and developing the necessary charging infrastructure. Additionally, bike-sharing programs with mobile app access and designated parking areas provide residents and visitors with a convenient and eco-friendly last-mile connectivity solution (Elm et al., 2020; Ng, Kim, 2020; Manabu, 2020; Yagi, 2016).

Similarly, Tokyo has a highly integrated public transportation system that includes trains, subways, and buses. The city's transportation network provides extensive coverage and efficient services, catering to the needs of millions of commuters. Contactless smart cards like Suica and PASMO allow passengers to seamlessly pay for fares across various transportation modes. Real-time information on train schedules, delays, and platform changes is readily available through mobile apps and announcements, facilitating smoother and more informed travel. Tokyo also emphasizes multi-modal integration, ensuring well-connected transportation hubs and synchronized schedules for convenient transfers between different modes of transportation. The city actively promotes walking as a viable mode of transportation by prioritizing pedestrian-friendly infrastructure and implementing pedestrian zones. Additionally, smart parking systems guide drivers to available parking spaces, optimizing parking resources and reducing congestion (Adachi, 2021; Sadayuki, 2018; Chang, Das, 2020).

Both Singapore and Tokyo prioritize collaboration between government, transportation operators, and technology providers to drive innovation and implement advanced smart mobility solutions. They recognize the importance of sustainable initiatives and are actively promoting the adoption of electric vehicles and developing charging infrastructure. Furthermore, the integration of technology, such as mobile apps, contactless payment systems, and real-time information, enhances the overall travel experience for residents and visitors in both cities.

In the table 5 there is a comparison of smart mobility implementation in Singapore and Tokyo. The more extensive comparison was prepared in the table 6.

Table 5.
Comparison of Singapore and Tokyo smart mobility solutions

Factor	Singapore	Tokyo
Public Transportation	Extensive and efficient network of trains, buses, and taxis. High integration and seamless transfers.	Highly integrated public transportation system including trains, subways, and buses. Efficient and extensive coverage.
Fare Payment Systems	Contactless smart cards (e.g., EZ-Link) for seamless fare payment across multiple modes. Integration with retail and other services.	Contactless smart cards (e.g., Suica, PASMO) for integrated fare payment.

Cont. table 5.

Real-time Information	Real-time updates on train and bus schedules, delays, and disruptions through mobile apps and digital displays.	Real-time information on train schedules, delays, and platform changes through mobile apps and announcements.
Bike-Sharing Services	Bike-sharing programs with mobile app access, real-time bike availability, and designated parking areas.	Bike-sharing programs with mobile app access, real-time bike availability, and efforts to promote last-mile connectivity.
Walkability	Pedestrian-friendly infrastructure with well-designed sidewalks and crossings. Promotion of walking as a viable mode of transportation.	Emphasis on pedestrian infrastructure, including pedestrian zones and improved walking facilities.
Multi-Modal Integration	Seamless integration of various modes of transportation, including buses, trains, and bicycles.	Emphasis on multi-modal integration with well-connected transportation hubs and synchronized schedules.
Sustainable Initiatives	Active promotion of electric vehicles (EVs) and development of EV charging infrastructure. Incentives for EV adoption.	Active promotion of EVs and EV charging infrastructure to reduce emissions and air pollution.
Smart Parking Systems	Implementation of smart parking systems to guide drivers to available parking spaces.	Implementation of smart parking systems utilizing sensors and digital signage for efficient parking management.
Collaboration and Innovation	Collaborative approach among government, operators, and technology providers to drive innovation.	Collaboration between government, operators, and research institutions to foster innovation and implement advanced technologies.
Unique Characteristics/ Considerations	Emphasis on bike-sharing for last-mile connectivity and eco-friendly transportation. Utilization of advanced digital payment systems.	Prioritization of walking infrastructure and pedestrian zones. Cultural considerations for transportation planning.

Source: Authors own work on the basis of: (Sukawan, Rachmawati, 2021; Chin, 2021; Zhong et al., 2016, Jhoo, 2023; Ferro-Escobar et al., 2022; Shamsuzzoha et al., 2021, Zhang, 2021; Yagi, 2016; Vinod, 2022; Smart Tokyo, 2019; Manabu, 2020; Tokyo Smart City, 2015; Adachi, 2021; Sadayuki, 2018).

6. Conclusion

The paper analyzes the smart mobility solutions implemented in Singapore and Tokyo to improve urban transportation. Singapore and Tokyo have implemented smart mobility solutions to address transportation challenges and improve the overall mobility experience in their respective cities. Singapore has emerged as a global leader in smart mobility, with initiatives such as the well-connected MRT system, dedicated bus lanes, electronic road pricing, and intelligent transport systems. These measures have enhanced transportation efficiency, reduced congestion, and encouraged the use of public transport. Singapore has also embraced shared mobility options like bike-sharing and e-scooter sharing services, promoting sustainable and convenient alternatives to private vehicle ownership.

On the other hand, Tokyo has focused on creating an integrated and efficient public transportation system. The city's extensive network of trains, subways, and buses enables seamless transfers and convenient travel across the city. Real-time information systems, multi-modal integration, and sustainable initiatives have further improved transportation efficiency and connectivity in Tokyo. The city has also emphasized pedestrian-friendly infrastructure, promoted the use of electric vehicles, and implemented smart parking systems to reduce congestion and support sustainable mobility.

Analyzed cities have realized the importance of collaboration, innovation, and the use of advanced technologies to drive their smart mobility initiatives. However, they also face challenges such as integrating different systems and modes, managing technological complexities, ensuring public acceptance, and addressing potential privacy and data security concerns. Singapore and Tokyo have made significant progress in implementing smart mobility solutions, but there is still work to be done to overcome challenges and fully realize the potential of smart mobility in creating efficient, sustainable, and user-friendly transportation systems. By continuing to invest in infrastructure, fostering innovation, and engaging with stakeholders, both cities can further enhance their smart mobility landscapes and provide residents and visitors with seamless, eco-friendly, and accessible transportation options.

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THE BASIS OF PROSPECTIVE ANALYTICS IN BUSINESS

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Purpose: The goal of the paper is to analyze the main features, benefits and problems with the prospective analytics usage.
Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.
Findings: Prescriptive analytics aims to assist businesses in making informed decisions that optimize desired outcomes or minimize undesired ones. It goes beyond predicting future outcomes and provides recommendations on the best actions to achieve desired goals while considering potential risks and uncertainties. Prescriptive analytics finds applications in various domains such as supply chain management, financial planning, healthcare, marketing, and operations management. It empowers businesses to make data-driven decisions, optimize resource allocation, enhance efficiency, and gain a competitive advantage. Considered the highest level of analytics, prescriptive analytics combines historical data, real-time information, optimization techniques, and decision models to generate actionable recommendations.
Originality/value: Detailed analysis of all subjects related to the problems connected with the prospective analytics.

Keywords: Industry 4.0; diagnostic analytics, business analytics, data analysis, predictive analytics.

Category of the paper: literature review.

1. Introduction

Prescriptive analytics is a branch of advanced analytics that focuses on providing recommendations or actions to take based on the analysis of available data. It goes beyond descriptive and predictive analytics by not only answering the question of "what is likely to happen?" but also offering insights on "what should be done about it?".

Prescriptive analytics utilizes various techniques such as mathematical modeling, optimization algorithms, machine learning, and simulation to evaluate different possible scenarios and recommend the best course of action. It takes into account multiple factors, including historical data, real-time data, constraints, and objectives, to provide decision-makers with actionable insights.

The goal of the paper is to analyze the main features, benefits and problems with the prescriptive analytics usage.

2. Prospective analytics - definitions

The goal of prescriptive analytics is to help businesses and organizations make informed decisions that maximize desired outcomes or minimize undesired ones. It helps in solving complex problems and optimizing processes by considering different variables and potential trade-offs. Rather than simply predicting outcomes, prescriptive analytics suggests the best actions to achieve desired goals, taking into account potential risks and uncertainties. (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023).

Prescriptive analytics can be applied in various domains, such as supply chain management, financial planning, healthcare, marketing, and operations management (Patanjali, 2018; Nourani, 2021, Sharma et al., 2020). It enables businesses to make data-driven decisions, optimize resource allocation, improve efficiency, and gain a competitive advantage in today's complex and dynamic business environment. Prescriptive analytics empowers decision-makers by providing them with actionable recommendations based on thorough analysis, allowing them to make informed choices and achieve better outcomes (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021).

Prescriptive analytics is often considered the highest level of analytics because it not only provides insights into what is likely to happen in the future (predictive analytics) but also suggests the best course of action to achieve a desired outcome. It combines the power of historical data, real-time information, optimization techniques, and decision models to generate actionable recommendations (Hurwitz et al., 2015).

Prescriptive analytics can address a wide range of business problems, including supply chain optimization, resource allocation, pricing strategies, risk management, marketing campaign optimization, fraud detection, and healthcare treatment recommendations (Cam et al., 2021). It empowers organizations to make data-driven decisions, optimize processes, improve efficiency, reduce costs, and achieve their business goals (Wolniak, Sułkowski, 2015, 2016;

Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021, 2022).

