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CONTENTS

FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Presented papers contain result of researches conducted by various universities. The number consists of 39 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about human resource management, economics, social capital, strategic management, sustainable development, logistics, innovativeness, competitiveness, agile organization, organizational resilience, consumer behavior, the usage of AI in management, e-commerce, safety management, quality management and coopetition.

Radosław Wolniak

SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

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THE FOUR-DAY WORK WEEK – AN INEVITABLE REVOLUTION OR A PASSING FAD?

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Purpose: The aim of the article was to identify the effects of implementing a four-day working week based on selected experiments conducted in the period 2022-2024.
Design/methodology/approach: A review of experiments examining the effects of implementing the four-day workweek idea was conducted, and based on the collected material, its potential benefits were assessed and summarized.
Findings: Based on the critical analysis, a number of questions were asked about the justification for the great optimism regarding the shortening of the working week. It was pointed out that the conducted studies often present numerous benefits from the introduction of a four-day working week, but the barriers to the introduction of a new organization of working time, the costs associated with it are omitted and the effects of experiments in the long term are not sufficiently studied. The article opens a discussion on the research gaps in the area of the four-day working week.
Research limitations/implications: Three main limitations of the analysed studies were identified: too short a time of research implementation, which does not show the potential effects of a four-day work week in the long term, subjective assessments of employers and employees, including differences in defining individual phenomena and feelings, and the lack of examination of potentially negative effects of the experiments.
Originality/value: Conclusions from the analysis of selected studies shed new light on the approach to the four-day work week, revealing numerous research gaps in the experiments conducted so far, while asking a number of important questions, the understanding of which may influence the assessment of the idea of shortening the work week and may contribute to setting new standards in the implementation of subsequent studies.
Keywords: four-day work week, work-life balance, work time organization, labor market trends, working time reduction.
Category of the paper: Research paper.

1. Introduction

Panta Rhei [Gr. everything flows]. This phrase, attributed to Heraclitus of Ephesus, aptly describes many aspects of our environment. For over 2500 years, these two brief yet profoundly meaningful words have remained relevant. They are particularly fitting for describing the changes observed in management and quality sciences. Work is one of the fundamental human activities, and it is estimated that we spend more than half of our lives engaged in it (Zdun, Kopański, 2016). Globalization, social changes, and technological development strongly influence trends in work organization (Balcerowicz-Szkutnik, 2015; Błachowicz, 2019). A particularly interesting and currently widely discussed idea for reorganizing work is the four-day work week. This concept appears to have an almost equal number of supporters and opponents. The topic is so intriguing that extreme opinions often surface in the media, ranging from euphoria and certainty that this is the future of the labor market, perfectly aligning with Keynesian macroeconomic concepts, to skepticism and the belief that it is merely a temporary trend or pure populism. Moderate commentary is less frequently observed. Undoubtedly, this is a bold and electrifying idea, as it could significantly impact both the organization of enterprises and employees' private lives.

In Poland, the concept of a four-day work week remains under-researched. There have been few publications on the topic; however, in recent years, particularly since the COVID-19 pandemic, the idea of shortening the work week has increasingly appeared in the media and even within parliamentary debates. Internationally, the situation is different. In addition to lively discussions among business leaders and politicians, numerous studies have been initiated. These aim to help us understand whether the four-day work week is not only an attractive and futuristic concept but also a viable form of work organization that offers tangible benefits to both employees and employers. Examples of such initiatives include efforts in New Zealand, Iceland, and the United Kingdom. Organizations like *4 Day Week Global* have emerged to promote the reduction of the work week. Additionally, the first companies to adopt this system from the grassroots level have begun closely monitoring the outcomes of their actions. A frequently promoted slogan is *100/80/100*, which represents 100% pay for 80% of the work time, while maintaining 100% productivity.

The aim of this article was to identify the effects of implementing a four-day work week based on experiments conducted between 2022 and 2024. The analysis focused particularly on the benefits from both the employee and employer perspectives. Initially, the author intended to analyze both the benefits and costs; however, it turned out that reports from the experiments did not include information on the costs or potential negative side effects of this new work time arrangement.

2. Overview of Definitions and Historical Background Introduction

In 1956 R. Nixon said "The four-day work week is inevitable" (De Spiegelaere, Piasna, 2020). With these words, Nixon, one of the most prominent American politicians, sought to convince voters of his candidacy. It is clear that, even approximately 70 years ago, this topic was already present in public discourse and significant enough to be addressed during a presidential campaign. It is believed that the idea was popularized by W. Reuther in the 1950s (Hartman, Weaver, 1977). Some companies implemented this concept earlier, with American tanker drivers in the 1940s being an example, but such instances were marginal (Dunham, Hawk, 1977). Scientific research and numerous academic publications on the four-day work week began to emerge in the 1970s. During that period, scholars such as Hedges, LaCapra, and Gannon contributed to the development of this subject (Hedges, 1971; LaCapra, 1973; Gannon, 1974). Interest in this area was primarily observed in the United States, but it lasted only a few years (Campbell, 2024). The four-day work week had many skeptics, sparked controversy, and seemed unrealistic. Negative opinions began to dominate the public debate, leading to a reduction in actions supporting this direction. A more significant return to the topic occurred thanks to R. Bird in 2010, due to the changing work environment and new challenges facing enterprises (Bird, 2010). Over the following years, discussions continued across various sectors, including politics, journalism, and business, with growing public support for this idea (Srnicek, 2018; Peeples, 2009). However, it was only during the COVID-19 pandemic that the notion of a shorter work week returned to the forefront of public discourse. Increased interest can be observed in the frequency of searches for the phrase "four-day work week" over the past decade.

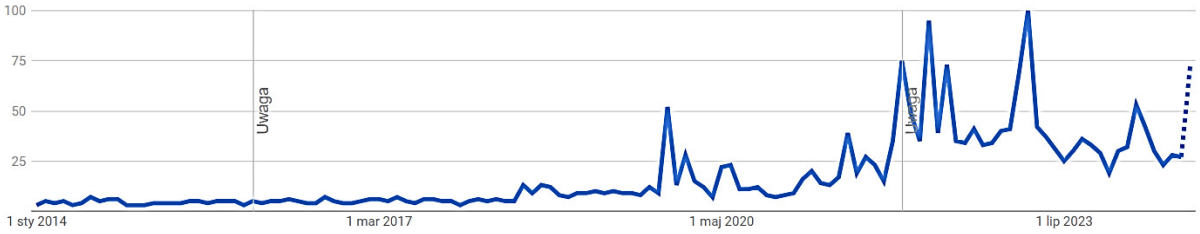

Figure 1. Number of searches for the phrase "four-day work week" in 2014-2024.

Source: Google Trends, https://trends.google.com/trends/explore?date=2014-01-01%202024-09-02&q=4%20day%20work%20week, 2.09.2024.

The first significant increase in interest can be observed during October-November 2019, attributed to the beginning of the COVID-19 pandemic. At that time, alternatives to the traditional employment model were being sought, with a focus on finding effective solutions to adapt to the new, challenging conditions for conducting business and balancing professional and personal life (Pang, 2020). The periods of November 2021-April 2022 and January 2023-March 2023 are also worth noting, possibly resulting from publications, scientific studies,

political actions, or media debates. Undoubtedly, the reduction of working hours remains of interest, despite the end of the pandemic period. It is worth emphasizing that the concept has been evolving autonomously, with various variants emerging dynamically, often driven by the diverse needs of both employees and companies. As a result, the four-day work week can be defined in various ways.

Table 1.
Overview of selected definitions of the four-day work week

Author	Definition
American Management Association (1972)	Any arrangement of working days and hours, planned by an organization, in which one or more groups of employees fulfill their professional obligations in less than the standard five full days.
Dunham R., Hawk D. (1977)	A type of compressed work schedule in which employees typically work four longer days as part of a full-time, four-day work week.
Eberle T. (1996)	A reduction in the total number of hours in which employees work four standard days and receive reduced pay.
Imber A. (2021)	The reduction of the work week to four working days, with employees receiving the same pay as if they were working a 40-hour, five-day work week.

Source: Own elaboration based on (Dunham, Hawk, 1977; Eberle, 1996; Imber, 2021; Yasmin, 2024).

Based on the above definitions, it is clear that the four-day work week has become increasingly expansive in meaning and can be understood as either a shortened or compressed work week. In the author's view, this distinction should be clearly made to maintain consistency in the information presented during discussions. These models may be associated with different opportunities and risks, leading to outcomes with distinct characteristics.

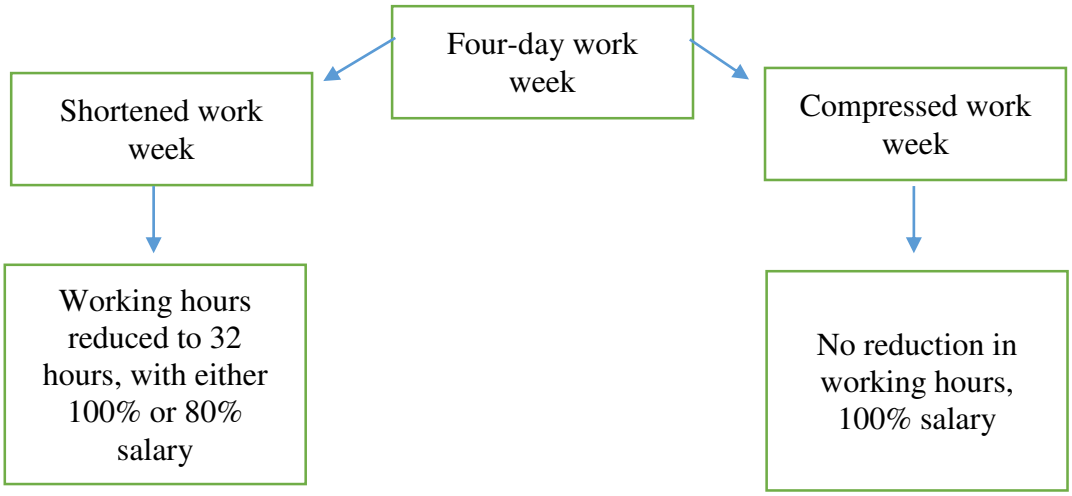

Figure 2. Types of the four-day work week.

Source: Own elaboration.

The concept of a shortened work week involves performing professional duties for four days, eight hours a day, per week. In this model, there are proposals to either maintain salaries at the same level or reduce them by 20%. The compressed work week, often referred to as the "false four-day work week," means receiving full pay but working an average of 10 hours per day. This solution potentially reduces work comfort and safety, while increasing stress, the risk

of accidents, and burnout. It undermines the foundation of the shortened work week, which aims to improve work-life balance. These models elicit very different levels of interest from employees. The model proposing 32 working hours per week without a reduction in pay is the most commonly chosen as the most attractive. This is well illustrated in the survey conducted by Hays Poland (2021, 2230 respondents).

Table 2.
Survey results from Hays Poland: Percentage of responses to the question "Would you like to work in a four-day work week model?"

Model type	Definitely yes	Yes	Rather yes	Total
Model 4 days x 8 hours, 100% salary	88%	6%	2%	**96%**
Model 4 days x 10 hours, 100% salary	15%	16%	21%	**52%**
Model 4 days x 8 hours, 80% salary	3%	5%	11%	**19%**

Source: Own elaboration based on Hays Poland survey, 2021, https://www.hays.pl/4-dni-pracy, 3.09.2024.

The results of the above survey demonstrate a significant difference in attitudes toward individual models. The publication *The Workforce View in Europe* (2019, 10,585 respondents) indicates that as many as 78% of respondents prefer to work longer hours and maintain their current salary. Employees are reluctant to accept a reduction in their pay, even if it would result in intangible benefits in their personal lives. Therefore, it should be emphasized that different interpretations of the concept of a 4-day workweek can create confusion in public debate. In practice, each of these models has various advantages and disadvantages, so discussions about the 4-day workweek require participants to clarify which specific model of the workweek is being analyzed.

3. Review of Selected Completed Experiments on the Four-Day Work Week

"The solution to (almost) all problems: work less" (R. Bregman). These words, spoken by a Dutch historian, suggest that reducing working hours could potentially bring positive outcomes in many areas of everyday life. The four-day work week is not merely about reducing hours spent on professional duties; it is a concept that seeks multidimensional benefits for both employees and employers. This idea has captured the imagination of many, who see it as an opportunity to de-standardize current forms of work organization. Research on shortening the work week has been conducted over the past few decades by private entities, organizations, and government bodies. These studies typically lasted from a few to several months, spanning across all continents, highlighting the importance of this topic. This article presents completed experiments on the four-day work week that meet the following criteria:

1. Full employee compensation was maintained during the experiments.
2. A real reduction in working hours was implemented, while compressed work week pilots were excluded.
3. Sample size exceeded 250 employees.
4. Research was conducted after 2021 (post-pandemic period).

Based on these selection criteria and a review of the literature, five studies were selected.

Table 3.
Overview of Selected Studies on the Four-Day Work Week Conducted in 2022-2024

No.	Study period (chronological)	Country	Sample size (employees/ organizations)	Dominant industries
1.	February 2022 – April 2023 (14 months)	USA, Canada	630 / 41	Professional services, marketing, non-profit
2.	June – December 2022 (6 months)	United Kingdom	2 900 / 61	Marketing/advertising, professional services, non-profit
3.	August 2022 – February 2023 (6 months)	Australia, New Zealand	547 / 26	Professional services, marketing/advertising, manufacturing
4.	March – August 2023 (6 months)	South Africa, Botswana	287 / 28	Professional services, IT, marketing
5.	January – June 2024 (6 months)	Brazil	252 / 19	Communication and media, technology, consulting and innovation

Source: Own elaboration based on The 4 day week: 12 months on with new US and Canadian research, The Results Are In: The UK'S Four-Day Week Pilot, Experimenting with a 4 day week in Australasia, South Africa A 4 Day Week Pilot Program, Brazil 4 Day Week Pilot.

USA/Canada

Study Conducted by: Researchers from Boston College in collaboration with 4 Day Week Global.

Participants and Timeline: 630 individuals, 41 companies (32 in the USA, 9 in Canada). Companies joined the study from February 2022 to April 2023, with effects measured up to 12 months after the introduction of the four-day work week.

Results: On a 10-point scale (1 being the worst, 10 the best), employers rated the pilot at 8.7, and employees rated it 9.1. The four-day work week significantly improved recruitment (8.7) and positively impacted productivity and efficiency (7.7). Company revenues increased by an average of 15% during the study. Among surveyed employees, 32% said they were significantly less likely to consider changing employers under this system. No company expressed interest in returning to the five-day week after the trial period, and 95% of employees wanted to continue the new arrangement. Burnout symptoms were reduced for 69% of respondents, 40% reported lower stress, and 59% observed a reduction in negative emotions. Employees reported less fatigue (45%) and improved sleep quality (40%). Work-family conflicts were less noticeable for 61% of participants. No "travel rebound" effect was observed (using free time to organize one-day car trips resulting in a larger carbon footprint),

and 42% of employees reported increased engagement in environmental activities such as recycling and biking.

United Kingdom

Study Conducted by: Think tank Autonomy and researchers from the University of Cambridge, Boston College, University College Dublin, University of Salford, and the University of Brussels, in collaboration with 4 Day Week Global.

Participants and Timeline: 2900 individuals, 61 companies, from June to December 2022.

Results: The overall rating of the experiment was 8.3/10. Of the 61 companies, 56 (91.8%) expressed a desire to continue, and 18 (29.5%) confirmed plans to implement the four-day work week permanently. Stress levels dropped for 39% of employees, while 71% reported reduced burnout symptoms. Employees found it easier to balance work and personal life (54%), and overtime hours decreased (34%). Job satisfaction increased for 48% of respondents, while mental health improved for 43%, notably with a reduction in negative emotions (54%). Physical health also improved (37%), which may reduce healthcare costs. Fatigue decreased for 46%, and sleep quality improved for 40%. Household finances improved for 44%, and relationships with family members strengthened for 45%. Company revenues remained stable, with an average increase of 1.4%. Employee resignations fell by 57%, and absenteeism decreased by 65%. The positive impact on company productivity was rated 7.5.

Notes: During the experiment, the following variants of the four-day work week were implemented:

- **Single additional day off for all employees** – Companies operated exclusively for four days a week, ensuring that all employees were present during this period. This was a centralized system with no internal rotations or divisions.
- **Alternating schedule** – Employees were divided into teams that worked on different days. This option was chosen by companies that needed to maintain operations for the entire week (five days).
- **Decentralized schedule** – Different groups worked according to varied time arrangements, which included situations where some employees worked for five days. This model was used in companies with diverse functions and challenges.
- **Annualized schedule** – Employees worked an average of 32 hours per week, calculated over the course of the year. This applied to companies with seasonal work, where longer hours during the summer season were compensated by shorter hours during the winter.
- **Conditional schedule** – The right to an additional day off was directly tied to the current performance of employees. Continuous monitoring of work outcomes was essential, and the shortened work week could be suspended if certain departments or individuals did not meet agreed productivity targets.

Australia, New Zealand, Europe, USA, Canada

Study Conducted by: Researchers from Boston College in collaboration with 4 Day Week Global.

Participants and Timeline: 547 individuals from 26 companies, mainly in Australia (10) and New Zealand (9), with some in Europe (4) and the USA/Canada (3). The study ran from August 2022 to February 2023.

Results: The program was well received, with companies rating it 8.2/10 and employees rating it 9.0/10. Recruitment improved (8.3), and productivity and efficiency were positively impacted (7.0 and 6.8, respectively). Most employees (95%) wanted to continue working under this system. Absenteeism decreased by 44.3%, and resignation rates dropped by 8.6%. Many employees wanted to continue working under this arrangement (96%), and 54% of them reported increased work capacity. Burnout symptoms were reduced for 64% of participants, stress decreased for 38%, and negative emotions decreased for 49%, while positive emotions increased for 62%. The work-family conflict was less noticeable for 49% of participants, and 38% reported feeling less fatigued and experiencing better sleep (35% of respondents). Some employees engaged in regular physical activity more frequently (36% of respondents, with the average duration of exercise increasing by 20 minutes per week). The division of household responsibilities also improved, with 27% of men and 15% of women reporting increased involvement. Additionally, more time was spent caring for children (17% of men and 11% of women). Commute time decreased by an average of 36 minutes per person per week. Moreover, 42% of employees reported increased engagement in environmental activities. There was no evidence of a "travel rebound" effect.