By leveraging prescriptive analytics, businesses can gain a competitive advantage, enhance customer satisfaction, and drive innovation (Hwang et al., 2017). It enables them to move beyond reactive decision-making and embrace proactive, forward-looking strategies that are based on a deep understanding of data and analytics (Greasley, 2019).

The process of prescriptive analytics typically involves several steps Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023, Scappini, 2016; Peter et al., 2023):

- Data Collection: Relevant data from various sources is collected, including historical data, real-time data, external data feeds, and contextual information. This data forms the foundation for analysis and decision-making.
- Data Analysis: Advanced analytical techniques, such as statistical analysis, machine learning, and data mining, are applied to the collected data to identify patterns, correlations, and trends. This analysis helps in understanding the relationships between different variables and uncovering insights.
- Predictive Modeling: Predictive models are built using the analyzed data to forecast future outcomes or events. These models use statistical algorithms or machine learning algorithms to make predictions based on historical patterns and trends.
- Optimization and Simulation: Optimization algorithms and simulation techniques are employed to evaluate different scenarios and determine the best course of action. Optimization takes into account various constraints, objectives, and trade-offs to find the optimal solution that maximizes desired outcomes or minimizes undesired ones.
- Decision Support: The results of the analysis and optimization are presented to decision-makers in a user-friendly format, often through interactive dashboards or reports. These outputs provide actionable insights and recommendations that help decision-makers understand the potential consequences of different choices.
- Implementation and Monitoring: Once a decision is made based on the prescriptive analytics insights, it is implemented in the real-world context. Monitoring and feedback mechanisms are put in place to assess the impact of the decision and refine the models and algorithms based on new data and insights.

Below in table 1 there is a comparison table highlighting the differences between predictive analytics and prospective analytics.

Table 1.
Comparison of predictive analytics and prospective analytics

Aspect	Predictive Analytics	Prescriptive Analytics
Objective	Predict future outcomes or events based on historical data and patterns.	Provide recommendations on the best course of action to achieve a desired outcome.
Focus	What is likely to happen?	What should be done about it?
Key Outputs	Predictive models, forecasts, insights on future trends.	Actionable recommendations, optimized solutions, decision support.
Techniques	Statistical analysis, machine learning, data mining, forecasting models.	Mathematical modeling, optimization algorithms, simulation, decision models.
Usage	Helps in understanding trends, identifying patterns, and making informed predictions.	Enables decision-makers to make data-driven decisions, optimize processes, and achieve desired outcomes.
Example	Predicting customer churn, forecasting sales, fraud detection.	Optimizing supply chain, resource allocation, pricing strategies.
Timeframe	Focuses on the future based on historical data.	Focuses on the future and suggests specific actions based on analysis and optimization.
Decision-making	Provides insights to support decision-making.	Provides actionable recommendations to guide decision-making.
Integration	Can be integrated into various systems and processes to enhance decision-making.	Requires integration into decision support systems and organizational workflows.
Data Requirements	Relies on historical and real-time data to make predictions.	Relies on historical and real-time data, as well as contextual information, to make recommendations.
Limitations	Predictions are probabilistic and subject to uncertainties.	Recommendations may be influenced by assumptions, constraints, and limitations of the models.

Source: Authors own work on the basis of: (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023).

3. Benefits and problems of prospective analytics usage

Prescriptive analytics empowers organizations to make better decisions, optimize processes, mitigate risks, allocate resources efficiently, and gain a competitive advantage. It enables organizations to leverage data and insights to achieve desired outcomes and drive success in a rapidly changing business landscape.

On the basis of literature analysis following benefits of predictive analytics can be formulated (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023).

- Informed Decision-Making: Prescriptive analytics provides decision-makers with actionable insights and recommendations. It goes beyond simply predicting outcomes and offers guidance on the best course of action to achieve desired outcomes. This enables organizations to make more informed decisions, considering various factors and potential trade-offs.

- Optimization and Efficiency: This type of analytics utilizes mathematical modeling and optimization algorithms to evaluate different scenarios and identify the most optimal solutions. By considering constraints, objectives, and resource allocation, organizations can optimize processes, minimize costs, maximize efficiency, and improve overall performance.
- Real-Time Adaptability: Prescriptive analytics can incorporate real-time data and continuously adapt to changing conditions. This enables organizations to respond promptly to dynamic environments and make real-time decisions based on the most up-to-date information. It supports agile decision-making and helps organizations stay competitive in rapidly evolving markets.
- Risk Mitigation: Describe in the paper type of analytics takes into account potential risks and uncertainties when recommending actions. By simulating different scenarios and evaluating the impact of different decisions, organizations can proactively identify risks, assess their potential consequences, and make risk-informed decisions. This helps in mitigating risks and minimizing the negative impact of uncertain events.
- Resource Optimization: Prescriptive analytics helps optimize the allocation of resources, whether it's workforce, inventory, budget, or equipment. By analyzing historical data, demand patterns, and other relevant factors, organizations can efficiently allocate resources to meet demand, reduce waste, and improve overall resource utilization.
- Competitive Advantage: By leveraging prescriptive analytics, organizations can gain a competitive edge in the market. It enables them to make data-driven decisions, optimize processes, and identify innovative strategies. Prescriptive analytics helps organizations stay ahead of their competitors by enabling them to make more accurate predictions, better allocate resources, and make informed choices.
- Enhanced Customer Experience: The usage of proscriptive analytics enables organizations to tailor their products, services, and experiences to individual customer needs. By analyzing customer data and preferences, organizations can make personalized recommendations, improve customer satisfaction, and enhance the overall customer experience.
- Continuous Improvement: Prescriptive analytics is an iterative process that allows organizations to continuously refine and improve their decision-making. By monitoring the outcomes of decisions made based on prescriptive analytics, organizations can collect feedback, identify areas for improvement, and refine their models and algorithms. This iterative approach ensures ongoing optimization and improvement.
- It automates decision-making, reducing manual work.
- It speeds complex approval processes, enabling faster time to value.

- It enables faster response to changing market conditions, for example, automating stock trades faster than humans can.
- It improves resilience to fast-changing circumstances, helping enterprises, for example ride out supply chain disruptions.
- It operationalizes predictive analytics insights, increasing the value of existing analytics.

Below are some of the key disadvantages and problems associated with the usage of predictive analytics (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- Uncertainty and Assumptions: Predictive analytics relies on historical data and statistical models to make predictions about the future. However, the accuracy of these predictions is inherently limited by uncertainties and assumptions. Factors such as changing market dynamics, unforeseen events, or data quality issues can affect the reliability of predictions.
- Data Limitations: Predictive analytics heavily relies on the availability and quality of data. Businesses may face challenges in obtaining relevant and comprehensive data sets, especially if data is scattered across multiple systems or if there are data privacy and security concerns. Incomplete or inaccurate data can negatively impact the accuracy and effectiveness of predictive models.
- Complex Implementation: Implementing predictive analytics solutions can be complex and resource-intensive. It requires expertise in data science, statistical modeling, and machine learning. Organizations need to invest in skilled personnel, appropriate technologies, and robust infrastructure to effectively implement and maintain predictive analytics capabilities.
- Interpretation and Communication: Predictive analytics outputs often require interpretation and context to be effectively understood and utilized. Decision-makers may not have the necessary statistical knowledge or expertise to interpret the predictions accurately. Communicating the insights and recommendations derived from predictive analytics to non-technical stakeholders can be challenging, potentially leading to misinterpretation or resistance to change.
- Overreliance on Historical Data: Predictive models are built based on historical data, assuming that the future will behave similarly to the past. However, market dynamics, consumer behavior, and other external factors can change rapidly, rendering historical patterns less relevant or reliable. Relying solely on historical data without considering emerging trends and evolving customer preferences can limit the accuracy and applicability of predictions.

- Ethical and Privacy Concerns: The use of predictive analytics raises ethical and privacy concerns, particularly when dealing with personal or sensitive data. Predictive models may inadvertently introduce bias or discriminatory outcomes if they are built on biased or incomplete data. Organizations must ensure proper data governance, transparency, and fairness in the predictive analytics processes to mitigate these risks.
- Implementation Challenges: Deploying predictive analytics solutions within an organization can face challenges related to integration with existing systems and processes. Organizations may encounter resistance to change or difficulties in aligning the predictive analytics outputs with existing decision-making frameworks. Ensuring a smooth integration and adoption of predictive analytics capabilities requires effective change management and organizational buy-in.

Despite these challenges, organizations can address many of these disadvantages through careful planning, data quality assurance, continuous model validation, and effective communication and training. It is essential to recognize the limitations and actively manage them to maximize the value and impact of predictive analytics in business decision-making (Sharma et al., 2020; Wolniak, 2013, 2016; Hys, Wolniak, 2018).

4. Example of predictive analytics usage in business

Predictive analytics is extensively used in businesses across different industries to make informed decisions. It involves analyzing historical data and patterns to predict future outcomes and trends. This information is valuable for organizations in multiple ways: One common application is customer analytics. By examining customer behavior, preferences, and buying patterns, businesses can anticipate future actions. This allows for effective customer segmentation, identifying potential churn, and personalizing marketing campaigns and product recommendations (Cam et al., 2021).

Sales forecasting is another important use of predictive analytics. By analyzing past sales data and considering market trends, businesses can make accurate predictions about future sales. This helps with optimizing inventory, production, and resource allocation to meet demand and improve sales performance. Risk assessment is crucial for businesses, and predictive analytics aids in this area. It helps identify potential risks such as fraudulent activities, credit defaults, and insurance claim fraud. By analyzing patterns and anomalies in data, organizations can detect and prevent financial losses (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023).

Supply chain optimization is also enhanced through predictive analytics. By forecasting demand, evaluating supplier performance, and optimizing inventory levels, businesses can streamline their supply chain operations. This leads to cost reduction, minimization of stockouts, and improved logistics processes. Quality control is another area where predictive analytics plays a role. By analyzing data from manufacturing processes and historical quality metrics, organizations can identify patterns contributing to defects or variations. This enables them to take corrective actions and improve product quality (Peter et al., 2023).

Predictive analytics aids in maintenance and asset management as well. By analyzing sensor data, maintenance logs, and historical performance, organizations can predict equipment failures, optimize maintenance schedules, and minimize downtime. This improves operational efficiency and reduces costs. In marketing and advertising, predictive analytics helps optimize campaigns and spending. By analyzing customer data, demographics, and online behavior, businesses can identify effective channels, messaging, and targeting strategies, maximizing their return on marketing investments (Hurwitz et al., 2015).

Human resources benefit from predictive analytics as well. It assists in talent acquisition, workforce planning, and employee retention efforts. By analyzing employee data, performance metrics, and external factors, organizations can identify high-performing candidates, predict attrition risks, and implement strategies to improve employee engagement and retention. Financial analysis benefits from predictive analytics in financial forecasting, portfolio management, and risk assessment. It helps predict market trends, optimize investment portfolios, and assess credit risks.

Lastly, in healthcare, predictive analytics aids in medical diagnosis, patient risk assessment, and disease prevention. By analyzing patient data, medical records, and clinical research, it helps identify health risks, improve patient outcomes, and optimize healthcare resource allocation. These applications highlight how predictive analytics enables businesses to gain valuable insights, optimize processes, and make data-driven decisions across various domains.

Predictive analytics is increasingly utilized in quality management to enhance product quality, identify potential issues, and optimize quality control processes. Predictive analytics supports quality management by providing insights, enabling proactive decision-making, and optimizing processes to ensure consistent product quality and customer satisfaction.

Below are some of examples of usage of predictive analytics in quality management (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- Predictive analytics can analyze historical quality data, manufacturing parameters, and other relevant variables to predict the likelihood of defects in products or processes. By identifying patterns and factors that contribute to defects, businesses can take proactive measures to prevent quality issues and improve product quality.

- Predictive analytics helps identify the root causes of quality problems by analyzing data from various sources, including production logs, sensor data, and historical quality data. It can identify correlations and patterns that contribute to quality deviations, enabling organizations to address the underlying causes and implement corrective actions.
- This type of analytics aids in failure analysis by examining historical data on product failures or breakdowns. By analyzing factors such as operating conditions, usage patterns, and maintenance records, businesses can predict failure probabilities and take preventive measures to reduce failures and improve reliability.
- Predictive analytics can analyze warranty claim data, customer feedback, and other relevant information to identify potential quality issues or failure patterns. By detecting emerging trends or patterns, organizations can proactively address these issues, improve product quality, and reduce warranty claims.
- Type of analytics described in the paper helps assess and monitor the quality performance of suppliers. By analyzing supplier data, historical quality records, and other relevant factors, businesses can identify high-risk suppliers and predict their quality performance. This enables organizations to take corrective actions or make informed decisions when selecting or managing suppliers.
- Predictive analytics can optimize manufacturing processes to improve quality. By analyzing process data, sensor readings, and historical quality metrics, organizations can identify process parameters or conditions that significantly impact product quality. This allows for process adjustments or optimization to maintain consistent quality levels and reduce variations.
- Predictive analytics can be used to develop early warning systems for quality deviations or failures. By continuously monitoring real-time process data, organizations can detect anomalies or deviations from expected quality standards. This enables timely intervention and preventive actions to mitigate quality issues before they escalate.
- This type of analytics assists in optimizing resource allocation for quality control activities. By analyzing historical quality data, defect patterns, and process variability, organizations can prioritize quality inspections or allocate resources to critical process steps or products that are more likely to have quality issues.

5. Conclusion

The goal of prescriptive analytics is to help businesses make informed decisions that maximize desired outcomes or minimize undesired ones. It goes beyond predicting future outcomes and suggests the best actions to achieve desired goals, considering potential risks and uncertainties. Prescriptive analytics finds applications in various domains such as supply chain management, financial planning, healthcare, marketing, and operations management. It enables businesses to make data-driven decisions, optimize resource allocation, improve efficiency, and gain a competitive advantage. Prescriptive analytics is considered the highest level of analytics as it combines historical data, real-time information, optimization techniques, and decision models to generate actionable recommendations.

The implementation process typically involves data collection, analysis, predictive modeling, optimization, decision support, implementation, and monitoring. By leveraging prescriptive analytics, businesses can enhance customer satisfaction, drive innovation, and move beyond reactive decision-making to proactive, forward-looking strategies based on a deep understanding of data and analytics. However, there are some challenges associated with predictive analytics, including uncertainty, data limitations, complex implementation, interpretation and communication, overreliance on historical data, ethical and privacy concerns, and implementation challenges. These challenges can be mitigated through careful planning, data quality assurance, continuous validation, and effective change management. Despite these challenges, the benefits of prescriptive analytics outweigh the disadvantages, making it a valuable tool for businesses to make better decisions and achieve their desired outcomes.

In conclusion, predictive analytics is a valuable tool utilized by businesses across various industries to make informed decisions. It involves analyzing historical data and patterns to predict future outcomes and trends, providing organizations with valuable insights and opportunities for optimization. Predictive analytics finds widespread application in customer analytics, sales forecasting, risk assessment, supply chain optimization, quality control, maintenance and asset management, marketing and advertising, human resources, financial analysis, and healthcare.

In the domain of quality management, predictive analytics plays a crucial role in enhancing product quality, identifying potential issues, and optimizing quality control processes. By analyzing historical quality data, manufacturing parameters, and relevant variables, organizations can predict the likelihood of defects and take proactive measures to prevent quality issues. It helps identify root causes of quality problems, facilitates failure analysis, detects emerging quality issues, assesses and monitors supplier quality performance, optimizes manufacturing processes, develops early warning systems, and optimizes resource allocation for quality control activities.

The applications of predictive analytics in quality management contribute to consistent product quality, improved customer satisfaction, and streamlined quality control processes. By leveraging predictive analytics, organizations can gain valuable insights, make proactive decisions, and ensure the delivery of high-quality products to meet customer expectations.

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OCCUPATIONAL SAFETY MANAGEMENT THROUGH TRAINING IN THE STEEL INDUSTRY

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Purpose: Managing the areas of occupational health and safety is a complex topic and requires a lot of knowledge from the management staff in relation to management sciences. The issue of human factor management is based on human behavioral factors. It refers to the psychological aspect of a given individual and often requires adjusting the way of expression and content to the level of the recipient of a given training. Therefore, the person conducting the training should have a large amount of knowledge and have many tools to both increase the effectiveness of the training and its verification can be done using various methods such as: tests (Kojnoková et al., 2023).
Design/methodology/approach It contained fifteen questions (the first five related to the metrics of respondents, the next five questions related to training in the field of occupational health and safety, the last five questions referred to the impact of training on the level of safety) ranks of factors according to the Likert scale has been presented. The part of research was the introduction of data into the enclosure sheet and the determination of mutual correlations using the correlation function.
Findings: The research showed a large relationship between the frequency of training and the level of safety among respondents. In addition, studies have shown that training conducted using methods that activate employees increases their effectiveness.
Originality/value: The article shows the forms of matching training in the field of occupational health and safety in steel plants. Due to the high risk occurring in the areas of steel mills, training plays a key role in the safety of employees. The content of the article is addressed both to academics who can obtain information on increasing the effectiveness of training in the areas of steel mills and to people training metallurgists to transfer knowledge as effectively as possible.

Keywords: safety, training, steel industry.

Category of the paper: Research paper, case study.