Notes: The four-day work week could be implemented in a flexible manner. The most common approach (adopted by 41% of companies) involved providing employees with an additional day off on different days of the week. This ensured that business operations could continue across all five days of the week.

South Africa, Botswana

Study Conducted by: Researchers from Boston College and Stellenbosch Business School, in collaboration with 4 Day Week Global.

Participants and Timeline: 287 individuals from 28 companies, conducted from March to August 2023.

Results: Participants of the pilot study rated the initiative at 8 (on a scale from 1, the lowest, to 10, the highest). 92% of respondents expressed a desire to continue the project. The four-day work week had a positive impact on company performance (rated 7.1), internal dynamics (7.7), and productivity (7.5). Employees reported a reduction in burnout symptoms (57%) and fatigue (36%). Some respondents increased the time spent on physical exercise (35%). Respondents also noted improved work-life balance (47%) and better mental well-being (35%). Companies reported an average revenue increase of 10.5%. Additionally, productivity, as assessed by

employees, also improved (49%). Interestingly, 25% of participants noticed a decrease in work intensity, 35% worked harder, and the rest did not observe significant changes. Respondents indicated that their work capacity increased (49%), and their creativity improved (58%). The number of resignations decreased by 11%, and employee absenteeism fell by 9%. Employers noticed a significant impact on recruitment capabilities (rated 7.9).

Brazil

Study Conducted by: Researchers from the Vargas School of Business Administration of Sao Paulo, in collaboration with Henley Business School, University of London, Boston College, and 4 Day Week Global.

Participants and Timeline: 252 individuals from 19 companies, conducted from January to June 2024.

Results: Participants expressed a strong desire to continue the four-day work week in their workplaces (97.5%). Surveyed employees noted improvements in project completion (56.6%) and adherence to deadlines (52.6%). Some reported an increase in creativity (80.7%), engagement (60.3%), and higher energy levels for task completion (87.4%). Additionally, some respondents reported a reduction in work-related stress (14.5%) and fatigue (45.9%). Increased sleep duration (42%) and reduced insomnia (49.6%) contributed to lower fatigue levels. Notably, 71.3% of respondents reported having more energy to devote to family and friends, leading to an improved work-life balance (44.4%). Respondents also reported better relationships with their supervisors (49%) and an improved organizational culture (83.2%), with enhancements in collaboration (90.1%), a greater sense of purpose in work and goals (86.5%), and pride in their job (85.1%). Overall employee satisfaction averaged 8.5, and engagement within the company was rated 9.2.

Notes: Prior to the pilot, the research team conducted interviews with management to understand their expectations for the program. The most frequently mentioned goals included reducing employee turnover, retaining talent, increasing engagement and productivity, and finding ways to positively impact employees' quality of life while promoting changes in work practices.

4. Review of the benefits of introducing a four-day workweek based on selected studies

"The four-day work week is regarded by some as a "triple dividend reform", which can bring positive economic, social, and environmental outcomes. In management and quality sciences, the issue of employees' psychophysical well-being is being increasingly discussed. There is a growing awareness of the harmful effects of overworking. A recent report by the

World Health Organization (WHO) indicated that spending excessive time on professional duties may be associated with a higher risk of heart and brain diseases.

The studies analyzed in this article were conducted between February 2022 and June 2024, involving a total of 4,616 employees from various industries and continents. Based on these data, it can be observed that the positive effects of implementing a four-day work week are evident in every pilot study, with both employees and employers being the main beneficiaries. From the analysis of the presented studies, the author categorized the benefits into four main areas: health, social, economic, and organizational.

Table 4.
Summary of Benefits of the Four-Day Work Week Based on Selected Studies

Area of Benefits	Main Beneficiaries	Identified Benefits	Study Results
Health	• Employees/Employers	• Reduced burnout • Reduced stress • Reduced negative emotions • Reduced fatigue	• 57-71% employees • 14,5-40% employees • 49-59% employees
	• Employees	• Improved sleep quality • Improved mental health • Improved physical health • Increase in positive emotions • Increased frequency of physical exercise	• 36-46% employees • 36-42% employees • 35-43% employees • 37% employees • 62% employees • 35-36% employees
Social	• Employees	• Reduced work-family conflict • Improved relationships with close people • More time spent with close people	• 44,4-61% employees • 45% employees • 71,3% employees
	• Society	• Increased environmental activities	• 42% employees
Economic	• Employers	• Increased revenue	• 1,4-15% of companies
	• Employees	• Improved household finances	• 44% employees
Organizational	• Employers	• Increased recruitment efficiency • Increased employee productivity and efficiency • Improved company performance • Reduced employee turnover • Reduced absenteeism • Decreased likelihood of job change	• 7,9-8,7/10 company rating • 7,5-8,4/10 company rating • 7-7,5/10 company rating • 8,6 -57% company rating • 9- 65% company rating • 32% employees
	• Employers/Employees	• Improved internal conditions • Reduced overtime • Increased job satisfaction • Increased work ability • Increased productivity • Increased creativity • Improved relationships with supervisors • Positive impact on organizational culture • Improved collaboration among employees	• 7,7/10 company rating • 34% employees • 48-85,1% employees • 49- 87,4% employees • 49-56,6% employees • 58%-80,7% employees • 49% employees • 83,2% company rating • 90,1% employees

Source: Own elaboration based on The 4 day week: 12 months on with new US and Canadian research, The Results Are In: The UK'S Four-Day Week Pilot, Experimenting with a 4 day week in Australasia, South Africa A 4 Day Week Pilot Program, Brazil 4 Day Week Pilot.

It is worth highlighting that the average rating of the new work schedule was very high, ranging between 8.0 and 8.7/10, with many companies expressing a desire to continue the pilot (91.8-97.5%). In the USA and Canada, no company indicated plans to return to the five-day work week. Employees responded enthusiastically to the new arrangement, rating it between 9 and 9.1/10, with 95-96% wishing to continue with the new work schedule. None of the studies reported a decline in revenues, and no significant negative effects were observed for either employers or employees. The four-day work week did not lead to increased stress, burnout, or other psychophysiological symptoms. The range of benefits presented in the reports suggests that the work environment was perceived positively by employees, who viewed it as motivating and conducive to creativity—an impression that was further strengthened by the shortened work week. The significant reduction in absenteeism and employee turnover suggests that this model could improve employer-employee relationships, foster loyalty, and increase commitment. In the table, the author identified the main beneficiaries of the advantages without specifying whether they applied solely to employees or employers, acknowledging that organizations should be seen as interconnected systems. Improvements in employee well-being can positively impact companies, and benefits to the company are likely to have a reciprocal effect on the workforce.

Although the results appear very promising, they should be approached with cautious optimism. The duration of most studies was typically only six months, which is sufficient to elicit a positive response to a new model. However, this is too short a period to determine how effective, or if at all, the model will be in the long term within an organization. Early in such projects, enthusiasm is often high, but over time, emotions may subside, and old habits and routines may resurface, not always contributing positively to task performance. It is unlikely that productivity gains, for instance, will be sustained at a high level over the long term. The key will be employers' awareness and competence in implementing appropriate change management strategies. Crucial elements could include training programs, effective communication tools, and control mechanisms. Furthermore, several challenging questions remain unanswered at this point.

1. Will employees, over the long term, be able to organize their work effectively enough to maintain the same productivity as they would in a five-day work week? Will they be able to sustain high levels of self-discipline?
2. Will employers implement the changes appropriately? A new work schedule requires systems, a deep understanding of the company and its employees, adjustments to organizational culture, management of internal tensions, effective communication, and numerous tools and competencies, which leadership teams must first acquire.
3. Could the four-day work week lead to conflicts within companies? This work arrangement may not suit all job positions. Some employees who continue to work five days a week may experience frustration or demotivation, ultimately seeking employment elsewhere.

4. In the long term, could a shortened work week, with unchanged employer demands, negatively affect the physical and mental well-being of employees, or increase the number of workplace accidents? Could this also result in increased pressure from employers, such as more frequent performance reviews or stricter day-to-day oversight?
5. Given that many reports currently indicate high levels of overtime, is the four-day work week feasible for a larger number of businesses, or will it remain limited to sectors such as marketing/advertising, IT, and non-profit organizations that can accommodate this model?
6. What are the actual costs associated with implementing the four-day work week? This question remains unanswered in the studies analyzed. It is crucial to understand whether the increased cost per working hour is offset by gains in productivity or creativity.
7. How will existing clients and competitors respond to this change?
8. Will the four-day work week force businesses to increase number of employees?

It is difficult to imagine that, particularly in certain professions, the same amount of work could be completed within four days. Good examples include positions such as teachers, hairdressers, drivers, manual laborers, doctors, psychologists, physiotherapists, and sports trainers. Additionally, it should be noted that Poland currently has low unemployment, and finding suitable employees is often a lengthy and costly process.

There is no doubt that many businesses experience so-called "inefficient hours", where employees do not spend the entire workday on their tasks. On the other hand, it is unclear which work-time arrangement offers more key advantages and fewer critical drawbacks. The four-day work week is undoubtedly a very intriguing solution, but it requires further, in-depth research over a longer timeframe. Such studies should objectively present both the numerous opportunities and risks associated with this model.

5. Conclusion

"The four-day work week has captured the public's imagination (…) but the most important question remains unanswered: is the shift from a five-day to a four-day work week inevitable?" (Hedges, 1971). This is yet another return to the topic, and notably, it comes with similar energy and a sense of mission as seen in the 1970s (Bird, 2010). Will public debate on this issue once again stall? Is this an inevitable revolution unfolding before our eyes, or just a passing trend leveraged as a marketing tool by populist parties? These questions remain unanswered. However, it can be stated that the present era is one of various transformations. Social changes, driven by factors such as the entry of a new generation into the workforce, globalization, and the pandemic, seem to be strong catalysts for continuing the discussion on the four-day

work week. The increasing familiarity with broad-based flexibility has made the four-day work week an attractive prospect for many. Similarly, the technological revolution, including digitization, cloud working, and particularly the impact of artificial intelligence on most areas of life, could be considered a new paradigm. This contributes to the de-standardization of working hours and the transformation of traditional forms of collaboration (Burchel et al., 2024). It is possible that we are witnessing irreversible changes in labor markets and demand for specific professions. It may also be that we are redefining time itself, as well as its value for both employees and employers.

On the other hand, the advantages of reducing working hours, as presented in public discourse, often appear overly optimistic. Current studies frequently do not show long-term effects, but instead highlight short-term gains, which may be difficult to sustain over a longer period. The same problem was evident in the 1970s (Campbell, 2024). One example is a company that reported a 400% increase in sales during that period (Bird, 2010). A common issue is the flawed research methodology and the over-reliance on subjective opinions (Mahoney et al., 1975). Presenting results without accounting for real costs and potential barriers undermines trust, which is a weakness of previous studies. Ultimately, attractive slogans and electrifying ideas about shortening the work week will need to be confronted with employer expectations and their economic balance sheets.

This article shows that the four-day work week may have both strong and weak points. It seems that governmental support could be crucial in providing the appropriate legal frameworks for this change. It is essential that the public debate be free from bias and unnecessary extremes of optimism or skepticism. The widely adopted eight-hour, five-day work model is likely to undergo changes in the future. In many countries, there is increasing pressure to reduce working hours. Today's social challenges, along with expanding technological capabilities, particularly the rapid development of artificial intelligence (AI), are strong stimuli for adjusting employee workloads. The near future will reveal whether the four-day work week has a real chance of becoming a widespread system of work organization.

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SEGMENTATION OF FOOD SERVICE CONSUMERS WITH SIMILAR CHOICE PREFERENCES

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Purpose: The paper presents the application of latent class analysis and conjoint analysis methods in the segmentation of food service consumers with similar choice preferences. The main aim of the research was to identify latent classes of consumers and then measure the preferences within the segments. An additional main of the research was to demonstrate the combination of the `poLCA` and `conjoint` R packages as the one common tool.
Design/methodology/approach: Latent class analysis (including latent class models and latent regression class models) was used in the segmentation of consumers, while traditional conjoint analysis was applied in the measurement and analysis of stated consumers' preferences. All calculations were carried out using the R program and appreciate R packages.
Findings: The research confirmed that consumers' preferences of food service are so diverse that they should not be analyzed at an aggregate level but rather within specific segments. Understanding detailed preferences in segments allows business to tailor their offerings and profiling food services for specific consumers' groups.
Research limitations/implications: It may be interesting to combine other clustering and preference measurement methods, as well as additional R packages in future research of stated preferences.
Practical implications: The combination of `poLCA` and `conjoint` R packages enables the measurement of heterogeneous preferences in the homogeneous food consumers' segments and can also be applied in other contexts. The presented research results can be utilized by practitioners of food service market.
Social implications: The second R package used in the research – authoring `conjoint` R package implements the traditional conjoint analysis method similarly to the module Conjoint IBM SPSS program. The statistics (over half a million of downloads by RStudio users) indicate that the non-commercial `conjoint` package is popular among R users.
Originality/value: The research results as well as the combined use of different R packages can interest of students and researchers in the field of microeconomics and marketing research in the practical application of the latent class analysis and conjoint analysis methods.
Keywords: stated consumers' preferences, latent class analysis, conjoint analysis, R program.
Category of the paper: research paper.
JEL Classification: C6, C8, D1.

1. Introduction

One of the most important elements of marketing research is the measurement and analysis of consumers' preferences. Measurement of preferences can be conducted at the individual level for each consumer separately, at the aggregate level for the entire consumer community, or at the segment level for previously identified groups of consumers.

The individual approach assumes that modeling the preferences of each consumer individually is the most natural and intuitive, because each consumer perceives the products and services offered on the market in an individual (heterogeneous) way. In this case, the estimation of the parameters of the preference model is carried out at the individual level by assigning a separate utility function to each respondent. Traditionally, data on preferences are collected using the full profile method, and partial utilities are estimated based on the multiple regression model. Although individual models, in terms of fit to data and forecasting accuracy, are characterized by good statistical properties, the limitation of the individual approach is the lack of theoretical foundations that would allow for the transformation of individual preferences into group preferences, which enable the estimation and forecasting of market shares (Moore, 1980; Bąk, 2013).

In the aggregated (homogeneous) approach, the estimation of the preference model parameters is carried out at the aggregate level, which means that one utility function is used for the entire group of respondents. Partial utilities are most often estimated based on probabilistic models (e.g. multinomial logit model, conditional logit model, probit model). The advantage of the aggregated approach is the possibility of obtaining an estimate of market shares, but homogeneous models (due to the heterogeneity of preferences) are not characterized by statistical properties as good as individual models in terms of fit to data and forecasting accuracy (Moore, 1980; Bąk, 2013).

Both approaches can be considered as extremes, which are characterized by mentioned advantages and disadvantages. A compromise approach is the measurement of preferences at the segmental level, in which the parameters of the preference model are estimated for homogeneous groups and the heterogeneous nature of the preference measurement is preserved. A feature of the segmental approach is taking into account the advantages of extreme approaches while eliminating their main disadvantages. In the segmental approach, with a reduced number of estimated utility functions[1] it is possible to estimate market shares, and one can also have the appropriate predictive accuracy of the model (Moore, 1980; Bąk, 2013).

The paper presents the results of measurement and analysis of preferences of food service consumers at the segmental level by combining proven methods that enable consumer segmentation and preference analysis. For segmentation, latent class analysis (latent class

[1] In comparison to the number of utility functions necessary to estimate at the individual approach.

models and latent class regression models) was used, allowing for the clustering of consumers into homogeneous groups and the preliminary measurement of preferences. Then, for each group separately, a detailed measurement of preferences was conducted at the individual (heterogeneous) level using the conjoint analysis method (traditional conjoint model).

The main originality of the paper is demonstrated by the obtained results of the research, which confirmed some of the expected results, including the importance of some variables, and helped to discover unexpected differences between the segments of respondents at the detailed level of preference measurement.

All calculations and visualizations of the obtained results were carried out using R program and appropriate R packages.

2. Methods

In the segmentation and measurement of consumers' preferences, various multidimensional data analysis methods can be used. For segmentation, subjective *a priori* or formal *post hoc* methods (such as cluster analysis, latent class analysis models, models with random parameters) are most commonly applied (Bąk, 2013). For measurement of preferences, conjoint analysis and discrete choice models are typically used. Given the tools employed, latent class analysis and traditional conjoint analysis are discussed in more detail in the next sections of the paper.

2.1. Latent class analysis

The latent class analysis (LCA) method has over fifty years of history and a well-established position among other clustering methods. The first publications discussing the concept of a latent variable were introduced by Lazarsfeld (1950), but due to the lack of formal methods for estimating model parameters, the application of latent class analysis was limited at that time. The breakthrough period was 1968, when Lazarsfeld and Henry (1968) presented the mathematical workshop and the concept of the method, and then 1974, when Goodman (1974) presented statistical solutions for estimating model parameters, developed the maximum likelihood method, extended the application of latent class analysis to polytomous variables and multidimensional latent class models (Goodman, 1974). To date, many publications have been published on the issue of latent class analysis, presenting various models of data analysis. Also many computer programs and packages supporting empirical research have been developed.

Latent class analysis is a cluster analysis tool representing an approach based on a probability model, in which the research material is marketing data on the declared preferences of respondents, obtained mainly as a result of survey research. Unlike classic cluster

analysis methods, which use distance measures (similarity, dissimilarity) for classification, latent class analysis uses a model approach in which the probabilities of objects belonging to classes are calculated and then objects are classified based on these values. In this way, objects (individuals, respondents, entities) are grouped (divided) into separate and homogeneous classes (segments). The advantage of the model approach is the ability to take various variables (continuous and discrete) measured on different scales (metric and non-metric) in the research (Everitt et al., 2011; Bąk, 2013; Brzezińska 2021).

Latent class analysis assumes the existence of some abstract characteristic that cannot be observed directly by the researcher. This means that there are some hidden, unobserved variables that constitute the basis of interest in latent class analysis. Hidden dependencies between variables describing the examined objects determine whether the objects belong to particular classes.