1. Introduction

Managing the areas of occupational health and safety is a complex topic and requires a lot of knowledge from the management staff in relation to management sciences. The issue of human factor management is based on human behavioral factors (Wolniak, 2013). It refers to the psychological aspect of a given individual and very often requires adjusting the way of expression and content to the level of the recipient of a given training. Therefore, the person conducting the training should have a large amount of knowledge and have many tools to both increase the effectiveness of the training and its verification can be done using various methods such as: tests or quizzes (Furman, Małysa, 2023). Training as well as audits, inspections and monitoring of the work carried out have a very important impact on the formation of safety culture in entrepreneurs (Gajdzik, 2008; Chaib, 2014). Activities aimed at shaping a safety culture and promoting aimed at increasing work safety are very important aspect determining the reduction of accidents in enterprises (Chaib, Taleb, Benidir, Verzea, 2014). Promoting safety behaviour is a very important aspect conditioning the overall culture of occupational health and safety in a given company (Vranješ, Todić, 2019). These activities can be carried out using various tools and methods also during training in the field of occupational health and safety (Gembalska-Kwiecień, 2018; Elles, Villabona, Martelo, 2018). Training methods and tools needed for their implementation should be tailored to the recipients and the subject matter (Lee, F.H., Lee, T.Z., Wu, 2010; Lakra, 2016). Therefore, the main purpose of this article is to examine the important role of training in the field of occupational health and safety in the areas of steel plants. Determining mutual correlations regarding the form and frequency of training will allow to determine the optimal methods and tools needed to train steel plant employees. And content as well as findings can be interested to academics who can obtain information how to increase the training and to people training metallurgists to transfer knowledge as effectively as possible.

Teaching resources and their distribution

Didactic means are all materials of a material nature that increase the effectiveness of the education process. They are aimed at facilitating and increasing the effectiveness of learning. The following didactic means are distinguished:

- Didactic aids are all means that can be read directly, among others: maps, textbooks, models and photographs.
- Didactic materials are a group of measures requiring a specific technical measure. Materials can be transferred only in an indirect form, e.g.; through multimedia presentations.
- Technical means of education are all means that make it possible to read the content of materials prepared in advance. These include: projectors, computers and laptops.

- Pedagogical means of work is a group of measures thanks to which it is possible to perform certain activities in practice. These include: laboratory equipment, measuring instruments and other means of communication.

The selection of didactic means in relation to OSH training is variable depending on the subject and group of recipients (Einarsdóttir, Snorradóttir, 2020). These trainings are characterized by high variability, because they can apply to almost any type of work. This determines the trainer selection in terms of their knowledge and experience in a given industry (Panfil, 2013).

Forms of conducting training in the areas of occupational health and safety

The use of various training techniques is aimed at increasing the assimilation of a given material. A an example toutoring (in relation to science, which aims at a long period of time such where there is a student-master relationship) can be also used to convey simple educational content. However, it requires from the lecturer high flexibility and the ability to select materials and content to the needs of the recipient. The use of this method favors the individualization of the teaching process and gives the opportunity to shape attitudes (Saunders, Ron, et al., 2020). Another positive aspect is the ability to verify knowledge after each stage of teaching. Due to the master-student relationship, a bond is established where the learner gains a kind of mentor who can be a "model". Both this can be considered as a positive and negative aspect, because the student may have a distorted view of a given topic. Such a phenomenon occurs when an individual does not confront his knowledge with others and/or does not deepen his knowledge from other sources (Barnová, Krásna, Gabrhelová, 2019). This method is implemented by the "5 I" rule. It is determined by five instruments, each of which begins with the letter "i":

- Identification – to determine the needs of the students, determine their strengths and weaknesses.
- Individualization – to notice the individuality of participants by the lecturer and adapting didactic materials and methods to them.
- Intellectualization of the education process – to determine by the teacher the psychological profile and the intellectual type that of the students, which gives the opportunity to extract and stimulate to development.
- Integration - to combine didactic and practical means.
- Institutionalization - which results from the fact that this method is used in the areas of educational institutions, but recently it is increasingly used in companies.

Companies use this method of education in relation to the aspect of occupational health and safety. Regarding the law of the Republic of Poland, every employer is obliged to create a special unit for health and safety when it employs more than one hundred people. This is specified in the Regulation of the Council of Ministers of 2 September 1997 (on occupational health and safety services, Dz.U. 1997, No. 109, item 704). However, any economic operator, regardless of size, can employ an OSH unit, but this is a voluntary action. Such a practice is

aimed at increasing the organizational culture in the area of occupational health and safety in a given workplace (Mollo, Emuze, Smallwood, 2019). If the company has a permanent employee of the OSH service, it can use the toutoing method as a very good tool shaping good safe work habits. However, the toutoing method is well known as a long-term measure (Tracz, Rachwał, 2008; Rybina, Fontalina, 2020).

One of the most classic teaching methods is the giving method in the form of an information lecture. This method is used to convey information in a theoretical way. A characteristic feature of this method is the transfer of knowledge by the teacher, where the student (employee) plays rather a passive role. The role of the lecturer is to transfer knowledge in such a way that the recipient feels interested in the topic discussed. For this purpose, the teacher is required to start the class before the start of the class:

- Recognize the needs of the listeners.
- Prepare working materials.
- Prepare the structure of the training.
- Determine the level of understanding of the terminology used.

After the lecture begins, the lecturer should adapt the dynamics of the lecture to the audience. A very important aspect is that knowledge is transferred in an orderly manner. Other equally important factors determining the effectiveness of an information lecture are:

- maintaining eye contact with listeners,
- determining the positive after gaining knowledge,
- use of voice modulation,
- use of illustrative measures,
- taking care of the clarity of the message,
- summary of uploaded content.

The main advantage of the information lecture is the fact that it can be used in equal and variable conditions of training. Another advantage is the ability to transmit information in a large group. In the area of training, the advantages of this method should also be noted the possibility of conducting training in various industries. It can also encourage reflection of employees and inspire to deepen the presented topics. The disadvantage of this method is the low participation of participants, which in turn may lead to a decrease in the involvement of the subject matter. Therefore, special attention should be paid to the fact that the classes are conducted in a concise and logical way, in such a way that the recipient feels as much involved as possible in the subject matter (Mose, Reszka, 2010).

Another methods used in OSH training is "brainstorming", which is a loose form of conducting a discussion where each participant has the opportunity to speak freely. In this way, ideas are generated that can be saved to include any ideas and then the best ones are selected. Each participant of this form of training should be provided with the feeling that their statements are taken seriously. Therefore, there can be no situation in which an employee feels that his or her ideas are being discriminated against (Srihandayani, Marlina, 2019). This method distinguishes four successive phases:

- Containing an introduction to the subject of the discussion, theoretical explanations of the methodology itself, and setting rules during its conduct.
- Containing submission and reading of ideas. Participants in this phase also have the opportunity to ask questions to clarify the issue.
- Discussion of derived theses and ideas.
- Specifying the choice of a given solution, its justification, as well as determining its practical implementation. This phase is also designed to summarize the entire class and the subject matter taken up in it.

Brainstorming is one of the most creative methods of conducting training, because it encourages participants to have an open discussion and increases the creativity of employees. The openness of the lecturer to new ideas can give many unusual but accurate solutions to a given problem. A very important aspect of the whole method is the fact that it assumes the equality of each participant. Such an assumption has a positive effect on the freedom of expression of each group of the organizational structure of a given company. Thus, the most dominant entities cannot influence the group (Paulus, Kenworthy, 2019).

2. Methods and results

The main objective of the research was to determine how the selection of methods and means are most often used when conducting training by the occupational health and safety service and which of them are most often used by the introduction of training in steel plants. For this purpose, a research survey was developed in the form of a survey questionnaire. The questionnaire consisted of 15 questions. The first 5 questions referred to the respondents' metric which included questions such as: age of respondents, seniority, level of education and size of the town in terms of the number of inhabitants, in which they perform training in the field of occupational health and safety at the steelworks. The next 5 questions related to the manner and frequency of training.

1. Does your company provide periodic training (1 time per year)?
2. Do you change the method of conducting the training depending on the subject of the training?
3. Are the trainings conducted in your company conducted with the use of didactic materials in the form of: scripts, multimedia presentations?
4. Do you use elements that activate training participants during the training?
5. In your opinion, does the choice of the method of conducting OSH training affect the degree of understanding of the subject matter undertaken during the training?

The last 5 questions concerned the impact of training on safety.

1. In your opinion, does the increased frequency of training have a positive impact on the safety of employees?
2. Along with the increase in the frequency of training, do you observe an increased involvement of employees in shaping the OSH culture in your company?
3. After using methods activating training participants, do you observe an increase in the effectiveness of the training?
4. Does the presentation in a visual form increase the effectiveness of the training in your opinion?
5. In your opinion, does the involvement of the trainer in the training affect work safety throughout the company?

The respondents' answers were compiled using a five-point Likert scale (Suasapha, 2020), in which individual answers were given the following ranks:

- Yes, always - 5 points,
- Yes - 4 points,
- I don’t know - 3 points,
- No - 2 points,
- No, never - 1 point.

The tests were conducted from January 20, 2023 to February 20, 2023. The survey involved 60 respondents who declared conducting training in steel plants. The collected responses have been entered into a spreadsheet. Then, each of them was assigned ranks according to the five-point Likert scale. The next step was to develop a correlation function between individual questions and determine the most correlated questions to determine the relationships between individual questions. Results of the correlation is presented in Table 1.

Table 1.
Correlation distribution between individual survey questions

	Question 1	***Question 2***	***Question 3***	***Question 4***	***Question 5***	***Question 6***	***Question 7***	***Question 8***	***Question 9***	***Question 10***
Question 1	1									
Question 2	-0.159	1								
Question 3	0.333	0.863	1							
Question 4	-0.0417	0.985	0.918	1						
Question 5	0.992	-0.274	0.217	-0.160	1					
Question 6	0.352	0.835	0.996	0.902	0.237	1				
Question 7	0.974	-0.369	0.115	-0.260	0.995	0.134	1			
Question 8	0.993	-0.041	0.445	0.078	0.971	0.463	0.940	1		
Question 9	-0.066	0.957	0.912	0.979	-0.186	0.911	-0.286	0.057	1	
Question 10	0.137	0.941	0.979	0.975	0.016	0.971	-0.086	0.256	0.973	1

Source: Own elaboration.

When describing the correlation function, the following values were adopted:

- -1 very strong negative correlation,
- 0 no correlation between the examined features,
- 1 very strong correlation between the examined traits.

The relationship between the frequency of training and its impact on safety was investigated. Thus, only the last ten questions are considered for the correlation function. The study of the relationship between these questions was crucial for the whole article due to the subject matter undertaken. The study of the metrics was aimed at characterizing the studied community in terms of gender, education, seniority, and the size of the locality in terms of the number of towns in which they perform training in the field of occupational health and safety.

One of the strongest correlations occurs between question number one and question number seven and the correlation value is 0.975. Question number one concerned the frequency of training and periodic training (1 time per year). Question number seven concerned respondents' opinions on whether, as the frequency of training increases, they observe increased involvement of employees in shaping a culture of health and safety at work. In addition, question number one also showed a very high correlation value with question number five, which was 0.997. Question number 5 concerned whether, in the opinion of respondents, the choice of the method of conducting training in the field of occupational health and safety affects the level of understanding of the subject matter. Taking into account both values of the above-mentioned correlations, it can be concluded that not only the frequency of training, but also the selection of methodology for the training undertaken has a significant impact on the understanding of the information and health and safety at work in steel plants.

A very high correlation was also shown by question number 3 and question number 10, where the correlation value was 0.979. Question number 3 is to conduct trainings using didactic materials in the form of scripts or multimedia presentations. On the other hand, question number 10 concerned the respondents' opinions on whether, in their opinion, the involvement of the trainer in the training affects work safety throughout the company. From such a high correlation value, it can be concluded that the activation of training participants lies with the trainer and depends on his involvement in the training course. This is also confirmed by the correlation between question number 4 and question number 10, where question number 4 concerned the use of activating elements by the trainers. The correlation value in this case was 0.975. This is a very high correlation coefficient indicating a high relationship between the examined questions. In addition, a high correlation coefficient can also be observed between question number 9 and 10, whose correlation coefficient was 0.974. And question number 9 concerned whether, in the opinion of respondents, the presentation in a visual form increases the effectiveness of the training. Presentation in a visual form can also be a method of activating training participants because, depending on the content of the presentation, it may contain various means of communication (film, instructions, open question, problem to solve together, tasks for the group). Therefore, it can be concluded that the activation of training participants has a positive effect on occupational health and safety in the case of steel plants.

The darkest negative correlation is between question 2 and question 7, which is -0.367. Question number 2 concerned the variability of the methodology of conducting training depending on the subject. Question number 7 concerned the opinion whether, along with the increase in the frequency of training, you observe an increased involvement of employees, shaping the safety culture of your company. Therefore, it can be concluded that the variability of the training methodology depending on the subject matter is not correlated with the involvement of employees in shaping the culture of occupational health and safety. Taking into account the previous correlation results, it can be observed that the variability of the methodology of conducting training, in the opinion of respondents, does not affect the formation of occupational health and safety culture, but the activation of training participants. It can therefore be concluded that as the involvement of employees increases, the training is greater, their involvement in shaping the culture of occupational health and safety at the steel plant. This may result from the practical dimension of the training, where the employee, remaining in constant interaction with the trainer, remembers much more (Chatigny, 2022). Consolidation of information on occupational health and safety, in turn, determines the employee's tendency to behave more safely in his workplace (Niciejewska, Idzikowski, Lestyánszka-Škurková, 2021). A very important role in shaping these behaviors is played by all employees employed in the company (Duan, Zhu, K., Wang, Zhou, M., 2023). Thus, the promotion of socially responsible behaviour in the metallurgical sector is a very important safety factor Elles, R., Villabona, N., & Martelo, R. (2018). The greatest influence in shaping culture is the management and the occupational health and safety unit (Furman, 2023). Employee behavior can also be shaped using signs at workplaces to improve safety (Gunbeyaz, Kurt, Baumler, 2019).

3. Summary

Conducting training in plants with an increased risk of an accident at work or a potential accident situation is a very important aspect because it directly affects the level of safety at the steelworks. As research has shown, using a spreadsheet and correlation function, there is a very strong relationship between the activation of training participants and increasing the level of occupational health and safety in steel plants. Regarding occupational health and safety, this is a very important aspect of any training. The role of their ideas and knowledge can significantly contribute to reducing accidents. Therefore, the OHS service should use this form of training as often as possible to eliminate individual threats in the work environment. The second important aspect is the frequency of training, which, as respondents declare, is strongly correlated with increasing employee involvement and shaping a culture of occupational health and safety at steel plants (Claxton, Hosie, Sharma, 2022).

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IMPLEMENTATION OF CORPORATE SOCIAL RESPONSIBILITY CONCEPT IN SMES IN MALOPOLSKA

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Purpose: The aim of the article was to present the status of implementation of the CSR concept in small and medium-sized enterprises in the Małopolska province.
Methodology: The questionnaire contained closed and open questions, which enabled obtaining more precise answers. The first stage – the selection of enterprises – was carried out in a purposeful manner, based on their belonging to a determined sector. Then, on a random basis, 250 companies were selected in systematic selection from a base constituting the survey frame. The survey frame was the list of SME in Małopolska province. In total, 386 small and medium enterprises were randomly selected, from which a lower number of entities proceeded to participate in the survey. The remaining entrepreneurs refused to participate in the survey for unknown reasons.
The compared partial and synthetic results present primarily assessments with regard to the level of acceptance of entrepreneurs participating in the survey in relation to the issues of the survey. As a rule, positive replies usually have the character of quality features. The χ^2 (chi-squared) test was used as a verification tool to evaluate the results obtained in this manner. Irrespective of this, the interview questionnaire prepared for this survey enabled giving the character of quality features to its results.
Findings: 55% of respondents, admit that the very concept of corporate social responsibility is familiar to them, but they are not familiar with the details of the idea. Thirty per cent of respondents had never encountered the concept of CSR before, and 15% of respondents stated that it was well or even perfectly familiar to them.
Most respondents indicated concern for the environment (68%) or support for the local community (57%). Good contact with customers and concern for their satisfaction was indicated by only 48% of respondents.
The responses received show that the vast majority of respondents carry out their CSR activity in connection with increasing competitiveness (44%) or improving the company's image (48%). Among the respondents, about 13% indicated that the lack of appropriate tools used to promote the companies makes them undertake such activities. Only 11% of respondents stated that the reason for implementing CSR was socially motivated

Keywords: Corporate Social Responsibility (CSR), small and medium enterprises, competitiveness.

Category of the paper: Research paper.

1. Introduction

Over the past few decades, the economy has gone through the post-industrial era, characterized by the dominance of knowledge and provision of services alongside progressing automation of routine work. Leading companies in nearly all sectors are able to develop new models of business, while many companies struggle due to the lack of flexibility, low level of the staff's dedication, increasing complexity of the environment, and disturbances in process of the implementation of changes (Pasmore et al.,2019). Competition, its intensity, character and applied instruments undergo changes. There is a growing number of aware consumers, whose decisions are based on several criteria and the price is no longer most important. They become involved and engaged, often *pro publico bono*, in social activism, through which they shape the main current in the public and media discourse.

Conditions for running a business are changing rapidly and social reality and general living conditions are also constantly transforming. Furthermore, the network of relations between these two spheres is becoming more intense and complex. Overlapping boundaries between work and domestic life are one such example. The development of science, technology and access to a wide variety of solutions results in situations where choices between environmentally friendly and unsustainable solutions are being made within the framework of existing law. It is worth, therefore, considering issues related to Corporate Social Responsibility (CSR).

2. Review of Corporate Social Responsibility in literature

Corporate social responsibility refers to the formulation and implementation of social goals and programmers, and to the integration of ethical sensitivity in all decision-making processes, policies and actions (Carroll, 1991).