The following types of variables can be distinguished in latent class models:

- manifest variables or dependent variables that can be measured on different measurement scales,
- latent variables that can be measured on nominal or ordinal scales,
- predictor variables and covariates (concomitant variables) that can be measured on different scales.

A model in latent class analysis must contain at least one manifest (or dependent) variable and at least one latent variable. In addition, the model may include concomitant variables. Variables in the model can be continuous or discrete.

The basic types of models used in the approach based on probability models include:

- mixture models,
- latent class models,
- latent class regression models.

The basic types of models used in preference research and segmentation using latent class analysis method include latent class models and latent class regression models.

Latent class models can be written using the formula (Wedel and DeSarbo, 1994; Vriens, 2001), (Bąk, 2013):

$$f(y|\Phi) = \sum_{c=1}^{C} \pi_c \, f_c(y|\theta_C) \tag{1}$$

where:

f – distribution function of observations (empirical preferences),

y – empirical preferences,

$\Phi = (\pi, \theta)$ – unknown model parameters,

π_c – unknown size of c-th segment (interpreted as a mixing parameter representing the affiliation of observations to particular hidden classes),

f_c – distribution function of observations in *c*-th class,
θ_C – parameters estimated for *c*-th segment,
$c = 1, \ldots, C$ – number of segment.

Latent class regression models can be divided into two cases – a latent class regression model with explanatory variables (Vriens, 2001; Bąk, 2013):

$$f(y|x) = \sum_{c=1}^{C} \pi_c \, f_c(y|\pi_C, x) \tag{2}$$

where:
y – observation vector,
x – predictor variables that affect *y*,
π_C – probability of belonging to the *c*-th class or the the *y*-segment size; and a latent class regression model with predictor variables and covariates (Vriens, 2001; Bąk, 2013):

$$f(y|x) = \sum_{c=1}^{C} (\pi_C|z) \, f_c(y|\pi_C, x) \tag{3}$$

where: z – covariates that affect the latent variable (membership in latent classes).

Predictor variables should be understood as attributes of products or services. Including these variables in the model enables consumer segmentation using consumer characteristics (geographical, demographic, cultural, socio-economic and others) (Bąk, 2013).

One of the most important stages of using latent class analysis is estimating the model parameters. Among the most commonly used statistical methods for estimating the parameters of latent class models, the maximum likelihood method should be distinguished. The values of the maximum likelihood estimators are usually found using optimization algorithms, including the Expected Maximization (EM) algorithm (Dempster, Laird, Rubin, 1977) or the Newton-Raphson algorithm (Raphson, 1960). Both approaches rely on iterative estimation of the maximum likelihood value and both algorithms start with a certain initial value. The algorithms continue to operate until the specified criteria are met (Everitt, 1987; McLachlan, Krishman, 1977; Wedel, Kamakura, 2000).

The main advantage of the EM algorithm is the increase in the value of the likelihood function in each subsequent iteration, which makes it a more frequently used method compared to the Newton-Raphson method. In addition, the EM algorithm can also be used to supplement missing data in the sample. The disadvantages of the EM algorithm include a large number of necessary iterations, slower operation, and difficult estimation of standard errors (Brzezińska, 2021). The EM algorithm and its applications for LCA are presented e.g., in the following studies (Aitkin, Anderson, Hinde, 1981; McLachlan, Krishnan, 1997; Dempster, Laird, Rubin, 1977; Chen, 1981; Dempster, Rubin, Tsutakawa, 1981; Kamakura, Russell, 1989; Hamilton, 1991; DeSarbo, Wedel, Vriens, Ramaswamy, 1992).

In assessing the fit of latent class models to data and selecting the best-fitting model, relative fit criteria are most often used, of which the basic inferential rate is the likelihood ratio test. Additionally, various forms of information-heuristic rates are used, such as the Akaike Information Criterion (AIC) (Akaike, 1973; Akaike, 1987) and the Bayesian Information Criterion (BIC) (Schwarz, 1978; Konishi, Kitagawa, 2008).

LCA belongs to a larger family of latent variable techniques called finite mixture models (FMM) (Bouveyron et al., 2019), which comprises a wide range of cross-sectional and longitudinal models that all involve one or more latent class variables. More information about mixture models and latent class analysis can be found in the subject literature (Goodman, 1974; Wedel, DeSarbo, 1994; McLachlan, Peel, 2000; Oberski, 2016; Linzer, Lewis, 2022; Vriens 2001; Nylund et al., 2007; Vermunt, Magidson, 2002; Vermunt, 2010; Colins, Lanza, 2010; Nylund-Gibson, Choi, 2018; Lubke, Muthén, 2005; Masyn, 2013).

2.2. Traditional conjoint analysis

The traditional conjoint analysis method also has a long history of over forty years and holds a well-established position among methods of measurement and analysis of stated preferences. The first publication presenting conjoint measurement in psychometrics appeared in 1964 (Luce, Tukey, 1964), followed by additional works in the 1970s (Green, Rao, 1971; Green, Wind, 1973; Green, Srinivasan, 1978). Since then, numerous studies have discussed the methodological challenges and applications of conjoint analysis in marketing research. Nowadays, conjoint analysis is a widely used method for studying consumer preferences for products and services, as well as political opinions and religious attitudes. A comprehensive review of the existing achievements and future development perspectives in conjoint analysis is provided in (Green, Krieger, Wind, 2004; Gustafsson, Herrmann, Huber, 2007; Rao, 2014).

In empirical research, conjoint analysis methods are often used in the analysis of stated preferences measured on metric scales. In such cases, a multiple regression model with dummy variables is usually used, the parameters of which are estimated by the classical method of least squares (OLS).

The research material used in the conjoint analysis method is marketing data on respondents' declared preferences, obtained mainly as a result of survey research. Respondents evaluate product or service profiles[2] (real or hypothetical) described by a set of features (attributes), thus expressing their (empirical) preferences. Based on the collected data, the total preferences are decomposed using statistical methods by calculating the share of each attribute in the estimated total utility value of the profile. Part-worth utilities are estimated for each respondent individually and as average values for the studied sample (Green, Wind, 1975).

[2] Attributes and their levels generate different variants (profiles) of goods or services. The number of all possible profiles to be generated depends on the number of attributes and the number of levels (it is the product of level numbers of all attributes). In practice, only a subset of variants meeting the relevant conditions (e.g. of the system orthogonality) is ranked by respondents in the form of the so-called fractional factorial design.

One of the more important stages of the conjoint analysis procedure is the estimation of the parameters of conjoint analysis model. In the traditional conjoint analysis, the linear multiple regression model is developed, the parameters of which (part-worth utilities of the attribute levels) are estimated using the classical Ordinary Least Squares (OLS) method. The model for the selected respondent can be presented in the following form (Hair, Anderson, Tatham, Black, 1995):

$$\widehat{Y_s} = b_{0s} + b_{1s}X_{1s} + \cdots + b_{ms}X_{ms} = b_{0s} + \sum_{j=1}^{m} b_{js}X_j \tag{4}$$

where:
$s = 1, \ldots, S$ – respondent's number;
S – number of respondents.

The knowledge of part-worths utilities allows conducting the analysis covering:

- the theoretical total utilities of the profiles in the cross-section of respondents,
- the analyzed sample and the identified groups (segments) of respondents,
- the relative "importance" ranking of individual attributes in the cross-section of respondents in the analyzed sample,
- the simulation market shares of the selected profiles,
- the segmentation of respondents.

The total utility of i-th profile for s-th respondent (U_i^s) is calculated based on the following formula (Hair, Anderson, Tatham, Black, 1995; Walesiak, 1996):

$$U_i^s = \sum_{j=1}^{m} b_{0s} + U_{l_j^i}^s \tag{5}$$

where:
b_{0s} – the intercept for s-th respondent;
$U_{l_j^i}^s$ – part-worths utility of l-th level of j-th attribute of i-th profile for s-th respondent;
l_j^i – level number of j-th attribute in i-th profile.

The average theoretical total utility (at an aggregated level, i.e., for the whole sample covering S respondents) of i-th profile (U_i) is calculated based on the following formula (Hair, Anderson, Tatham, Black, 1995; Walesiak, 1996):

$$U_i = \frac{1}{S}\sum_{s=1}^{S}\left(\sum_{j=1}^{m} b_{0s} + U_{l_j^i}^s\right) \tag{6}$$

The knowledge of part-worths utilities also allows estimating the "importance" for every attribute in the assessment of profiles, which are the subject of research. The relative importance of j-th attribute for s-th respondent (W_j^s) is calculated using the formula (6) (Hair, Anderson, Tatham, Black, 1995):

$$W_j^s = \frac{max\{U_{l_j^i}^s\} - min\{U_{l_j^i}^s\}}{\sum_{j=1}^{m}\left(max\{U_{l_j^i}^s\} - min\{U_{l_j^i}^s\}\right)} \times 100\% \tag{7}$$

The average "importance" of particular attributes in the cross-section of the whole sample covering S respondents (W_j) is calculated based on the formula:

$$W_j = \frac{1}{S}\sum_{s=1}^{S} W_j^s \tag{8}$$

where: W_j^s – defined by a formula (7).

The results in the form of estimated partial utilities obtained in the conjoint analysis procedure can be used in simulation models of market events, the so-called choice simulators, which enable the analysis of what-if scenarios. Making some simulation analysis of market shares it is also possible to estimate the total utility of additional profiles, which were not ranked by the respondents in the survey. The anticipated market share of the selected profiles is estimated based on the maximum utility model, probabilistic BTL (Bradley-Terry-Luce) model and logit model (Hair et al., 1995; Walesiak, 1996; Walesiak, Bąk, 2000; Bąk, 2013).

The parameter values of the estimated conjoint analysis model (estimated part-worth and total utilities) can additionally constitute the basis for consumers' segmentation, as they reflect the respondents' preferences presented in the research regarding the specific profiles of products and services.

More information about conjoint analysis methods and its applications in practice can be found in subject literature (Hair et al., 1995; Coombs, Dawes, Tversky, 1977; Green, Rao, 1971; Green, Srinivasan, 1978, 1990; Green, Wind, 1975; Wilkinson, 1998; Vriens, Wittink, 1994; Zwerina, 1997; Poortinga et al., 2003; Gustafsson, Herrmann, Huber, 2007; Rao, 2014; Lu, Zhang, 2020; Walesiak, 1996; Walesiak, Bąk, 2000; Bąk, 2004; Bąk, Bartłomowicz, 2012, 2018b; Bartłomowicz, Bąk, 2021).

3. Segmentation and measurement of preferences

In the segmentation and measurement of food service consumers' preferences data from a survey conducted in 2022 were used. The survey questionnaire included questions for conjoint analysis method, questions for latent class analysis and questions about basic respondents'

characteristics. A total of 154 survey questionnaires were distributed electronically using the Microsoft Teams, of which 122 questionnaires were correctly completed and used as a source of statistical data. For the purposes of segmentation and the preliminary measurement of the consumers' preferences the appropriate latent class model and latent class regression models were used, while for the purposes of detailed measurement of stated preferences the traditional conjoint analysis method was used.

All calculations were carried out using the R program with `poLCA` package (Linzer, Lewis, 2024) for latent class analysis, the `conjoint` package (Bąk, Bartłomowicz, 2018a) for conjoint analysis method, the `ltm` package (Rizopoulos, 2022) for basic descriptive statistics and the `ggplot2` package (Wickham et al., 2024) for visualization of the obtained results.

3.1. Segmentation

For the purpose of respondents' segmentation, a question from the second part of the survey was used, in which 8 observed variables were selected: quality of products, originality of the dish, quality of service (by the salesperson or waiter), additional amenities, free parking, description of food allergens, use of organic ingredients and food service location. Respondents indicated the significance of each variable on a 5-point polytomous scale. Sample answers for first respondent are presented in Table 1.

Table 1.
Sample answers for first respondent

Variable	Significance to respondent				
	very small (1)	**small (2)**	**average (3)**	**high (4)**	**very high (5)**
Quality of products					X
Dish originality					X
Quality of service				X	
Additional amenities				X	
Free parking		X			
Food allergens	X				
Ecological ingredients	X				
Location			X		

Source: survey questionnaires.

The options for this question were included in the latent class models as manifest variables and served as the basis for respondents' segmentation. In the research, respondents were also asked to provide some of their own characteristics[3] which allowed for the inclusion of some selected covariates in the research using latent class regression models.

[3] The asked characteristics included the following variables (with corresponding levels): sex (male, female), age (open question), education level (basic education, secondary education, some university education, higher education), net income (up to 2000 PLN, between 2000 and 3500 PLN, between 3500 and 5000 PLN, above 5000 PLN), frequency of using food service (less than once a month, once a month, once a week, 1-3 times a week, more than 3 times a week).

First, the collected data were summarized using the `descript` function from `ltm` R package, which allows obtaining basic descriptive statistics for polytomous data (cf. Table 2):

```
> data=read.csv2("food_lca.csv", header=TRUE)
> library(ltm)
> des=descript(data)
> print(des)
```

Table 2.
Frequency of selecting a given option by respondents

Variable	Respondents' answers				
	very small (1)	small (2)	average (3)	high (4)	very high (5)
Quality of products	0,0082	0,0082	0,0246	0,1803	0,7787
Dish originality	0,0492	0,0984	0,2951	0,3197	0,2377
Quality of service	0,0082	0,0328	0,2213	0,4426	0,2951
Additional amenities	0,0984	0,1967	0,2213	0,3033	0,1803
Free parking	0,1885	0,1311	0,1475	0,2377	0,2951
Food allergens	0,2705	0,1311	0,1639	0,1803	0,2541
Ecological ingredients	0,1803	0,1721	0,2787	0,2541	0,1148
Location	0,0410	0,0246	0,2377	0,3525	0,3443

Source: author's compilation using `ltm` R package.

The initial data analysis indicates that not all variables are equally strongly preferred. The quality of products is very important to almost all respondents (77.87% of "very high" and 18.03% of "high" responses). In the case of the food allergens and ecological ingredients, respondents most often selected the option "very small" and "very high", which allows us to conclude that these features are important only to some respondents. In the case of the rest variables (dish originality, quality of service, additional amenities, free parking and location) respondents' responses were highly dispersed, which indicates the division of respondents into separate classes and need for further analysis using the latent class analysis method.

The first analyzed was the latent class model with all manifest variables. In order to select the optimal number of classes, models for 2, 3 and 4 classes were estimated (each model was estimated 3 times with different starting values of the optimization algorithm, each time from 100 models). In this way, using the `poLCA` function latent class models were estimated, the fit of which was the best based on the AIC and BIC criteria:

```
> model=cbind(quality, originality, service, amenities, parking, allergens,
ecology, location)~1
> for (k in 2: 4) {
+      min_ll=0
+      min_aic=10000
+      min_bic=min_aic
+      for (m in 1:100) {
+            lca=poLCA(model, data, nclass=k, nrep=3, tol=1e-10, verbose=FALSE)
+            if (lca$ll<min_ll) {min_ll=lca$ll}
+            if (lca$aic<min_aic) {min_aic=lca$aic}
+            if (lca$bic<min_bic) {min_bic=lca$bic}
+      }
+      cat("Model nr", k, "\n")
+      cat("LL: ", min_ll, "\n")
```

```
+      cat("AIC: ", min_aic, "\n")
+      cat("BIC: ", min_bic, "\n")
+ }
Model nr 2
LL:  -1279.827
AIC:  2639.755
BIC:  2822.016
Model nr 3
LL:  -1232.605
AIC:  2620.049
BIC:  2894.843
Model nr 4
LL:  -1201.035
AIC:  2621.632
BIC:  2988.958
```

The indications of the AIC and BIC criteria are not unambiguous (the AIC criterion indicates 3 segments, while the BIC criterion indicates 2 segments). The comparison of both models (cf. Figures 1-2) in terms of the assessment of the probability of choosing a food service due to the selected variables indicates that the division of the studied sample according to the AIC criterion (3 segments) has a greater interpretative value. Among the selected variables, the most important in all segments is "very high" products' quality, while the perception of the remaining variables by the respondents depends on the given segment. Therefore, the basis for further analysis was the division of the respondent population into 3 segments, with percentage shares of 38.9%, 32.7% and 28.4%:

```
> min_aic=10000
> min_bic=min_aic
> for (k in 2: 3) {
+      for (m in 1:100) {
+            lca=poLCA(model, data, nclass=k, nrep=3, tol=1e-10, verbose=FALSE)
+            if (lca$aic<min_aic) {min_aic=lca$aic; mod3=lca}
+            if (lca$bic<min_bic) {min_bic=lca$bic; mod2=lca}
+      }
+ }
> print(mod2)
> windows(width=5, height=4, pointsize=9)
> plot(mod2)
Conditional item response (column) probabilities,
 by outcome variable, for each class (row)

$quality
          Pr(1) Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.019 0.019 0.0190 0.1883 0.7548
class 2:  0.000 0.000 0.0289 0.1743 0.7969

$originality
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.0945 0.2085 0.2323 0.2736 0.1910
class 2:  0.0146 0.0145 0.3429 0.3547 0.2733

$service
          Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.019 0.0569 0.3030 0.4104 0.2107
class 2:  0.000 0.0144 0.1591 0.4671 0.3594

$amenities
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.2275 0.3380 0.1573 0.1477 0.1295
class 2:  0.0000 0.0891 0.2700 0.4218 0.2190
```

```
$parking
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.3408 0.2392 0.1153 0.1163 0.1885
class 2:  0.0725 0.0488 0.1721 0.3302 0.3763

$allergens
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.5965 0.3033 0.0000 0.1002 0.0000
class 2:  0.0221 0.0000 0.2888 0.2414 0.4477

$ecology
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.3600 0.3083 0.1374 0.1942 0.0000
class 2:  0.0435 0.0684 0.3863 0.2997 0.2022

$location
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.0744 0.0569 0.2836 0.3201 0.2650
class 2:  0.0155 0.0000 0.2028 0.3771 0.4046

Estimated class population shares
 0.4324 0.5676

Predicted class memberships (by modal posterior prob.)
 0.4344 0.5656

=========================================================
Fit for 2 latent classes:
=========================================================
number of observations: 122
number of estimated parameters: 65
residual degrees of freedom: 57
maximum log-likelihood: -1254.878
AIC(2): 2639.755
BIC(2): 2822.016
G^2(2): 1345.892 (Likelihood ratio/deviance statistic)
X^2(2): 1079715 (Chi-square goodness of fit)
```

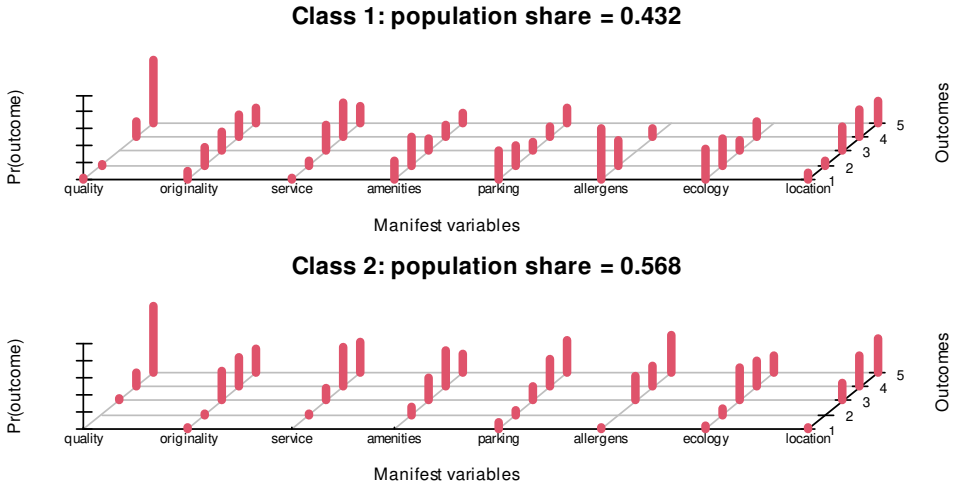


Figure 1. Estimated probabilities of selecting options for 2 classes.