Since the Lisbon Strategy in 2000, the European Commission has been supporting and promoting CSR. In a statement published in 2011, the Commission defines CSR as "the responsibility of enterprises for their impact on society" (European Commission 2011, p. 6). Along with this simplified definition it is stressed that a prerequisite for meeting that responsibility is respect for the applicable legislation and collective agreements between the social partners.

CSR is generally perceived as a complex set of policies and practices which are integrated with the actions and decision-making processes of a company, embracing issues related to business ethics, local society and environmental protection, human rights and the rights of employees and consumers (Koh, Heather, Yen, 2022).

The public awareness of social responsibility of any undertaken business activity is a relatively recent development, although its historical roots can be sought in the Roman Empire (Chaffee, 2017, pp. 347-373) and even in ancient Greece (Hetzner, 1987, pp. 23-37). In the past few decades, the firm's responsibility to the society has become a subject of social debate but has been developing in a variety of ways. Differences occur in the scope of the CSR notion, its origin, development pathways, character of the engagement of stakeholders and in the institutional aspects (regulations, cultural and cognitive questions) (Yevdokimova, Zamlynskyi, Kuznietsov, Sakovska, Anatolii, 2018, pp. 69-78; Garriga, Melé, 2004, pp. 51-71) drew attention to the multitude of CSR theories and classified them into four major groups:

1. instrumental theories, focusing on economic factors,
2. political theories, concentrating on the social power of corporations and a responsible use of this power,
3. integrative theories, demonstrating that corporations should be socially integrated,
4. ethical theories implicating that relationships between corporations and the society are based on ethical values, and social responsibility is seen as a corporation's ethical responsibility.

The essence of Corporate Social Responsibility is reflected in the definition published in 2010 by the International Organization for Standardization. In the first-ever management standard providing guidelines for social responsibility (ISO 26000) CSR is defined as "The responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparency and ethical behaviour that (Makuch, 2011, p.20):

- contributes to sustainable development, including health and welfare of society,
- takes into account the expectations of stakeholders,
- is in compliance with applicable laws and consistent with international norms of behaviour,
- is integrated throughout the whole organization and practiced within its sphere of influence".

The definition emphasizes the responsibility of an organization, which must certainly mean compliance with legal obligations and generally recognized ethical rules. Attention is also drawn to the expectations of stakeholders, which companies should incorporate in their strategy.

ISO 26000 also names and describes areas of Corporate Social Responsibility crucial for stakeholders.

According to ISO 26000, the perception of an organisation as socially responsible and its actual social responsibility activities can have an impact on:

- competitive advantage,
- the organisation's image,
- the ability to attract and retain employees, shareholders and customers,

- employee morale, engagement and performance,
- opinions of investors, owners, donors, community sponsors,
- the organisation's relationships with businesses, government agencies, the media, suppliers, partners, customers and the community within which the organisation operates.

Practical approaches to CSR can be diverse in nature and need not to be complex or involve large expenditures. In practice, CSR most often includes activities (Koncepcja CSR w MŚP):

1. addressed to the company's employees, e.g. improvement of working conditions (including health and safety), provision of greater professional satisfaction and development opportunities, work-life balance, equal treatment, training and professional development of employees (including career planning), communication/information to employees and their involvement in the company's decision-making process, responsible and fair remuneration or financial assistance to employees (e.g. pension insurance schemes, interest-free loans),
2. market-oriented - involves customers on the one hand and business partners and suppliers on the other e.g. improving the quality and safety of products, ethical advertising activities, providing voluntary services to customers, fair pricing, paying on time, honouring the terms of trade agreements, working with local partners, promoting standards through supply chains, supporting the creation of local/regional business agreements,
3. aimed at the public e.g. improvement of local infrastructure, financial support of local institutions of public interest, measures towards integration with society and/or the labour market at community level, support of the public in a broader context (e.g. the population of developing countries),
4. for the environment e.g. use of environmentally friendly products and production processes, efficient use of resources, use of "green rating" of suppliers in terms of their environmental standards, waste and pollution reduction, informing business partners, customers and the public about environmental issues.

The main areas of social responsibility, i.e.: organizational governance, human rights, labour practices, the environment, fair operating practices, consumer issues, and community involvement and development (Makuch, 2011) (Table 1.)

Table 1.
Areas of CSR according to ISO 26000

Key area	Definition	Good practices
Organizational Governance	Corporate governance is a set of rules and standards relating to a broadly defined management of a company	Improving the management efficiency of the organization, while taking into account the public interest, respect for stakeholders and ethical principles
Human rights	Respect for all human rights and dignity, in particular civil, political, economic, social and cultural rights	Anti-discrimination, strengthening the protection of labour rights
Labour practices	Relations concerning employees and cooperation with subcontractors, suppliers, competitors, etc.	Working conditions and social welfare, health and safety, social development (training), social dialogue, open and honest relationships with cooperating entities
Environment	Reduction and climate change adaptation and the protection and regeneration of the environment	Reducing emissions of pollutants, exploitation of natural resources, as a result of the operations
Fair operating practices	Ethical business behavior towards other organizations, including government organizations, partners, suppliers, contractors, competitors and associations to which it belongs	Preventing unfair competition, honest cooperation and respect for property rights, actively promoting the principles of social responsibility in area of influence (partners, suppliers, the environment)
Consumer issues	Fairness and transparency towards consumers	Application of fair practices in marketing products and services, fair contract terms, objective and reliable information, market education, commitment to protect the health and safety of consumers, the quality of service and support, and complaint handling
Community involvement and Development	Active support of local community aiming to resolve their problems, especially those that relate to its employees and other stakeholders	Social dialogue, recognition of stakeholders needs in engagement projects, including investments in areas such as education and culture, health, development and access to technology

Source: own work, based on http://www.pkn.pl/sites/default/fi les/discovering_iso_26000.pdf; http://www.odpowiedzialnafi rma.pl/o-csr/iso-26000, 27.04.2023; Szczanowicz, J., Saniuk, S. (2014). Implementation of CSR concept in manufacturing SMEs. *Management*, *18*(1), 71-82.

The literature on the subject stresses the importance of stakeholder involvement in the implementation of CSR. In this context involvement implies a two-way dialogue with key stakeholders at all stages of implementation, starting with planning, by carefully studying stakeholders' needs, through the implementation and evaluation of effects, as well as transparent communication. Transparency means presentation of non-financial results in a way that is meaningful to stakeholders. The results should also be published in a complete and measurable way so that the progress can be objectively assessed.

In 2013, the Polish Agency for Enterprise Development conducted a study aiming to verify the percentage of micro, small, and medium enterprises (MSMEs) executives declaring inclusion of the CSR concept into their business. The study was conducted on a group of 1000 companies from MSME sector, excluding the self-employed. The study has shown that the main barriers for CSR in SMEs are lack of awareness and knowledge about the concept. More than 66 per cent of the respondents were not able to define the concept of CSR.

3. Impact of CSR activities on the competitiveness of companies

The concept of social responsibility is treated as a tool for gaining competitive advantage on a global market, where customers, employees and investors attach increasing importance to non-economic values. Enterprises, wishing to build the trust of the community towards their business activities, are developing a social responsibility strategy (Adamczyk, 2009, p. 39).

Corporate Social Responsibility, in order to become an effective tool for building a company's competitive advantage, must be carried out in the form of long-term, carefully thought-out and planned activities, in the form of a strategy. A CSR strategy is a comprehensive, formulated and programmed set of activities covering relations with both the enterprise's key partners (clients, owners, employees, suppliers, investors, competitors and other business partners) and with social organisations, media, authorities, local and global community, research institutions. Moreover, it is important to remember that the development of the CSR strategy is gradual, stage by stage (Adamczyk, 2009, p. 39).

Although corporate social responsibility is generally considered in the context of large enterprises, it is also a strategic tool for improving the competitiveness of small and medium-sized companies. In practice, CSR activities are present in the activities of both small and medium-sized companies as well as large enterprises, in the latter case sometimes on a larger scale, and information about such involvement is generally better communicated externally (Bieńkiewicz, 2008, pp. 5-13).

The benefits of implementing a corporate social responsibility strategy can be considered in two scopes: for the enterprise and for society. At the enterprise level, benefits can be divided into internal and external (Adamczyk, Nowak, Kuraszko, Panek-Owsiańska, Rok, Zadrożna, 2007, p. 120).

Internal benefits of the company include:

- increased employee involvement and motivation - CSR increases employee motivation and loyalty, which translates into their increased creativity, innovation and activity for the benefit of the company, as well as the recognition of their superiors; this aspect also translates into an increase in the appeal of the company on the labour market, resulting in the attraction of new, good employees,
- creating company culture,
- lower supervision costs,
- increased innovativness,
- marketing benefits through donations.

The company's external benefits include:

- positive image among stakeholders, increased stakeholder loyalty and satisfaction with using the company's services and/or products - nowadays every consumer is aware of his/her choices and often, when choosing a product or service, is guided by trust in the company, its image, its perception by the environment; a contemporary contractor, apart from price and quality, also pays attention to the company's reputation and what is associated with it; at the same time better relations with external interest groups give the company easier access to information useful in its operations,
- conflict-free operation in the local community - CSR strengthens the company's position on the labour market (thanks to a good reputation, the company is perceived as a good employer, which may allow to reduce the problem of staff migration, and this is extremely important, especially for small and medium-sized enterprises, which are often not perceived as attractive employers), facilitates cooperation with business partners and state administration, and this translates into improved relations with the community and local authorities; by applying CSR principles, the company perpetuates itself positively in the awareness of local residents, gains recognition of local authorities, which in turn may simplify access to public funds,
- increased numer of loyal customers,
- increased competitiveness - resulting in increased sales, savings in costs and higher profits,
- increased interest from investors - companies pursuing socially responsible ideas can count on recognition from investors, which translates, among other things, into easier access to sources of funding; any lender will be more willing to grant it to a company that demonstrates both a positive financial result and a positive social image,
- prestige in the community due to sponsorship and charitable activities - by carrying out socially responsible activities, the company gains popularity, wins awards, which gives it greater publicity among clients, business partners and society, and thus increases its credibility in the eyes of these groups; the company thus becomes locally famous (also through word-of-mouth marketing); greater publicity is also important for the company in terms of entering new markets or reaching new groups of clients, as well as making wider use of the opportunities to operate in the existing market (e.g. through greater client loyalty).

Benefits to society include:

- active participation of enterprises in solving social problems,
- environment protection,
- activating the local community,
- educational and training programmes for residents,
- possibility of using employees' time (volunteering),
- financing of sports, cultural and charitable activities.

Aim, scope of research and research methods

The aim of the study was to assess the level of awareness and degree of implementation of the CSR concept, expressed in stakeholder relations, among small and medium-sized enterprises conducting business in the Małopolskie Voivodeship. The main research method used for the purpose of this study was primary research, which involved a quantitative method. The research was conducted in late 2022 and early 2023 using a survey questionnaire, which consisted of 30 open, closed questions. The survey was divided into four stages. The first stage verified the respondents' eligibility for the survey. The second stage verified the respondents' knowledge of corporate social responsibility, while in the third stage, the respondents answered questions about their experiences of corporate social responsibility. Finally, respondents were asked to fill in a metric to characterise the people surveyed. A total of 300 respondents took part in the survey.

4. Results of the research

The study focused on identifying the level of familiarity with the concept of Corporate Social Responsibility among employees of enterprises in the SME sector. Respondents were presented with a definition of Corporate Social Responsibility, and asked to refer to it and indicate one of the proposed answers. The largest number, 55% of respondents, admit that the very concept of corporate social responsibility is familiar to them, but they are not familiar with the details of the idea. Thirty per cent of respondents had never encountered the concept of CSR before, and 15% of respondents stated that it was well or even perfectly familiar to them. Those who stated that they knew the CSR concept "well" also declared that it is a concept that is often used in their companies. Respondents who were very familiar with the CSR concept stated that it was an integral part of their enterprises. It should be taken into account that mere familiarity with the concept of Corporate Social Responsibility does not necessarily imply full understanding of its assumptions (Figure 1).

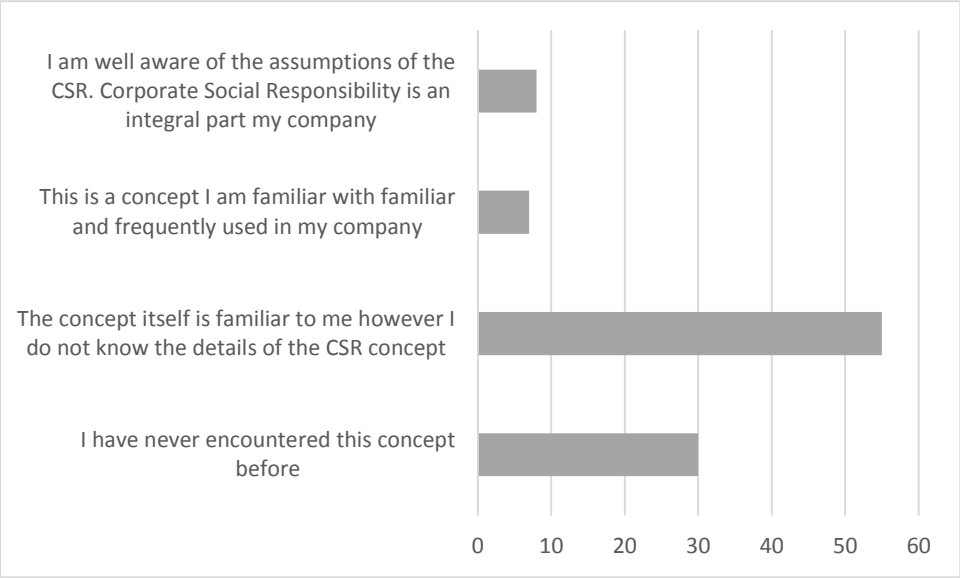

Figure 1. Awareness of the concept of corporate social responsibility among employees of small and medium-sized enterprises [in %].

Source: study based on own research.

According to the survey, knowledge of CSR largely depends on the position an employee holds in the company. Respondents who were owners of the company or held a managerial position were far more likely to respond that they were familiar with the idea to a good or excellent degree than lower-level employees (Figure 2).

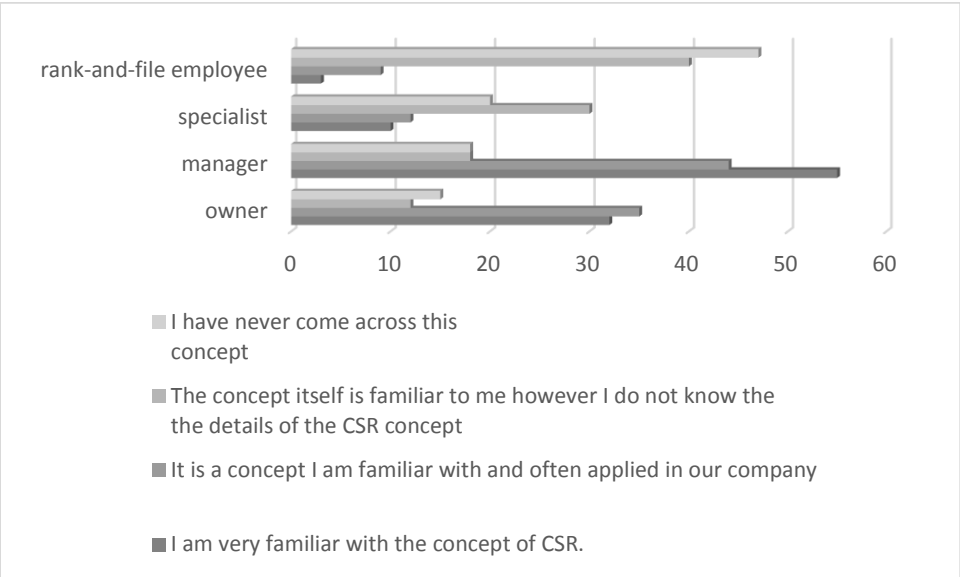

Figure 2. Awareness of the concept of Corporate Social Responsibility among employees of small and medium-sized enterprises by position held [in %].

Source: study based on own research.

Respondents were also asked to indicate the activities by which they understood corporate social responsibility. Most respondents indicated concern for the environment (68%) or support for the local community (57%). Good contact with customers and concern for their satisfaction

was indicated by only 48% of respondents. Similarly, almost half of the respondents stated that their company's CSR activities include concern for maintaining good relations with employees.

Despite the fact that activities related to the ethical behaviour of a company in the market are the basis for the operation of any company, only 41% of respondents indicated a link between this factor and the idea of CSR. Charitable activities were mentioned by 27% of respondents. The rest maintained their opinion that they had never encountered the concept of CSR before (Figure 3).