Source: author's compilation using `poLCA` R package.

```
> print(mod3)
> windows(width=5, height=4, pointsize=9)
> plot(mod3)
Conditional item response (column) probabilities,
```

```
 by outcome variable, for each class (row)

$quality
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.0211 0.0211 0.0211 0.1871 0.7497
class 2:  0.0000 0.0000 0.0253 0.2035 0.7712
class 3:  0.0000 0.0000 0.0287 0.1443 0.8270

$originality
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.1053 0.2315 0.2161 0.2922 0.1550
class 2:  0.0251 0.0252 0.4637 0.4042 0.0819
class 3:  0.0000 0.0000 0.2092 0.2599 0.5309

$service
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.0211 0.0632 0.3335 0.4102 0.1721
class 2:  0.0000 0.0000 0.1961 0.6459 0.1580
class 3:  0.0000 0.0289 0.0964 0.2527 0.6220

$amenities
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.2526 0.3549 0.1706 0.1489 0.0729
class 2:  0.0000 0.1790 0.3289 0.4582 0.0340
class 3:  0.0000 0.0000 0.1669 0.3366 0.4966

$parking
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.3826 0.2741 0.0992 0.1121 0.1320
class 2:  0.0000 0.0462 0.2114 0.5934 0.1490
class 3:  0.1396 0.0328 0.1403 0.0000 0.6873

$allergens
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.5478 0.3369 0.0000 0.1154 0.0000
class 2:  0.0325 0.0000 0.2984 0.2707 0.3984
class 3:  0.1643 0.0000 0.2339 0.1652 0.4365

$ecology
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.3377 0.3194 0.1384 0.2045 0.0000
class 2:  0.0590 0.0000 0.5086 0.3400 0.0925
class 3:  0.1043 0.1685 0.2062 0.2232 0.2980

$location
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.0686 0.0632 0.2954 0.3468 0.2260
class 2:  0.0000 0.0000 0.1482 0.6343 0.2174
class 3:  0.0503 0.0000 0.2616 0.0353 0.6528

Estimated class population shares
 0.3893 0.327 0.2836

Predicted class memberships (by modal posterior prob.)
 0.3852 0.3197 0.2951

=========================================================
Fit for 3 latent classes:
=========================================================
number of observations: 122
number of estimated parameters: 98
residual degrees of freedom: 24
maximum log-likelihood: -1212.025
AIC(3): 2620.049
BIC(3): 2894.843
G^2(3): 1260.186 (Likelihood ratio/deviance statistic)
X^2(3): 825988.5 (Chi-square goodness of fit)
```

The obtained results present the probability of respondents choosing a given option for each analyzed variable. The `poLCA` function optionally creates a graph presenting the probability of choosing an option. Additionally, information about the size of individual segments is visible.

Additionally, using latent class regression models, it is possible to determine the influence of variables characterizing respondents on the segmentation. For this purpose, the parameters of the latent class regression models with the covariate net income, with the covariate education and with the covariate frequency of service use were estimated (sample for first covariate):

```
> model=cbind(quality, originality, service, amenities, parking, allergens,
ecology, location)~income
> min_aic=10000
> for (m in 1:100) {
+      lca=poLCA(model, data, nclass=3, nrep=3, tol=1e-10, verbose=FALSE)
+      if (lca$aic<min_aic) {min_aic=lca$aic; mod3i=lca}
+ }
> ps_aic=poLCA.reorder(mod3i$probs.start, order(mod3i$P, decreasing=TRUE))
> lca_aic=poLCA(model, data, nclass=3, probs.start=ps_aic)
> windows(width=3.0, height=3.5, pointsize=10)
> par(cex.main=0.9, cex.lab=0.85, cex.axis=0.85)
> pd=cbind(1, c(1:4))
> exb=exp(pd%*%lca_aic$coeff)
> par(cex.main=0.9, cex.lab=0.85, cex.axis=0.85)
> pic=cbind(1, exb)/(1+rowSums(exb))
> matplot(c(1:4), pic, ylim=c(min(pic), max(pic)), xaxt="n",
+ col=c("#C79a9a", "#9fc79a", "#ff0010"), type="l", lwd=3,
+ main="Model with covariate (3 classes)",
+ xlab="Net income low (1) - high (4)", ylab="Probability of class membership")
> axis(1, at=c(1, 2, 3, 4))
> text(1.1, 0.34, "1", col="#C79a9a", cex=0.9)
> text(3.9, 0.22, "2", col="#9fc79a", cex=0.9)
> text(1.1, 0.22, "3", col="#ff0010", cex=0.9)
> model=cbind(quality, originality, service, amenities, parking, allergens,
ecology, location)~education
> min_aic=10000
> for (m in 1:100) {
+      lca=poLCA(model, data, nclass=3, nrep=3, tol=1e-10, verbose=FALSE)
+      if (lca$aic<min_aic) {min_aic=lca$aic; mod3e=lca}
+ }
> ps_aic=poLCA.reorder(mod3e$probs.start, order(mod3e$P, decreasing=TRUE))
> lca_aic=poLCA(model, data, nclass=3, probs.start=ps_aic)
> windows(width=3.0, height=3.5, pointsize=10)
> par(cex.main=0.9, cex.lab=0.85, cex.axis=0.85)
> pd=cbind(1, c(1:4))
> exb=exp(pd%*%lca_aic$coeff)
> par(cex.main=0.9, cex.lab=0.85, cex.axis=0.85)
> pic=cbind(1, exb)/(1+rowSums(exb))
> matplot(c(1:4), pic, ylim=c(min(pic), max(pic)), xaxt="n",
+ col=c("#C79a9a", "#9fc79a", "#ff0010"), type="l", lwd=3,
+ main="Model with covariate (3 classes)",
+ xlab="Education level basic (1) - high (4)",
+ ylab="Probability of class membership")
> axis(1, at=c(1, 2, 3, 4))
> text(1.1, 0.34, "1", col="#C79a9a", cex=0.9)
> text(1.1, 0.15, "2", col="#9fc79a", cex=0.9)
> text(3.9, 0.22, "3", col="#ff0010", cex=0.9)
```

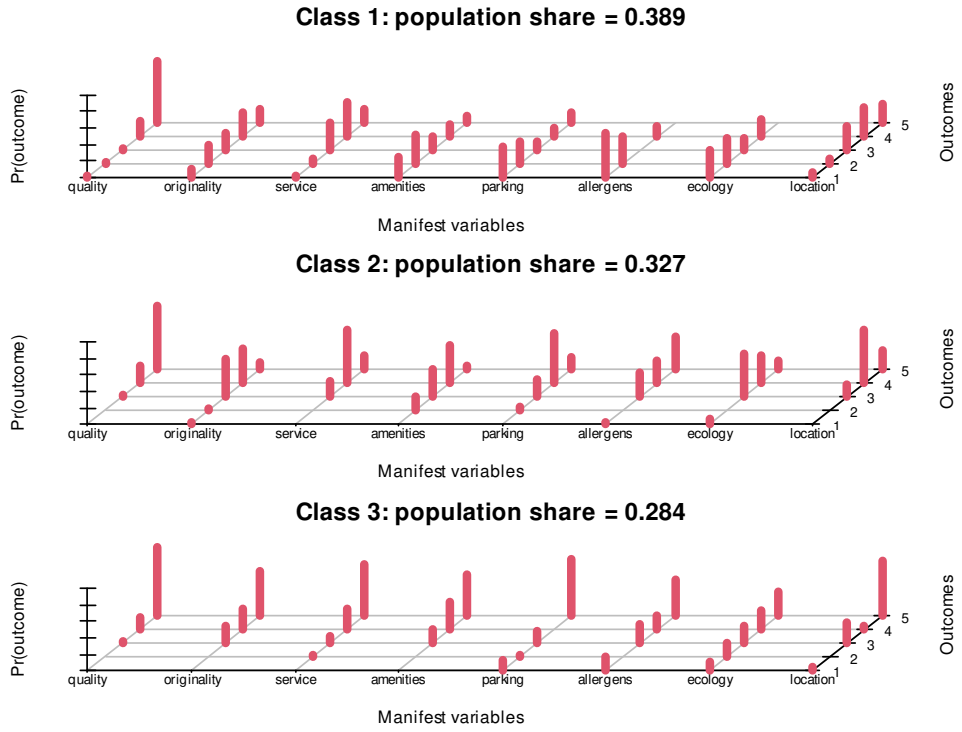
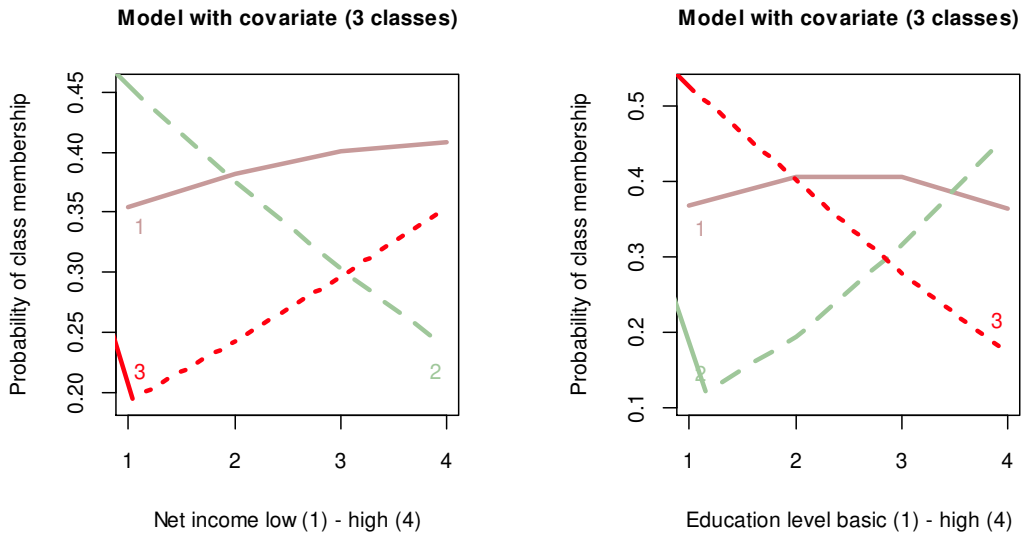


Figure 2. Estimated probabilities of selecting options for 3 classes.

Source: author's compilation using `poLCA` R package.



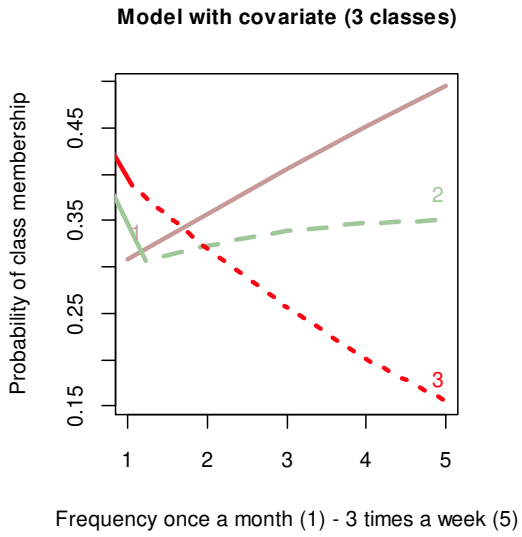


Figure 3. The influence of covariates on segments membership.
Source: author's compilation using `poLCA` R package.

The analysis of the graphs indicates that the probability of belonging to segment 1 does not depend significantly on the level of income or education. This segment is the largest and includes people who, due to lower income, pay attention mainly to such features as product quality, service and location. The increase in the frequency of using food service, which translates into higher expenses, only confirms the increase in the probability of belonging to this class.

In the case of segment 2, the probability of belonging to this segment decreases with increasing income, and any more frequent use of food services does not affect the probability of changing the segment. Segment 2 includes people with average incomes, for whom basically all variables are important, but they allow for some deviations from the ideal state (they much more prefer "average" or "high" level then "very high"). Obtaining a higher education increases the probability of belonging to this segment, which may mean stabilized preferences. In turn, an increase in income decreases the probability of belonging to the segment, which may mean migration to the class with the highest income.

Segment 3 (the smallest) are people declaring the maximum possible importance ("very high" level) of all features, including the description of food allergens and the use of organic ingredients. These are people with the highest incomes, but not necessarily with the highest education. The premise of this state is the rapidly decreasing probability of belonging to this class as a result of the increase in the level of education.

Assuming the division into 3 segments as a starting point, it is possible to learn about the belonging of each of the respondents to a given segment. In further analysis, this will allow for a detailed analysis of food service preferences in each segment separately:

```
> print(mod3$predclass)
  (1) 1 3 1 1 2 3 1 3 2 1 1 3 2 1 2 3 1 1 3 3 1 2 3 3 2 3 3 1 2 1 3 3 3 3 3
 (36) 2 2 3 1 1 2 3 1 3 2 3 1 1 3 3 3 2 3 3 2 2 1 3 2 1 1 1 2 3 2 1 1 2 3 1
 (71) 2 2 2 1 1 1 2 2 3 1 1 1 1 3 1 2 3 2 2 1 1 1 1 1 1 2 2 2 2 1 3 2 1 2 3
(106) 2 2 3 1 1 1 1 1 3 3 1 2 2 2 2 2 1
```

3.2. Measurement of preferences

For the purpose of detailed measurement of preferences using the conjoint method, the research identified 5 variables (attributes) of food service (with their corresponding levels): form of consumption (for here, takeaway), meal price (low, medium, high), place of consumption (bar, canteen, restaurant, food outlet), type of cuisine (polish, italian, asian, american) and menu (short, long):

```
> library(conjoint)
> full<-expand.grid(
+ form=c("for here","takeaway"),
+ price=c("low","medium","high"),
+ place=c("bar","canteen","restaurant","food outlet"),
+ cuisine=c("polish","italian","asian","american"),
+ menu=c("short","long"))
```

In the conjoint analysis method, where survey questionnaires are employed, respondents evaluate hypothetical profiles of products or services. In the research, the number of variables combined with the number of their levels enables the construction of a total of 192 different profiles of food services. Due to the respondents' limited capacity to evaluate a large number of profiles, a final set of 16 profiles was selected in a form of fractional factorial design that met the criterion of experimental orthogonality.

The building fractional factorial design and its coding in the `conjoint` package is possible using the `caFactorialDesign` and `caEncodedDesign` functions. The orthogonality of the design is validated by the identity matrix of variable correlations, as well as the appropriate determinant value of this matrix:

```
> factorial<-caFactorialDesign(full,"orthogonal")
> prof<-caEncodedDesign(factorial)
> print(prof)
    form price place cuisine menu
2      2     1     1       1    1
23     1     3     4       1    1
31     1     1     2       2    1
39     1     2     3       2    1
58     2     2     2       3    1
66     2     3     3       3    1
75     1     2     1       4    1
94     2     2     4       4    1
106    2     2     2       1    2
111    1     2     3       1    2
126    2     3     1       2    2
142    2     2     4       2    2
147    1     2     1       3    2
163    1     1     4       3    2
179    1     3     2       4    2
182    2     1     3       4    2
> print(round(cor(prof),5))
        form price place cuisine menu
```

```
form       1     0     0       0     0
price      0     1     0       0     0
place      0     0     1       0     0
cuisine    0     0     0       1     0
menu       0     0     0       0     1
> print(det(cor(prof)))
(1) 1
```

The respondents evaluated each of the profiles (cf. Table 3) on an interval scale [1-10] considering the relative attractiveness of the profiles and assigning a higher value to the profile that was more attractive to the respondents than the others. This means that the data was collected as a form of rating. With the respondent population divided into 3 segments, a detailed measurement of preferences was carried out separately for each segment.

Table 3.
Sample answers for first respondent

Number of profile	Attributes of food service					Rating [1-10]
	Form of consumption	Meal price	Place of consumption	Type of cuisine	Menu	
1	takeaway	low	bar	polish	short	10
2	for here	high	food outlet	polish	short	5
3	for here	low	canteen	italian	short	10
4	for here	medium	restaurant	italian	short	10
5	takeaway	medium	canteen	asian	short	5
6	takeaway	high	restaurant	asian	short	5
7	for here	medium	bar	american	short	3
8	takeaway	medium	food outlet	american	short	3
9	takeaway	medium	canteen	polish	long	10
10	for here	medium	restaurant	polish	long	10
11	takeaway	high	bar	italian	long	10
12	takeaway	medium	food outlet	italian	long	10
13	for here	medium	bar	asian	long	5
14	for here	low	food outlet	asian	long	5
15	for here	high	canteen	american	long	3
16	takeaway	low	restaurant	american	long	3

Source: author's compilation.

In the `conjoint` package, the experimental design, specifically the profile information (`prof`) is supplemented by a matrix containing the empirical preferences of respondents for each segment (`pref1`, `pref2`, `pref3`) and a vector with the names of the levels for all attributes (`levn`):

```
> pref1=read.csv2("preferences1.csv",header=TRUE)
> pref2=read.csv2("preferences2.csv",header=TRUE)
> pref3=read.csv2("preferences3.csv",header=TRUE)
> print(head(pref1))
  p1 p2 p3 p4 p5 p6 p7 p8 p9 p10 p11 p12 p13 p14 p15 p16
1 10  5 10 10  5  5  3  3 10  10  10  10   5   5   3   3
2 10 10 10 10  4  4  3  3 10  10   9   9   4   4   3   3
3  8  3  6  5  2  3  4  5  9   9   5   6   4   4   3   4
4  6  3 10 10  7  7  1  1  6   6  10  10   6   6   1   1
5  9  5 10  9  9  7  8  8  4   4   4   7   7   8   5   7
6  7  5  7  5  6  8  6  7  6   8   8   6   7   6   7   5

> print(levn)
        levels
```

```
1     for here
2     takeaway
3          low
4       medium
5         high
6          bar
7       canteen
8    restaurant
9   food outlet
10       polish
11     italian
12       asian
13    american
14       short
15        long
```

Having the above data sets allows obtaining the results of conjoint analysis. The estimation of the preference model is carried out using the least squares method with the help of the `caPartUtilities` function (results for the 6 respondents from segment 1):

```
> part1=caPartUtilities(pref1,prof,levn)
> print(head(part1))
     intercept for here takeaway    low medium   high    bar canteen
(1,)     6.583   -0.312    0.312  0.417  0.417 -0.833  0.313   0.312
(2,)     6.625    0.125   -0.125  0.125  0.000 -0.125 -0.125   0.125
(3,)     4.833   -0.250    0.250  0.667  0.667 -1.333  0.250   0.000
(4,)     5.625   -0.312    0.312  0.125  0.250 -0.375  0.062   0.313
(5,)     6.917    0.062   -0.062  1.583  0.083 -1.667  0.062   0.063
(6,)     6.542   -0.125    0.125 -0.292 -0.167  0.458  0.500   0.000
     restaurant food outlet polish italian  asian american  short   long
(1,)      0.312      -0.938  2.062   3.313 -1.687   -3.688 -0.313  0.313
(2,)      0.125      -0.125  3.375   2.875 -2.625   -3.625  0.125 -0.125
(3,)      0.250      -0.500  2.250   0.500 -1.750   -1.000 -0.500  0.500
(4,)      0.313      -0.688 -0.438   4.313  0.813   -4.688 -0.062  0.062
(5,)     -0.187       0.063 -1.438   0.562  0.812    0.063  1.187 -1.187
(6,)      0.000      -0.500  0.000   0.000  0.250   -0.250 -0.125  0.125
```

The summary of the results regarding part-worth utilities and attributes' importance at the segment level is possible with the `Conjoint` function (results for segment 1):

```
> Conjoint(pref1,prof,levn)

Call:
lm(formula = frml)

Residuals:
    Min      1Q  Median      3Q     Max
-5,7396 -1,6997 -0,1007  1,6840  4,9340

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)         6,04861    0,09957  60,745   <2e-16 ***
factor(x$form)1     0,03472    0,09446   0,368   0,7133
factor(x$price)1    0,22222    0,14769   1,505   0,1330
factor(x$price)2    0,12500    0,12595   0,992   0,3214
factor(x$place)1    0,16319    0,16362   0,997   0,3190
factor(x$place)2   -0,10069    0,16362  -0,615   0,5385
factor(x$place)3    0,03125    0,16362   0,191   0,8486
factor(x$cuisine)1  0,38542    0,16362   2,356   0,0188 *
factor(x$cuisine)2  0,38542    0,16362   2,356   0,0188 *
factor(x$cuisine)3 -0,31597    0,16362  -1,931   0,0540 .
factor(x$menu)1     0,11458    0,09446   1,213   0,2256
```

```
---
Signif. codes:  0 ‘***’ 0,001 ‘**’ 0,01 ‘*’ 0,05 ‘.’ 0,1 ‘ ’ 1

Residual standard error: 2,267 on 565 degrees of freedom
Multiple R-squared:  0,04295,   Adjusted R-squared:  0,02601
F-statistic: 2,535 on 10 and 565 DF,  p-value: 0,005389

(1) "Part worths (utilities) of levels (model parameters for whole sample):"
        levnms    utls
1    intercept  6,0486
2     for here  0,0347
3     takeaway -0,0347
4          low  0,2222
5       medium   0,125
6         high -0,3472
7          bar  0,1632
8      canteen -0,1007
9   restaurant  0,0313
10 food outlet -0,0938
11      polish  0,3854
12     italian  0,3854
13       asian  -0,316
14    american -0,4549
15       short  0,1146
16        long -0,1146
(1) "Average importance of factors (attributes):"
(1)  6,67 18,71 18,89 39,95 15,77
(1) Sum of average importance:  99,99
(1) "Chart of average factors importance"
```

The application of the `caUtilities` function using the appropriate data sets (`pref1`, `pref2`, `pref3`) was repeated 3 times. The visualization of the obtained results was realized using the `ggplot` function of the `ggplot2` package:

```
> library(ggplot2)
> util1=caUtilities(pref1,prof,levn)
> h=util1(2:16)
> df=data.frame(names=levn$levels(1:15),h)
> df$type=ifelse(df$h>=0,"above","below")
> df$names<-factor(df$names,levels=rev(df$names))
> ggplot(df,aes(x=names,y=h))+
+ xlab("Atrributes' levels")+ylab("Part-worth utilities (segment 1)")+
+ geom_bar(position='stack',stat='identity',width=.9,aes(fill=type))+
+ scale_fill_manual(values=c("above"="#9fc79a","below"="#C79a9a"))+
+ theme(legend.position='none',axis.title=element_text(size=12),
+ axis.text=element_text(size=12))+
+ geom_text(aes(label=round(h,3),y=h+.00),size=4)+
+ coord_flip()+geom_hline(yintercept=0)
```

The analysis of part-worth utilities indicates that respondents' preferences regarding the levels of food service attributes are different in each of the segments. Only the perception of the menu variable is similar – in each segment, respondents at a similar level prefer a "short" menu to a "long" one (cf. Figure 4).

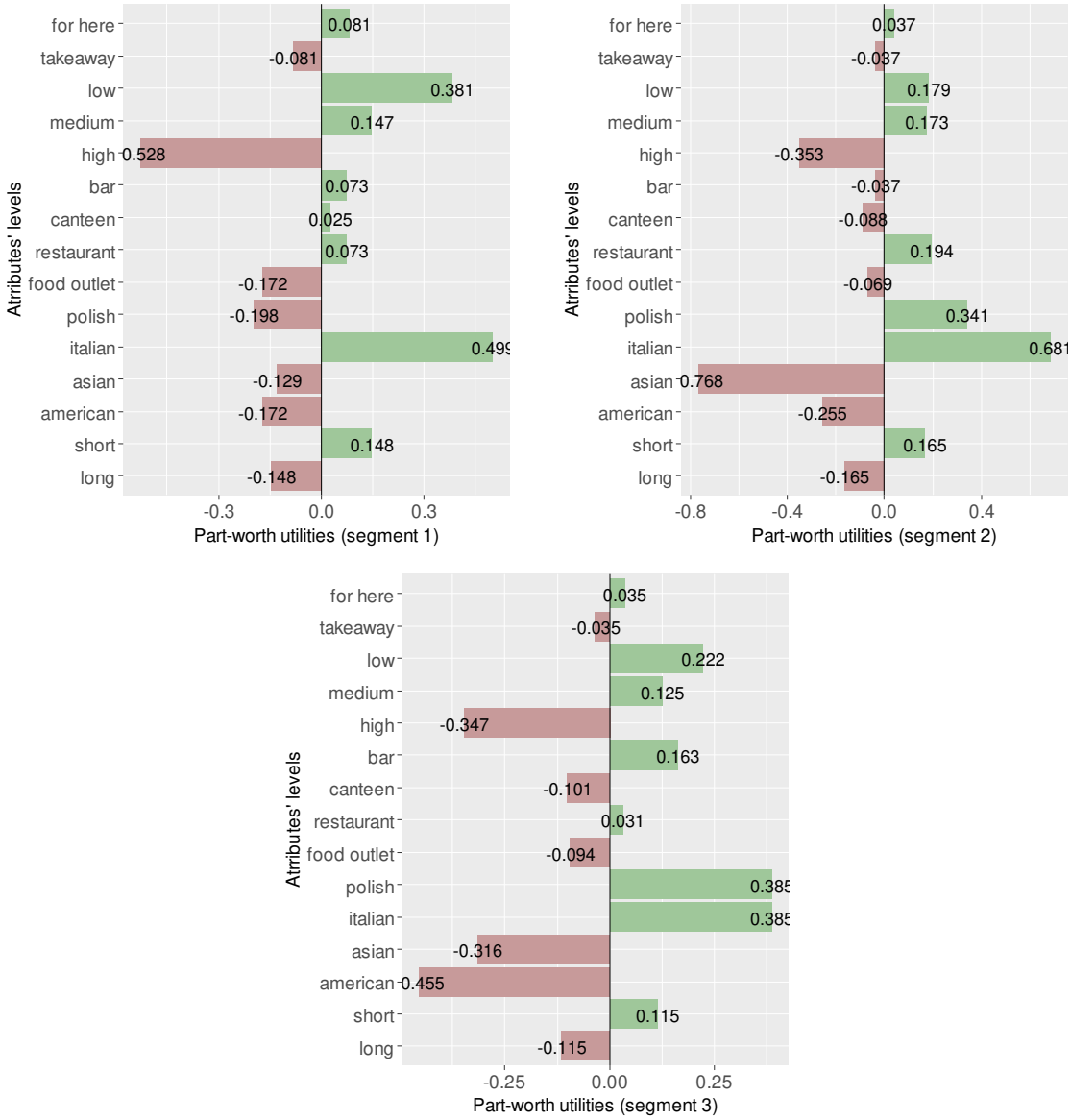


Figure 4. Part-worth utilities of attributes' levels.

Source: author's compilation using `conjoint` R package.

In segment 1, respondents exhibit a strong preference for consuming their meals "for here" rather than opting for "takeaway" options. Additionally, respondents demonstrate a marked sensitivity to pricing, with a pronounced preference for "low" prices. This is coupled with a strong rejection of "high" prices, which further reinforces the classification of this group as belonging to a lower income bracket. The aversion to "high" prices suggests that their economic situation significantly influences their dining choices, leading them to prioritize affordability above other factors. When evaluating the various levels of the variable concerning the place of consumption, it is noted that individuals in segment 1 are generally accepting of all types of dining venues except for "food outlets." This particular rejection indicates a preference for more traditional or formal dining settings rather than casual, fast-food environments. In terms of cuisine, respondents in segment 1 show clear and exclusive preference for "italian" cuisine. Their rejection of food outlets in favor of more traditional dining settings, coupled with a strong

preference for italian cuisine, provides valuable insights for businesses seeking to attract this group. By focusing on affordable pricing and offering italian dishes in a comfortable and engaging dining atmosphere, establishments can effectively cater to the needs and preferences of consumers from 1 segment.

In segment 2, respondents exhibit another approach to pricing, displaying less aversion to "high" prices compared to other segments. While they show a clear preference for "low" and "average" prices, their acceptance of higher prices indicates a greater flexibility. This suggests that members of segment 2 are able to pay a more for quality ingredients, provided they feel that the expense is justified. The only acceptable places of consumption are "restaurants" offering "polish" and "italian" cuisine. The detailed results obtained for this segment, taking into account information on income, confirm the previous assumptions that this segment includes people with a solid economic situation. Understanding these characteristics allows business to tailor their offerings, ensuring they meet the expectations of this economically stable and discerning consumer group.

Segment 3 consists of respondents who demonstrate the least aversion to high prices among all segments but this does not imply they are indiscriminate in their spending. In combination with information about respondents, this is group of people with the highest income is confirmed, although these people clearly feel better in a "bar", or possibly in an informal "restaurant", than in other places of consumption. Their inclination toward bars suggests that they might prefer establishments that offer a balance of quality and comfort. People from segment 3 (similarly to segment 2) prefer "polish" and "italian" cuisine. It means that for businesses, attracting persons from segment 3 may involve creating upscale-casual dining environments.

In order to determine the importance of attributes, the `caImportance` function was used in a similar way (also for 3 segments):

```
> impo=caImportance(pref1,prof)
> df=data.frame(names=colnames(prof),impo)
> df$names<-factor(df$names,levels=c("form","price","place","cuisine","menu"))
> ggplot(df,aes(x=names,y=impo))+
+ xlab("Attributies")+ylab("Importance (%) (segment 1)")+
+ geom_bar(stat='identity',width=.9,fill="#9fc79a")+
+ theme(legend.position="none",axis.title=element_text(size=12),
+ axis.text=element_text(size=12))+
+ geom_text(aes(label=round(impo,3),y=impo+.00),size=4)+
+ geom_hline(yintercept=0)
```

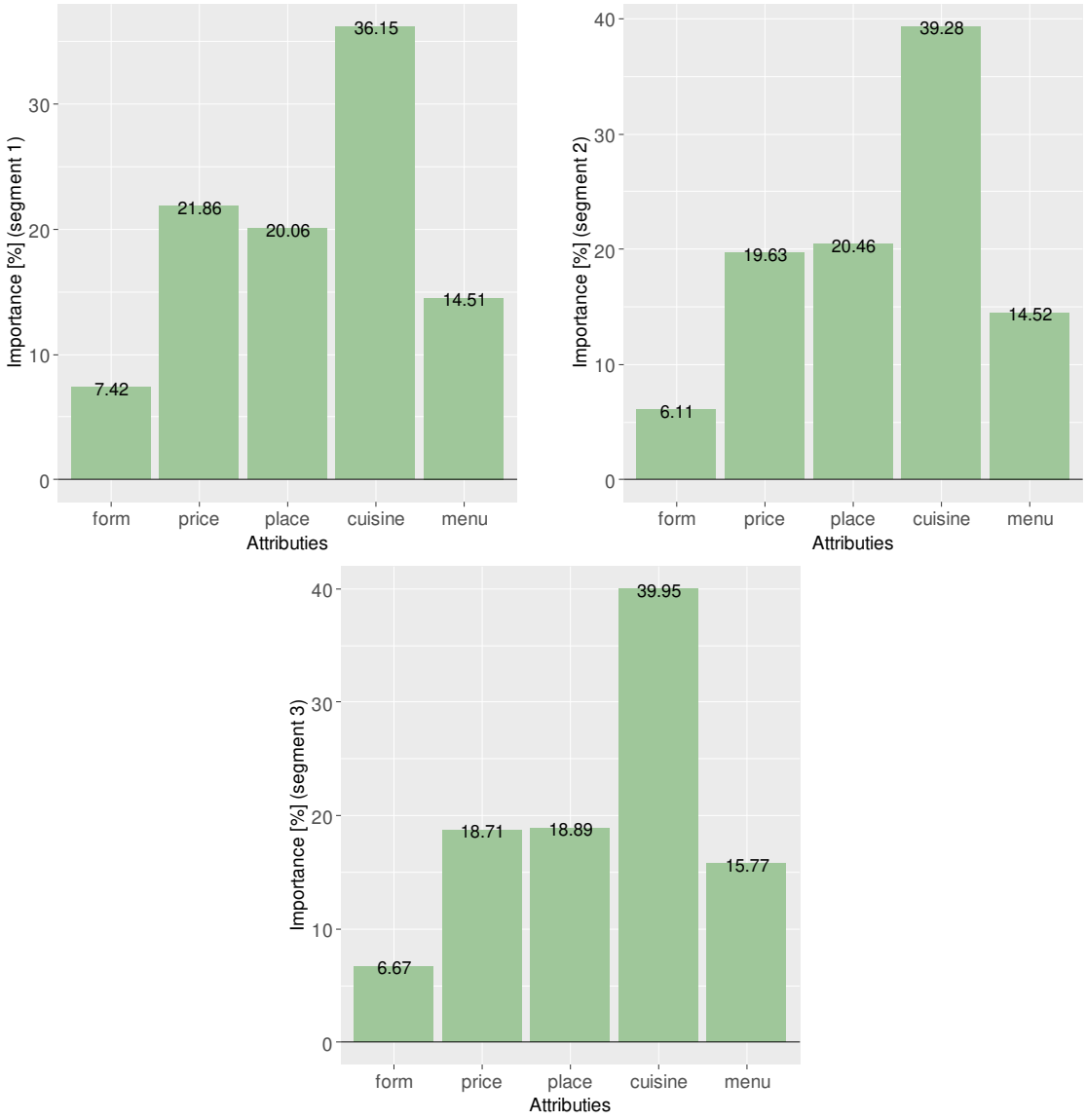


Figure 5. Importance of attributes.

Source: author's compilation using `conjoint` R package.

In examining importance of analyzed attributes across segments (cf. Figure 5), it becomes evident that there is a high degree of consistency among respondents. The type of cuisine emerges as the most significant factor. The importance of this variable is nearly identical across all segments, with respondents from segment 1 placing a 36.15% weight on cuisine type, and those from segments 2 and 3 weighing it even higher at 39.28% and 39.95%, respectively. Conversely, the form of the consumption consistently ranks as the least important attribute for all segments, with percentages ranging from 6.11% to 7.42%. This indicates that whether a consumption is "for here" or "takeaway" does not strongly influence respondents' dining decisions. The relatively low importance assigned to this variable suggests that while respondents care about what they eat (cuisine type), they are less concerned with form the consumption is served. Small differences in the perception of the importance of attributes occur between segment 1 and the others.