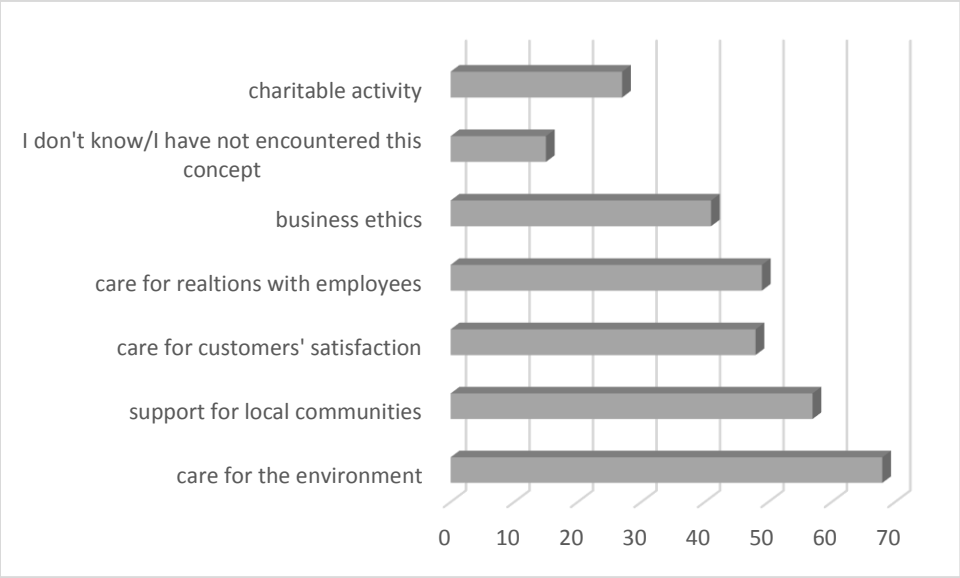

Figure 3. Activities understood by respondents under the term corporate social responsibility
Source: study based on own research

As the presented research shows, the knowledge of the very definition of CSR, as well as its assumptions, are not sufficiently known among the surveyed entrepreneurs. The reason for such a state can be seen in the accessibility to the degree of formalisation of Corporate Social Responsibility in these enterprises. The lack of information on the subject was indicated most frequently in small enterprises (65%), and in medium companies, where the share was almost 50%. Information was provided to employees in both small and medium-sized companies at a rate of 30% and 23% respectively.

Such low interest in activities related to the CSR concept may be due to a misconception among entrepreneurs about the high costs of its implementation. In addition, some entrepreneurs may not see a direct correlation between environmental or social commitment and their company's financial performance. Therefore, it was very important to establish the reasons why companies engage in CSR activities. The responses received show that the vast majority of respondents carry out their CSR activity in connection with increasing competitiveness (44%) or improving the company's image (48%). Among the respondents, about 13% indicated that the lack of appropriate tools used to promote the companies makes them undertake such activities. Only 11% of respondents stated that the reason for implementing CSR was socially motivated (Figure 4).

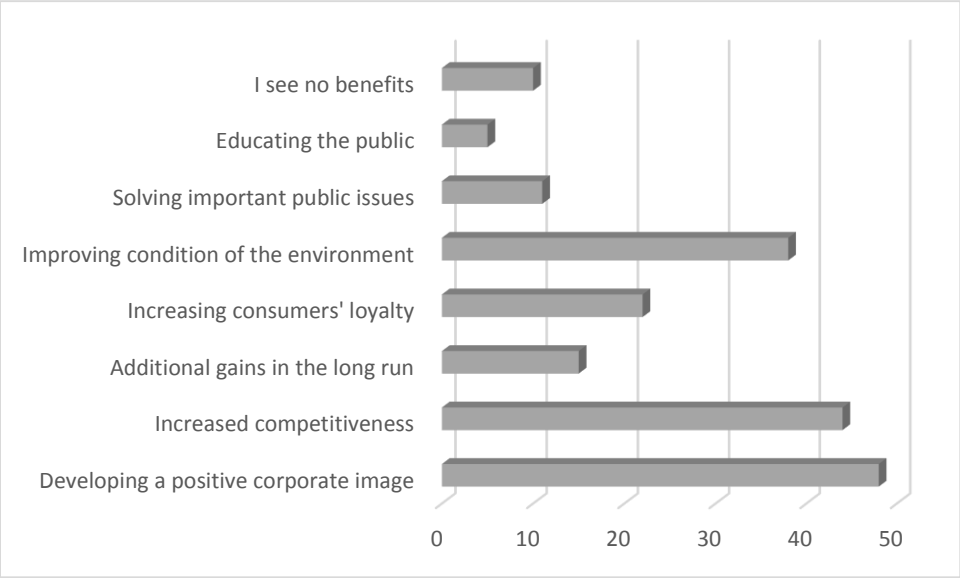

Figure 4. Benefits of applying CSR principles in the company as perceived by respondents.

Source: study based on own research.

The research carried out shows that a fuller understanding of the importance of Corporate Social Responsibility by entrepreneurs is needed in SMEs. Too little awareness on the part of the management about the benefits of applying this concept will effectively block the process of its implementation. However, where actions are taken in this direction, the vast majority of respondents agreed (85%) that Corporate Social Responsibility is needed.

Entrepreneurs were also asked to indicate the main problems they perceive in implementing CSR principles (Figure 5). More than 62% of respondents indicated a lack of time needed to implement CSR in their companies.

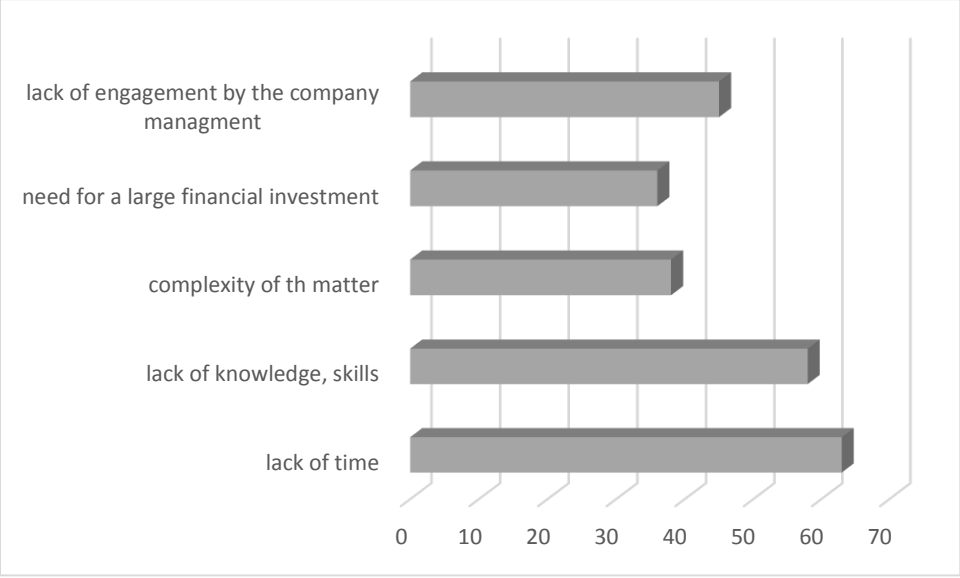

Figure 5. Problems in the implementation of CSR principles in the company in the opinion of the surveyed community.

Source: study based on own research.

Only slightly fewer (58%) see the problem as a lack of knowledge and skills. Implementation of the concept, for 36% of the surveyed, is associated with the need to incur high financial expenditures (this mainly concerned owners of companies). The above shows how low the awareness of entrepreneurs in the SME sector is, both in terms of Corporate Social Responsibility itself, as well as benefits resulting from its application in the long term. As shown earlier, the highest knowledge of CSR in the studied SMEs is held by persons employed in them on managerial positions. It can be assumed that the owners' low awareness of CSR may be a real barrier to attempts to implement the concept by employees in managerial position.

5. Conclusions

The need for corporate social responsibility (CSR) is imposed by globalization, which amplifies the business not only in a positive sense, but also results in predatory competition. Aiming at highest profitability, entities often use practices contrary to the law or those not legally forbidden but nevertheless having a detrimental or adverse impact on stakeholders or sustainable development. The need to rebuild social trust, not only through relevant legislation but also through an economy based on social responsibility, understood as transparency of decisions and actions, as well as stakeholder involvement.

The role of Corporate Social Responsibility is to drive all the players of economy towards ventures aimed at minimizing the negative impacts of their activities. By following this concept enterprises of all sizes not only contribute to social welfare, but also - through a strategic approach – build their value and competitive advantage. This is particularly important in the case of small and medium-sized enterprises, as it is increasingly difficult for them to compete with large international corporations. In this case, their small sizes and simple organizational structures give them a potential advantage in the local market.

On the basis of the above considerations, CSR can be defined as a concept through which enterprises, at the stage of building strategies, voluntarily take into account social interests and environmental protection, as well as relations with various stakeholder groups. Being responsible does not only mean meeting all formal and legal requirements, but also increased investment in human resources, environmental protection and stakeholder relations, i.e. voluntary commitment. Social responsibility is the process by which companies manage their relationships with a variety of stakeholders who can have a real impact on their business success.

It is worth noting that corporate social responsibility is a concept that affects both the environment and the enterprise itself. Some business entities apply this method of management disinterestedly, while other enterprises apply it guided mainly by economic benefits. Entities in

the SME sector are increasingly recognising that pro-social and pro-environmental activities are profitable in the long term and can contribute to the organisation's success on the market. These activities translate not only into an improvement of the company's image, but also into tangible financial effects.

Competition may tempt entrepreneurs with grey zone practices that are legal, but generally considered unethical. In the face of these problems, CSR becomes in a way a necessity of today. SME sector significantly affects development of domestic economy, therefore it is important to focus on the research that would promote and facilitate application of the social responsibility concept among companies operating within this sector. The challenge is to design a CSR model which can be used in an SME company with no need for expensive specialists or large-scale cost-intensive projects.

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