For respondents belonging to segment 1, the price of the meal is in second place, while in segments 2 and 3, this place is occupied by the place of consumption. These two attributes switch places of importance between the above-mentioned segments (place of consumption is in third place in segment 1, while third place in segments 2 and 3 is occupied by the price of the meal). The importance of the menu variable, like the form of consumption, is one of the least important features for all respondents.

4. Discussion

The paper explores the use of latent class analysis and conjoint analysis methods in segmentation of food service consumers based on their choice preferences. The obtained research results confirmed the value of examining food consumers' preferences within specific segments rather than at the aggregate level.

The analysis of food service preferences across all segments reveals distinct patterns shaped by income, dining priorities and the significance of certain attributes. Segment 1 is the largest group, comprised mainly of lower-income individuals who prioritize affordability, product quality, food service, and location. They prefer dining "for here" and have a strong inclination toward "italian" cuisine, avoiding "high" prices and casual "food outlets". Segment 2 represents middle-income individuals who are slightly more flexible with prices, often willing to pay more for quality. They favor "polish" and "italian" cuisine, primarily in "restaurant" settings, and maintain a balanced approach to pricing. Higher education aligns with segment 2 membership, suggests more stabilized food service preferences. Segment 3 includes high-income consumers who value all attributes, from quality of cuisine and service to the most specific attributes. This group shows the least sensitivity to price, opting bars and, to a small extent, restaurants for consumption. Across all segments, cuisine type is the most valued attribute, while the form of the meal and menu variety hold lower importance.

The results of the study confirmed earlier assumptions that perceptions of the most important factors would be similar across segments and that price is not the most important factor in choosing a food service. Respondents are willing to accept an average or even high price in exchange for high-quality products. It is also not surprising that polish and italian cuisine is the most preferred. What stands out, however, is the significant divergence between segments at a detailed level of respondents' preferences. The results confirm the need to divide the respondents into 3 separate segments, who differ fundamentally in terms of income, the possibility of going to bars (especially to food outlets), as well as aversion to asian and american cuisine. Additionally, it is noteworthy that a relatively large share – nearly 30% of respondents pays attention to allergens and organic ingredients.

Presented segmentation approach should allow food service providers to better tailor their offerings to distinct consumer groups. Businesses targeting these segments should tailor their offerings to meet the unique food service priorities of each group, from affordable italian options for segment 1 to quality-focused, upscale-casual experiences for segment 3.

5. Conclusions

The paper identifies latent consumer segments, measures their preferences and presents the integration of the poLCA and conjoint packages as complementary analytical tools. The paper shows that combining R packages effectively captures different preferences, making them useful for foodservice professionals and adaptable to other market contexts.

It is possible thanks to the possibilities (advantages) offered by the used tools - research methods and the R packages and the R environment. However, it should be noted that these solutions also have their limitations (disadvantages). The basic limitation of the conjoint analysis method, and consequently the conjoint package, is the number of possible variables to use (5-6) and their levels (3-4). In addition, the method assumes the rationality of consumer choices, which has been successfully challenged, as well as reliance on declared preferences, which may be different from the real market choices. In the case of latent class analysis, a sufficiently large research sample is needed, there are doubts to the number of classes, and the method does not offer the possibility of modeling causality. What more, computer calculations for LCA are laborious and time-consuming.

All these remarks encourage searching for other solutions, e.g. discrete choice methods and exploring some other R packages. It should be also remembered that the obtained conclusions are not timeless, which means the need to repeat the research in the future.

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COMMUNICATIVE COMPETENCE OF NURSING STUDENTS: STEPS TO IMPROVE

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Purpose: Communicative competence of nursing students is one of the central prerequisites for success in education and future occupation. However, some countries including Ukraine have faced low levels of communicative competence in nurses and the need to introduce this topic into the nursing curriculum. The aim of the research is to identify key factors associated with communicative competence.
Design/methodology/approach: Ukrainian nursing students were surveyed to determine specific policies on how to improve shaping communicative competence during education and in-service. Since communicative competence is one of soft skills, another survey was conducted among nursing teachers and students to explore their readiness to develop soft skills. Factor analysis was performed to process the survey data.
Findings: Factor analysis showed that students' communicative competence has a significant relationship with five factors indicating communication effectiveness, the ability to work together, willingness to improve communicative skills and availability of nursing-specific trainings. It was found that over 60% of teachers and 70% of students support introducing soft skills classes or trainings.
Research limitations/implications: The research was limited to nursing students and teachers. Practicing nurses will participate in the next phase that will allow developing specific trainings for the curriculum.
Practical implications: The research results are summarized in the program for developing soft skills in nursing students and nurses employed. The study was carried out at an initial stage of a short-term program suggested to improve communicative competence. The subsequent stages and management tools are addressed.
Social implications: The program outlined in the research can lead to deeper international contacts and partnerships in nursing education, facilitate the exchange of experience and best practices. As a result, nursing profession will become increasingly attractive and prestigious for local and international students, which will contribute to further improvement of the quality of nursing and life in general.
Originality/value: Factor analysis was used to process the survey data and identify key factors which influence shaping communicative skills in nurses. It makes it easier to determine priorities when planning programs to develop communicative competence, which is a common task engaging educational and public institutions, local and government authorities.

Keywords: communicative competence, nursing education, factor analysis, soft skills, program of improving communicative competence.
Category of the paper: Research paper.

1. Introduction

Before discussing how to improve the communicative competence of nursing students, it is necessary to define the meaning of the terms used. So, what is communicative competence? Turning to dictionaries, these trusted and reliable sources, we get:

Collins Dictionary (https://www.collinsdictionary.com/) – «a speaker's internalized knowledge both of the grammatical rules of a language and of the rules for appropriate use in social contexts».

The Cambridge Dictionary (https://dictionary.cambridge.org/) – «These words are often used together. Click on the links below to explore the meanings».

The final sentence suggests that this phrase does not have a universal and unchanging definition. Its meaning depends on the situation and the nature of the activity. If we talk about nursing, there is probably no serious doubt that it deals with many situations and is an ever-evolving field. The same will be true for the concept of communicative competence of nursing students.

Therefore, let us refer to the literature that attempts to address this issue. For many researchers, it appears most obvious to bring together the ideas about skills with the concept of competence. This approach resulted in a reasonable explanation that «understanding of communicative competence can benefit from understanding it as the situation-specific use of specific skills. We might then transfer what we already know about the acquisition of motor and other skills to the domain of communication, and this knowledge can help us to systematically train communicative competence» (Kiessling, Fabry, 2021). For pragmatic purposes, this definition covers a full scale of teaching, acquisition, and testing of skills of communicative competence in nursing.

Research findings reported in numerous publications show that communication difficulties are a two-sided problem, engaging both patients and nurses. For instance, «studies show that a low level of patient satisfaction occurs in the case of an inadequate interpersonal communication between nurses and patients», and one contributing reason is the «poor effectiveness of shaping communicative competences of nurses based on standard education in the area of general psychology and communication knowledge, because this knowledge does not convert itself «spontaneously» into communicative competences during occupational activity» (Włoszczak-Szubzda, Jarosz, 2013). This is what nursing teachers worry about: «Nursing trainees have reported a lack of preparation and confidence in communication and interpersonal skills with patients and members of the health care team» (Del Vecchio et al.,

2022). It was also shown that nurses «have difficulty prioritizing dialogue with patients, due to lack of time, organizational and cultural factors. Like other health care professionals, nurses may also have difficulties communicating with patients due to personal fears and shortcomings» (Partsch et al., 2021).

Healthcare practitioners «identified patient-doctor and patient-nurse communication as an area for intervention to improve suboptimal patient satisfaction» (Allenbaugh et al., 2019; Mehralian et al., 2023). In its turn, nursing education community responds with many creative suggestions on curriculum development, instruction tools, technology, «methods of shaping and evaluating professional nursing communication», «both among student nurses and occupationally active nurses» (Włoszczak-Szubzda, Jarosz, 2013). Long-known methods are complemented by alternatives: «Role-playing, open dialogue, guessing games, and simulation activities may be given to the student-nurses to cultivate more on their skills in using varied communication strategies and to achieve a holistic approach to giving quality and excellent care to their patients» (Eustaquio, 2022). Other method, «an acting- based workshop, inspired by classic acting exercises taught in drama conservatories for decades, to develop core communication and interpersonal skills», appears «efficacious in instilling core communication and interpersonal skills to preclinical nursing students based on participants' self-efficacy ratings» (Del Vecchio et al., 2022). Some researchers make more specific suggestions regarding communicative competence in the curriculum: «In particular, students in the third and fourth years need a continuous/intensified curriculum that fosters their communicative competencies, such as listening to patients' needs and establishing effective interpersonal relationships with peers/superiors» (Kang, Lee, Cho, 2021). Communicative competence can be reframed within the broader context of nursing competence (Fukada, 2018) or even clinical competence (Kang, Lee, Cho, 2021).

It is truly said that the importance of communicative competence «does not guarantee its uniform and proper implementation in undergraduate curricula», and to achieve this several interventions are recommended, e.g. monitoring the allocation of credits assigned to communicative competence, «increasing the teaching load of these contents, improving their proportional distribution in all courses and warranting the presence of exclusive and compulsory subjects» (Ferrández-Antón et al., 2020).

The prerequisites of the nursing profession are numerous. Spiritual intelligence is one of them. Since it impacts the competency and self-efficacy of communication, «it is recommended to promote problem-solving skills, improve self-awareness, and pay attention to moral standards to nurture communicative competence and self-efficacy among nurses» (Bullington et al., 2019).

There are approaches underpinned by complicated philosophical principles, as in this example: «The communication training curriculum based upon phenomenology aims at systematically training students to stay focused upon patients' and relatives' narratives, allowing them to reflect upon and better understand their current situation» (Partsch et al., 2021).

The authors compare the approach to «other common communication methods used in nursing (motivational interviewing, caring conversations, empathy training)» and «highlight the nurses' role as dialogue partner as well as emphasize the importance of communication skills training in nursing education».

Nursing education has an international perspective «focused on determining outcomes, content, methods of teaching and learning, and the order of the learning situations for the 3 years of training» (Darmann-Finck, Reiber, 2021). The competence-based and situation-based curriculum gradually fosters communicative competences to a higher level, «with learning situations becoming more and more complex as the training progresses».

The communicative competence of nursing students is one of the central prerequisites for establishing positive therapeutic relationships with patients. Students' ability to effectively interact with patients contributes to patient satisfaction with medical care and reduces the likelihood of errors in treatment. High levels of communicative skills among medical students increase the overall standard of nursing care they demonstrate during practical classes and internships (Pope, Rodzen, Spross, 2008; Vaghee, Lotfabadi et al., 2018).

A few of principal features of communicative competence and recommendations on development of communicative skills are presented in many publications about medical and nursing education. The USA and the UK can be mentioned as useful examples (BMA, 2004). These details are not listed here because developing a specific syllabus on communicative competence is beyond the scope of this study.

Ukraine, like several other countries, has faced the problem of insufficient attention to the development of communicative competence in nurses. This may be due to long-standing traditions and standards in medical education, where the main emphasis is placed on clinical skills and theoretical knowledge, leaving aside communicative competence. It is often assumed that everyone has communicative competence, because this concept gives a misleading view of intuitive plainness, however, as can be seen from the above, it is quite difficult to define it. However, qualitative nursing care and a patient-oriented approach require professional communicative competence, thus it is necessary to actively introduce programs and trainings on the development of professional communicative competence into nursing curriculum in Ukraine (Holovchak, 2024b).

The issue of developing communicative competence among nursing students in Ukraine is relevant and important for several reasons. Firstly, communication helps maintain the patient's trust, understand patient's needs and expectations, and build fruitful relationships in the team of medical workers.

Secondly, the education of students cannot be reduced only to teaching professional skills. Successful nursing requires medical personnel with a high level of morality, ethics and the ability to empathize. These traits are associated with the level of communicative competence, which helps nurses to respond to difficult situations, interact with patients, colleagues with respect and empathy.

Thirdly, nursing students should be trained to transfer their communicative skills in various socio-cultural contexts because of extending international cooperation.

Finally, during the ongoing armed conflict in Ukraine and the following time of reconstruction nurses will care of patients who have survived and now are suffering of stresses, psychological disorders, and uncertainty in future. Nevertheless, they must start new life, and nurses' support at this time cannot be overestimated.

Direct borrowing of international experience seems unlikely possible due to some specifics of both Ukrainian nursing education and patients. Some topics are perceived as taboo when communicating with patients (e.g. sexually transmitted diseases, malignant neoplasms, abortion, mental disorders, etc.). Information literacy of Ukrainian patients is insufficient. Most of them prefer to ask a neighbor or relative or read posts on social networks instead of reading reliable patient-oriented literature available on trusted web resources (Mayo Clinic is one of them). They also do not have much experience in using IT, for example, contacting a family doctor by email. Formal patient education has not become a common practice in Ukrainian hospitals and library, so nurses are often forced to fill this gap in their communication with patients.

The above shows the urgent need to improve shaping communicative skills in nurses, starting from college training. The study presented below was designed and conducted as an initial stage of a short-term program to figure out key issues of introducing a communicative competence curriculum in nursing education and to achieve better understanding about how this initiative will be accepted by nursing community in Ukraine.

2. Search and Method Procedure

The general outline of the research is shown in Figure 1.

The research algorithm includes steps for collecting and analyzing data to draw conclusions based on the findings.

The main objects of this study were students at nursing schools. The study covered 35% of non-public nursing colleges, which ensures the representativeness of the sample surveyed, since the variety of educational institutions and their contribution to the training of healthcare practitioners is considered.

Anonymous online survey of students using the Google Forms tool was used for the primary data collection. The data obtained relate to students' opinions, attitudes, and needs for developing communicative competence. This very valuable direct feedback from future nurses helps identify the weaknesses and strengths of the existing education system and to determine specific policies for its improvement. The research was conducted from October 17, 2023, to November 4, 2023.

Factor analysis using Minitab software (https://www.minitab.com/) was used to process the survey data. In general, factor analysis identified groups of interrelated variables (factors), which helped to find complex relationships in the phenomenon under consideration and make it more understandable.

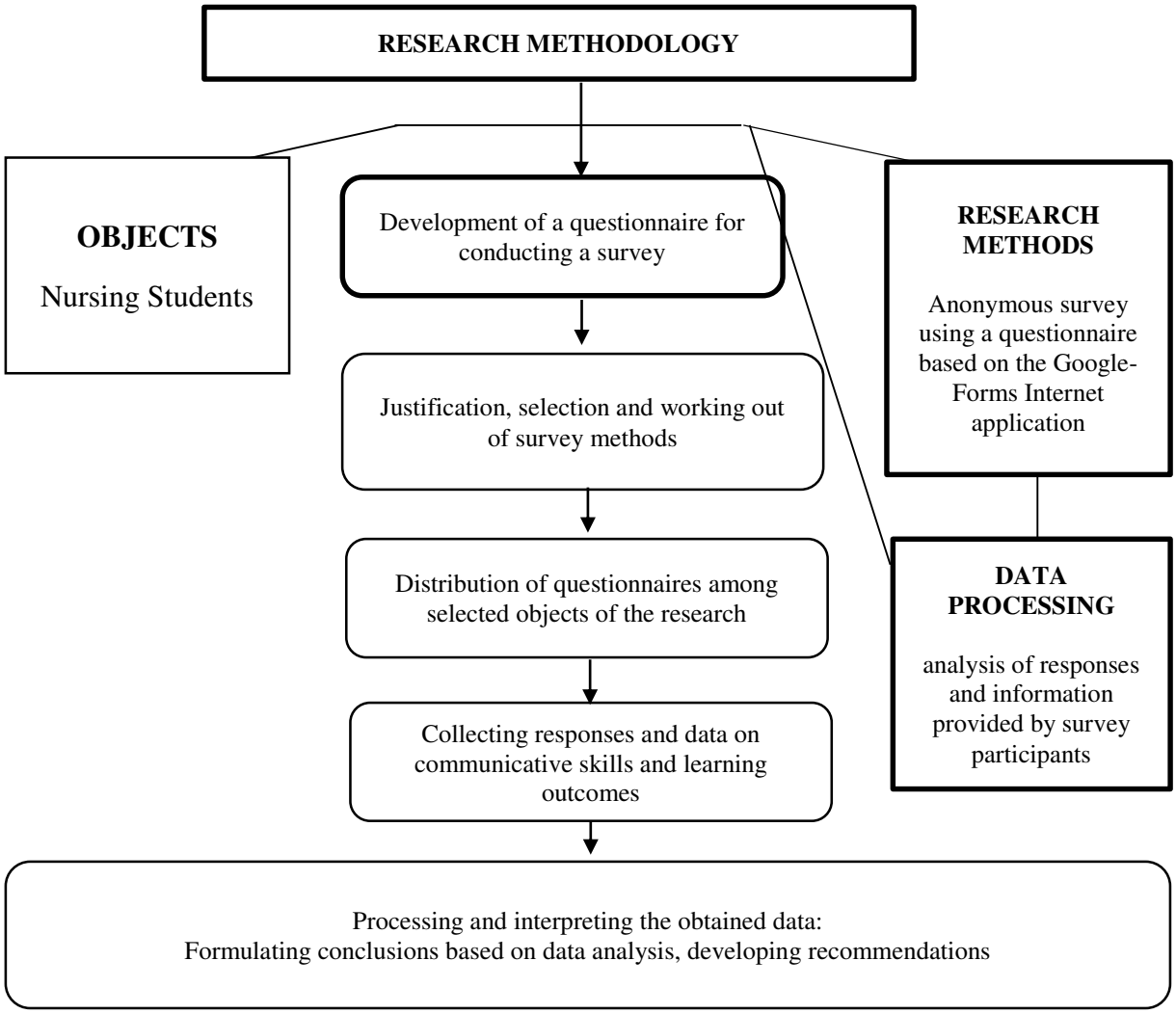

Figure 1. The general outline of the research.
Source: developed by the authors.

3. Results

During factor analysis various indicators were used to measure factors and the value of «Communality», indicating what portion of the variation in the initial data is due to each factor (Table 1).

The results obtained for the data below show that five main factors can be identified, since their Communality exceeds the threshold value (0.5 - usually used as a criterion for including a factor in further analysis). Each factor explains from 7.2% to 25.7% of the total variation in the data, which indicates their significance. Five factors were identified because each factor's communality exceeded the threshold value of 0.5, indicating their significance in explaining the variance in the data. Each of these five factors accounts for between 7.2% and 25.7% of the total variation, demonstrating their contribution to understanding students' communicative competence. Additionally, the method of principal components highlights the strong relationships between variables and factors, reinforcing the importance of these five factors in the analysis. A communality of 0.5 is used as a threshold in factor analysis because it indicates that at least 50% of the variance in a variable is explained by the factors, ensuring that the included variables have a meaningful contribution to the analysis.

Table 1 «Determining the Number of Factors by the Principal Component Method», presents the loading coefficients for each variable on each of the five factors. These coefficients indicate how strongly each variable is related to each factor. The Communalities indicate how much of the variance in the variable is explained by all factors together.

Table 1.
Determining the Number of Factors by the Principal Component Method

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Communality
The level of understanding between students and teachers	0,112	-0,156	0,095	0,056	-0,420	0,226
Effectiveness of communication during internship	-0,114	-0,466	0,321	0,133	-0,000	0,351
Effectiveness of interaction with different age groups	-0,141	-0,446	0,318	0,174	-0,019	0,350
Communicative skills	0,603	0,411	0,417	0,089	-0,077	0,721
Improving communicative skills	-0,488	0,291	0,466	-0,416	-0,036	0,714
Communicative skills and improved learning outcomes	0,499	-0,126	0,154	-0,126	0,165	0,331
Students with high levels of communicative skills are best team workers	-0,027	-0,044	0,253	0,119	0,255	0,146
Programs or courses on developing communicative skills offered in nursing colleges	0,312	-0,445	-0,082	-0,506	-0,015	0,558
The importance of students' self-esteem of communicative skills in their development	0,035	-0,113	0,060	0,025	0,062	0,022
Variance	0,99521	0,92282	0,70264	0,51853	0,28067	3,41987
% Var	0,257	0,238	0,181	0,134	0,072	0,882

Source: Computated by Holovchak.

Table 2 «Factor structure regarding the development of students' communicative skills obtained by the normalized rotation method» shows the same data after applying the factor rotation. This method makes the relationships between variables and factor loadings more evident to make the structure easier to interpret.

Table 2.
Factor structure regarding the development of students' communicative skills obtained by the normalized rotation method

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Communality
The level of understanding between students and teachers	0,062	-0,096	-0,035	0,030	-0,459	0,226
Effectiveness of communication during internship	-0,065	-0,575	0,019	0,074	-0,099	0,351
Effectiveness of interaction with different age groups	-0,075	-0,576	0,016	0,021	-0,112	0,350
Communicative skills	0,834	0,114	0,011	-0,056	-0,091	0,721
Improving communicative skills	-0,023	-0,017	0,838	-0,074	0,071	0,714
Communicative skills and improved learning outcomes	0,392	-0,073	-0,156	0,377	0,075	0,331
Students with high levels of communicative skills are best team workers	0,131	-0,270	0,045	-0,061	0,225	0,146
Programs or courses on developing communicative skills offered in nursing colleges	-0,047	-0,018	-0,057	0,735	-0,112	0,558
The importance of students' self-esteem of communicative skills in their development	0,021	-0,125	-0,041	0,059	0,031	0,022
Variance	0,88416	0,77904	0,73624	0,70465	0,31578	3,41987
% Var	0,228	0,201	0,190	0,182	0,081	0,882

Source: Computated by Holovchak.

Table 3 «Factor Structure of Students' Communicative Skills Development» contains factor score coefficients for each variable. These coefficients are used to calculate factor scores for each observation in the factor analysis.

Table 3.
Factor Structure of Students' Communicative Skills Development

Variable	F	F	F	F	F
The level of understanding between students and teachers	0,019	0,013	0,042	-0,069	-0,798
Effectiveness of communication during internship	0,006	-0,446	0,008	-0,003	-0,073
Effectiveness of interaction with different age groups	0,001	-0,449	-0,003	-0,057	-0,111
Communicative skills	0,823	0,030	0,083	-0,144	-0,250
Improving communicative skills	0,042	0,026	1,004	0,150	-0,006
Communicative skills and improved learning outcomes	0,288	-0,097	-0,072	0,342	0,323
Students with high levels of communicative skills are best team workers	0,112	-0,233	-0,017	-0,034	0,412
	-0,101	0,114	0,138	0,845	-0,105
The importance of students' self-esteem of communicative skills in their development	0,014	-0,060	-0,020	0,021	0,060

Source: Computated by Holovchak.

A more detailed analysis of the results indicates that:

1. The loading coefficients show that all variables have a significant relationship with all 5 factors. The strongest relationship is observed for communicative skills (0.603) and improvement of communicative skills (0.499), while the importance of students' self-esteem is characterized by the lowest loading coefficient (0.035);

2. Communality indicates what part of the variance of each variable is explained by all factors together. It also shows the importance of each variable for the overall explanation of variance. For example, for communicative skills, communality is 0.72%, i.e. 72% of the variance of this variable is explained by all five factors;
3. After rotation of factors has changed the loading coefficients for some variables, the relationship with the relevant factor becomes more obvious. For example, the loading coefficient of communicative skills increases from 0.603 to 0.834.

Overall, the analysis shows that students' communicative competence has a significant relationship with all five factors. Particular attention should be paid to the relationship between communicative skills and the factors indicating communication effectiveness and the ability to work together.

The Kaiser criterion (sedimentation graph) was used to select the number of factors in the system of developing students' communicative skills. Figure 2 shows that a certain turning point is observed at the fifth factor. This indicates the consistency of the criteria used.

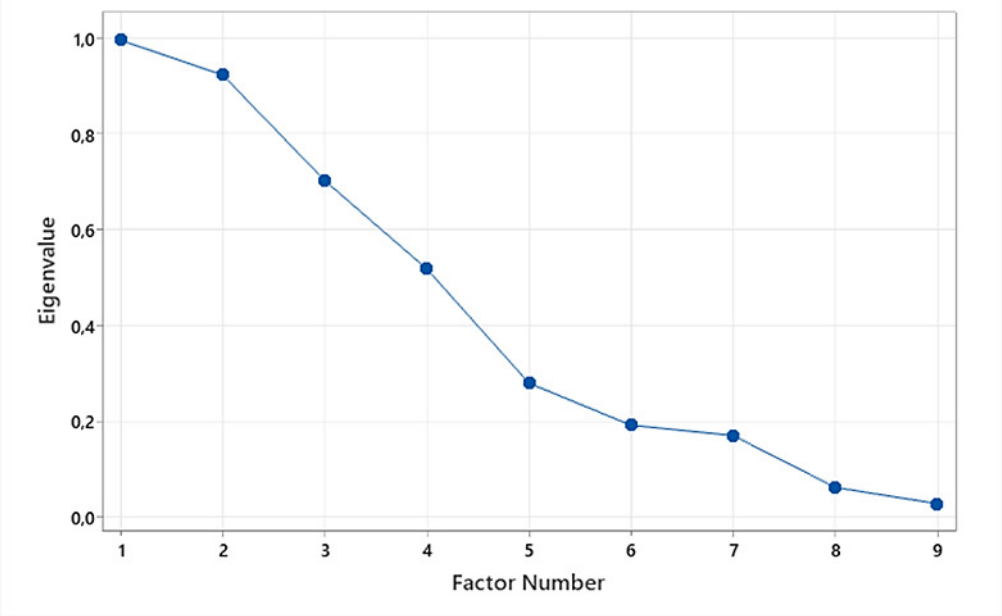

Figure 2. The sedimentation graph to specify the number of factors describing the development of students' communicative skills.

Source: created by the authors based on the conducted research.

In conclusion, it is important to note that students with a higher level of communicative skills tend to be more successful in their education and professional development compared to those with less developed skills.

The results obtained from the study show that «Improving communicative skills» and «Programs or courses on developing communicative skills offered in nursing colleges» are factors with high loading coefficients which is evidence of their substantial relationship with communicative competence of nursing students. This is consistent with the findings regarding the role of training reported in a few studies (Yusef, 2013; Holovchak, 2024a): it is nursing-

specific trainings on the development of the communicative competence, which differ from traditional academic courses, that are an effective instruction method, since they are based on previous communicative experience and allow the application of acquired knowledge in action without delay. Trainings on the development of communicative competence of nurses are very intensive and emotionally saturated educational processes. The knowledge obtained during the training is not provided in a ready-to-use form but is the result of a team effort with many participants. An important aspect is the independent learning of the particpants and their intensive communication. Responsibility for the training efficiency is shared between the leader and each participant in the training (Yusef, 2013). Particular attention is given to introducing simulation and interactive technologies into instruction programs, which contributes to more effective development of communicative competence in the digital information environment (Holovchak, 2024a). Thus, training acts as a special technology that fosters a better understanding of one's personality, increasing success in life and managing one's own desires and actions (Totska, 2001).

Training as one of the education forms has certain objectives. Many guidelines on training objectives can be found on the Internet. We will mention here only one objective that is important specifically for nurses - the development of assertive communication (Yusef, 2013). Assertive communication skills are an important tool for improving teamwork in the healthcare, and nurses can acquire these skills during studies (Mansour et al., 2020).

The results of the training are not assessed immediately after its completion. Training outcomes can only be fully assessed later, when the participants apply the acquired knowledge and skills in their practice and everyday life. Only observation of changes in participants' work and behavior can help understand how successful the training was and what benefits it brought them.

Communicative competence takes its place in the structure of soft skills and has already become part of the curriculum at institutions of higher medical education (Kienle et al., 2021; Schick et al., 2020; Exenberger et al., 2021). It is obvious that health care workers should not only have professional skills (hard skills), but also have developed soft skills, including the ability to communicate effectively, listen, collaborate in a team, resolve conflicts, and understand (Education Hub, 2021). Such skills help improve the quality of healthcare delivery, increase patient satisfaction, and improve the standard of healthcare services.

It should be recognized that special educational programs, trainings and practical classes to develop leadership skills, emotional intelligence and other soft skills have not yet become a mandatory component of curriculum in nursing educational institutions in Ukraine. Thus, the development of nurses' soft skills should become an important aspect of public policy regarding the nursing educational reform which is in progress now.

In order to find out what issues should become key in the soft skills development program in nursing education institutions, the Google Forms tool was used to conduct a survey among teachers and students of nursing colleges in Ukraine. One of the objectives was to study their

readiness to develop soft skills. Respondents from 13 regions of Ukraine, a total of 2000 people, took part in the survey. Although an invitation to participate in the survey was sent to both students and teachers, it was students who took a more active part. In total, 87.6% of the survey participants were students, and only 13.4% were teachers.

Examination of soft skills in nursing students has significant potential to influence their social skills and future career. Firstly, knowledge of the soft skills concept allows students to understand the importance of these skills for their future career in the healthcare. Involvement in the survey allowed respondents to confirm or determine their level of proficiency in these skills. The survey results are presented in Figure 3.

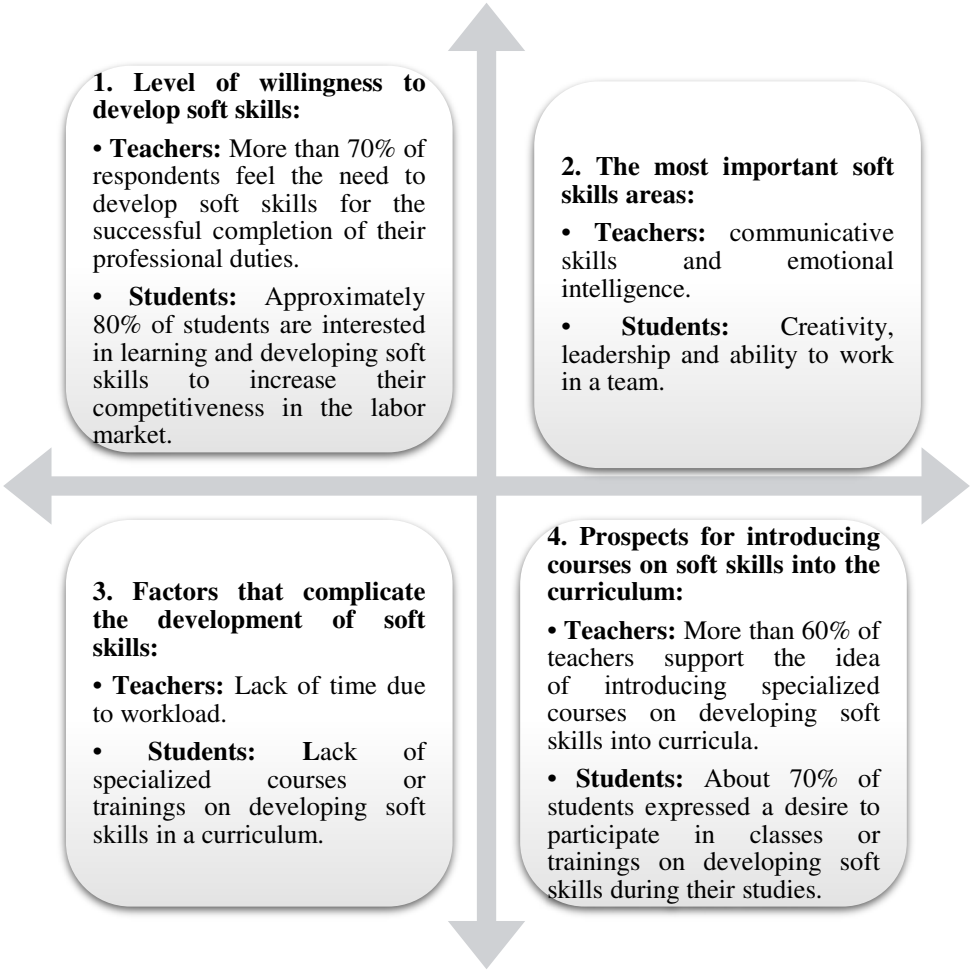

Figure 3. Results of the survey on willingness to develop soft skills.

Source: prepared by the authors.

The results of the survey and the respondents' comments in the open-ended questions of the questionnaire are summarized in the proposed program for developing soft skills in students of nursing education institutions (Figure 4).

It should be emphasized that the program also reaches nurses already employed in healthcare in accordance with the concept of continued or lifelong learning. In addition, the program will contribute to create an innovative environment for scientific research and the development of new methods of providing medical care of patients.

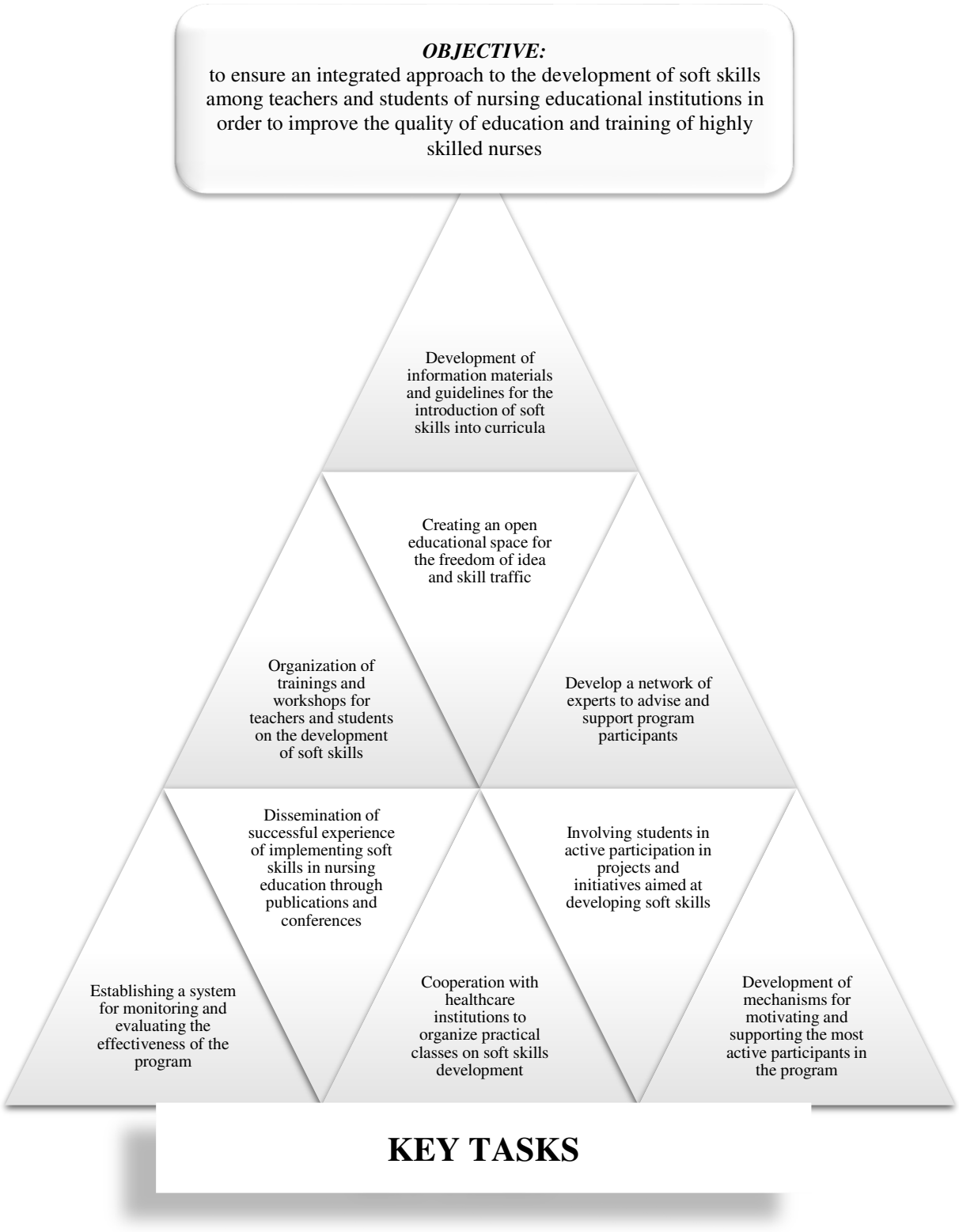

Figure 4. Program for developing soft skills in students of nursing education institutions in Ukraine.

Source: prepared by the authors.

4. Discussion and Conclusions

The results of the study confirm the importance of developing students' communicative skills for their success in education and future professional occupation. That factor analysis gives a better sense of the nature of these relationships. It is also easier to see how to determine priorities in planning programs for the development of communicative skills.

In the long term, the program outlined may lead to deeper international contacts and partnerships in nursing education, which will facilitate the exchange of experience and the implementation of best international practices. It is quite reasonable to expect that nursing schools in Ukraine will become increasingly attractive and prestigious for students from different countries, which will also contribute to the development of international cooperation and knowledge exchange. As a result, further improvement of nursing education will be possible.

The subsequent stages of the program of improving communicative competence in nursing students will include the development of trainings and workshops followed by verification of them in educational institutions. At the final stage, an assessment of the results through testing, surveys and observation is planned.

Some management tools can be added to support the program implementation. For example, mentoring programs which involve experienced colleagues to assist students in developing communicative skills. The level of students' communicative competence will be more accurate evaluated if assessment criteria and tools are implemented. Involvement of psychologists to provide individual consultations on emotional and social intelligence seems very helpful. These measures may help prepare nursing students for future occupation (Holovchak, 2024a).

Consequently, developing a communicative competence among nursing students in Ukraine is a common task engaging educational and public institutions, local and government authorities. The patients, that is, literally each of us, will express their opinion on the progress achieved, because it is communication with the nurse and doctor that creates our first impression of their qualifications, which determines our trust in them, the willingness to cooperate during treatment and, ultimately, the success of the outcome.

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THE ROLE OF REMITTANCES IN ECONOMIC GROWTH OF POLAND

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Purpose: The paper aims to investigate the relationship between inflow of remittances and economic development of Poland.
Design/methodology/approach: The study uses annual, secondary data spanning from 2004 to 2023, collected from Eurostat. The data gathered in the research were analysed using the ordinary least squares (OLS) and backward stepwise regression.
Findings: The empirical results of research show negative impact of annual remittances ratio to GDP on economic growth. Furthermore, the results for the control variables indicate that trade openness and investment have a positive and significant effect on economic growth.
Practical implications: Understanding variables that influence countries' economic growth is essential for designing appropriate economic policies, including debt management strategy. The research results can be used to formulate the policy measures which provide more efficient management of remittances.
Originality/value: Until now, little research has been done about the impact of remittances on economic growth of Poland. The study contributes to better understanding of implications of migration and dynamics of economic growth of Poland.
Keywords: remittances, economic growth, Poland, migration.
Category of the paper: Research paper**.**

1. Introduction

Global flows of remittances have significantly increased over recent decades and become an important source of foreign exchange in many countries (Giuliano, Ruiz-Arranz, 2005, p. 3). In contrast to other foreign capital flows, the remittances are more stable in the face of external shocks and countercyclical (Meyer, Shera, 2017, p. 149; Frankel, 2009). This stability helps to improve the income support of recipient households and prevent current account reversals (Ratha, 2013, p. 6).

The rise in the flow of remittances (increasing importance, rising magnitude of remittances in total international flows) caused an increased interest in their role in economic development of the country. Despite the growing research the results about relationship between growth and remittances are inconclusive. Until now, little research has been done about this issue in Poland. The relevance of debate on the role of remittances in financing the development process in Poland is crucial, as over the past two decades, after accession to European Union, the Poland's remittance flows have increased from 3,8 bln EUR in 2004 to 6,3 bln EUR in 2023 (NBP, 2024) and have become an important source of foreign capital inflow.

The purpose of this paper is to study whether there is a link between remittances and economic growth in Poland. The article addresses the hypothesis that remittances have positive growth potential in Poland. For this purpose, data for the period from 2004 to 2023 have been used. The results can be important for defining the policy measures and providing more efficient management of remittances. The remainder of this article is organized as follows: the next section reviews the relevant literature. The third section outlines the model specification and econometric method. The results and discussions of the study are presented in the fourth section. The last section provides the conclusion of the paper.

2. An overview of the literature

Remittances are private transfers in the form of either cash or goods, send home by migrants to meet specific needs of the recipients (Ratha, 2005). Receiving transfers allows recipient households to spend more on consumption of goods, housing and children's education, health care and thus tend to reduce poverty. They may also increase savings, provide capital for small businesses and entrepreneurial activity or land investments (Ratha, 2005). The way in which remittances are used by households has important implications for economic growth of receiving countries (Dridi et al., 2019, p. 9). According to theory, remittances can positively affect economic growth through their direct implications for savings and investment in human and physical capital and indirect effects, through consumption expenditures (Meyer, Shera, 2017, p. 150).

Higher income levels of households, due to remittances, are usually associated with rising saving rates in developing countries (Dash, 2020, p. 10). Using data for Nigeria (Osei-Gyebi et al., 2023, p. 11) found that receiving remittances improve the propensity of individuals to save, especially if they are financially included. The higher savings of households receiving remittances in Vietnam were also confirmed by (Thanh, Kessels, Erreygers, 2022). If savings are channelled towards productive investment, they can expand the local production, improve the export base and lower unemployment. (Kapingura, 2018, p. 565) found that remittances are important determinant of investment in the Southern Africa Development Region. They help to

overcome the limits of the domestic capital formation allowing the countries for higher rate of investment than could be generated by domestic savings. Results of (Keho, 2024) suggest that some of the migrants may send remittances home for investment purposes in perspective of their return. This finding aligns with (Dash, 2020, p. 21), who reported a positive effect of remittances on domestic investment in South Asian countries in the short term, as well as in the long run. This indicates that remittances are used not only for consumption purposes but also for investment activities such as human and physical capital development.

Remittances may also have a favourable impact on growth through their effect on the recipient economy's financial system (Chami et al., 2008, p. 59). Yaseen (2012) shows a positive correlation between remittances and the development of financial systems in developing or emerging countries, mostly in the Middle East and North Africa. Aggarwal, Demirgüç-Kunt, Martínez Pería (2011) show that remittances are strongly associated with greater banking breadth and depth, increasing the number of branches and accounts per capita and the ratio of deposits to GDP. It is worth noting that according to (Giuliano, Ruiz-Arranz, 2005, p. 30) impact of remittances on growth varies across levels of financial development in the recipient countries. Economies with a relatively underdeveloped financial system experience a greater impact what implies that remittances can also increase investments by substituting for the lack of financial development and improving credit availability. In countries with limited access to credit, remittances can encourage entrepreneurial activities by providing financial resources for new investments (Piras, 2023, p. 2559). Several studies have explored the impact of immigrants' remittances on entrepreneurial activities and have found a positive correlation between remittances and establishment of new firms (Yavuz, Bahadir, 2022, p. 1943). The inflow of remittance can also positively impact investment by increasing supply of foreign exchange that is used for import. This is especially important in countries where domestic investment is dependent on imported capital and intermediate goods.

A significant part of the relevant literature argues that majority of remittances received by developing countries are spent on consumption of goods and services, housing and land, instead of productive investment purposes that would contribute to long run growth (Giuliano, Ruiz-Arranz, 2005, p. 3). However, remittances used for consumption may have a positive impact on the economy, by stimulating the demand for goods and services. Lack of effective demand for local goods and services imposes limits on economic growth in many developing countries. If part of remitted funds is spent on domestically produced goods or services, it can determine the growth of investment in order to increase production, income and employment (Qutb, 2022, p. 159). The positive effect of remittances may spread to the rest of economy, if these flows increase consumption in sectors that have strong linkages with the rest of the economy. Thus, many sectors not directly benefiting from remittances expenditures would nonetheless experience an increase in demand for their output inducing investment and fostering employment (Dridi et al., 2019, p. 6).

Another channel through which remittances may have a positive impact on growth is by the facilitation of human capital formation (Chami et al., 2008, p. 59). Spending remittances on consumption of food, education or health services might increase the level of investment in human capital. Recent studies have proved a positive and significant correlation between remittances and human capital accumulation in some developing countries (SeyedSoroosh, 2018; Khan, 2024).

In the empirical literature, the hypothesis that remittances are able to stimulate the economic growth of the receiving countries was examined by Kumar (2013), who confirmed that remittances have both, short run and long run effects on the growth of Guyana. Another study which supports for positive influence of remittances on economic growth is (Rausser et al., 2018) that found that remittances had impact on economic development in Lithuania, Latvia and Estonia. Results of (Cooray, 2012) suggest that remittances have a positive effect on economic growth when education levels and financial sector development are comparatively high. (Goschin, 2014) in a sample of 10 economies in Central and Eastern Europe for 1996-2011 found a positive impact of remittances on both absolute and relative GDP growth. Meyer, Shera (2017, p. 147) using panel data set of six Balkan countries during the period 1999-2013 confirmed that remittances have a positive impact on economic growth and that this impact increases at higher levels of remittances relative to GDP.

However, remittances can potentially have negative economic effects. A remittance-induced demand can lead to inflation, if local manufacturers are unable to increase supply. Narayan P.K., Narayan S., Mishra (2011, p. 923) examined the determinants of inflation for 54 developing countries and found evidence, that remittance inflows increased inflation during the research period. Another risk posed on economy by inflow of remittances is the possibility of exchange rate appreciation and lower export competitiveness and contraction of tradable sector, i.e. the Dutch disease phenomenon, which is detrimental to economic growth (Acosta, Lartey, Mandelman, 2009). Maduka, Madichie, Ekesiobi (2019, p. 12) provide evidence of the Dutch disease effect of remittance inflows in Nigeria. The study shows that a percentage increase in remittance inflows is expected to deteriorate trade balance by about 52% over the long run. Remittances can also have negative impact on growth in recipient countries by reducing incentives to work and reducing labour supply or labour force participation (Dridi et al., 2019, p. 7). Chami (2018) points to an increasing evidence of a remittance trap, meaning situation, when an economy is trapped on a lower-growth, with increased emigration and dependency on remittances.

The existence of a negative relationship between remittances and growth was revealed by (Chami, Fullenkamp, Jahjah, 2005, p. 75), that found that remittances do not serve as a source of economic growth in recipient countries, suggesting that they are "compensatory transfers", that provide support to poor families and should not be considered equivalent to profit-driven capital flows. A similar conclusion can be found in (Qutb, 2022, p. 168) who identified a long term negative impact of remittances on development of Egyptian economy growth, suggesting

that a large proportion of these inflows stimulate consumption rather than investment in the economy. A study done by (Tung, 2018, p. 204) found that remittances have a negative and statistically significant impact on domestic investment. The results suggest that remittances may be used to increase the household consumption in the Asia-Pacific region. Study done by (Karagöz, 2009) investigated relationship between foreign exchange sources and economic growth (GDP per capita) in Turkey and also provided evidence that remittances had negative impact on growth. According to (Barajas et al., 2009, p. 6) the more highly integrated an economy is with world financial markets and the more highly developed the domestic financial system, the less likely it is that remittance receipts will stimulate investment by relaxing credit constraints. Hosny (2020) using data over 2010-2015 for 72 developing studied the implications of the geographic concentration of the sources of remittances and found that large remittances when combined with high concentration from source countries can aggravate economic volatilities in recipient countries. Among the studies conducted in the countries of Europe the one that supports for the negative impact of remittances on economy is (Gjini, 2013, p. 201). The author investigated the role of remittances on economic growth in Central and Eastern European countries (Albania, Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Slovakia, and Slovenia) using balanced panel data covering the period from 1996-2010 and found that an increase in remittances by 10% decreases the output by about 0.9%. Another study is (Cismaş, Curea-Pitorac, Vădăsan, 2020, p. 1091), that examined the impact of remittances on Romania' economy and found that although the inflow of remittances was more stable over the business cycle than other private flows, they did not stimulate significantly economic activity.

3. Research methods

In line with the objective of this study, to empirically examine the relationship between remittances and economic growth in Poland, secondary, annual data, spanning from 2004 to 2023, collected from the Eurostat were used. The selection of period is based on the availability of data. The ordinary least squares (OLS) regression and backward stepwise regression model were employed for the study. Based on the research that have been discussed in the literature, the basic model estimated in this study takes the following form:

$$\ln GDP_t = \alpha_0 + \alpha_1 \ln REM_t + \alpha_2 \ln FDI_t + \alpha_3 \ln INV_t + \alpha_4 \ln TROPEN_t + u_t,$$

where (at time t):

$\ln GDP_t$ is the natural logarithm of real GDP per capita,

$\ln REM_t$ is the natural logarithm of remittances inflow as a percentage of GDP,

$\ln FDI_t$ is the natural logarithm of foreign direct inflow as a percentage of GDP,

$\ln INV_t$ is investment rate calculated as a gross fixed capital formation in relation to GDP,

$lnTROPEN_t$ is the natural logarithm of trade openness measured by summing of imports and exports as a percentage of GDP,
u_t is the error term.

Result of descriptive statistics (the average, standard deviation, largest and smallest value of independent and control variables) of selected variables is provided in Table 1.

Table 1.
The descriptive statistics of selected variables

Variables	Mean	Std. Deviation	Minimum	Maximum
GDP	10710,50	2298,463	7250,000	14750,00
REM	1,50	0,469	0,836	2,45
FDI	3,63	1,462	0,214	6,20
INV	19,35	1,732	16,400	23,10
TROPEN	46,34	8,435	34,200	62,90

Source: Author's computation using STATISTICA version 13Software.

4. Results of the research and discussion

The estimated regression results presented in Table 2 reflect negative impact of annual remittances ratio to GDP on economic growth in Poland. The estimated regression coefficient indicates that one percent increase in remittances as percent of GDP causes a decline in real GDP per capita by 0,24 percent per year. The main hypothesis of the paper about positive influence of the remittances on economic growth is not true in case of Poland. These results seem to support the findings of other studies like (Chami, Fullenkamp, Jahjah, 2005; Qutb, 2022; Gjini, 2013), that also found a negative and significant impact of remittances on economic growth.

Similar to the results in (Bruckner, Lederman, 2012), the findings reveal that trade openness positively and significantly affects the GDP per capita in Poland. This indicates that greater openness to international trade leads to an increase in the real GDP per capita.

Table 2.
The OLS estimation results of modelling Poland's GDP in the period 2004-2023

	R- squared 0,98416488 Adjusted R-squared 0,97994219 F(4,15) = 233,07 p < ,00000 standard error: 0,03047			
N = 20	**Coefficient**	**Std. Error**	**t-Statistic**	**P -value**
Constant	4,679148	0,544205	8,59814	0,000000
lnREM	-0,248086	0,065020	-3,81555	0,001689
lnFDI	0,015672	0,009886	1,58533	0,133743
lnINV	0,402115	0,115355	3,48590	0,003318
lnTROPEN	0,905701	0,102889	8,80273	0,000000

Note. For variables definitions and sources see section 3. The p-values are in fact very small and not equal to 0, which is due to rounding to four decimal places. N – number of observations. Significance was tested for $\alpha = 0.05$.

Source: Author's computation using STATISTICA version 13Software.

Moreover, the results reveal a significant positive effect of investment on economic growth, consistent with several economic growth theories, which point to the prominent role of domestic investment as an engine of growth (Keller, Yeaple, 2009). Foreign direct investment has a positive sign, however this impact is statistically insignificant. At the theoretical level it has been argued that FDI is growth enhancing. However, existing empirical studies do not appear to find a strong relationship between the two variables (Makiela, Ouattara, 2018). The model is meaningful as a whole (F statistic is 233,07) and has a strong explanatory power (R-square is 0.9799).

The results of modelling GDP based on the backward stepwise regression model confirm the findings of ordinary least squares (OLS) regression (Table 3). As with the previous method, there is a significant positive relationship between trade openness, investment rate and economic growth and negative in case of remittances.

Table 3.
The results of backward stepwise regression modelling Poland's GDP e in the period 2004-2023

	R- squared ,98151168 Adjusted R-squared ,97804512 F(3,16) = 283,14 p < ,00000 standard error: 0,03188			
N = 20	**Coefficient**	**Std. Error**	**t-Statistic**	**P -value**
Constant	4,709082	0,569016	8,27583	0,000000
lnREM	-0,233257	0,067318	-3,46503	0,003191
lnINV	0,380054	0,119805	3,17226	0,005912
lnTROPEN	0,918230	0,107326	8,55550	0,000000

Note. For variables definitions and sources see section 3. The p-values are in fact very small and not equal to 0, which is due to rounding to four decimal places. N – number of observations. Significance was tested for $\alpha = 0.05$.

Source: Author's computation using STATISTICA version 13 Software.

5. Conclusions

Poland has experienced a rising inflow of remittances due to increased emigration over the past two decades. Despite their potential to increase the standards of living of the family left home, they might not translate into economic growth. The paper attempts to determine the impact of remittances on economic growth of Poland. In order to empirically examine this relationship two models were employed for the study: the ordinary least squares (OLS) regression and backward stepwise regression.

Notwithstanding the importance of remittances in foreign capital inflows to Poland, the relationship between remittances and economic growth has not been extensively studied. The article contributes to the existing literature by providing evidence of negative impact of remittances to GDP per capita in Poland. In line with other research (Gjini, 2013), this finding could be explained, that remittances in Poland are used mostly for consumption and to increase the standard of living for family in the home country (food, durable goods, health care, housing)

of families left home rather than using it for profit-driven investments. Furthermore, economic activity in Poland could be reduced due to unfavourable effects of emigration on domestic labour markets in same sectors. In addition, the emigration of skilled workers contributes to the so-called "brain drain", which leads to a shortage of key skills needed to create and implement innovations. As a result, some sectors of the economy may experience a lack of human resources capable of initiating R&D projects, which reduces the overall level of innovation. However, it would be useful to carry out the study in the future and to extend its scope in order to analyze the reasons of negative role of remittances in economic growth in Poland. In addition, the results for the control variables indicate that trade openness and investment have a positive and significant effect on economic growth. The limitation of the study is that we investigated the remittances that enter into Poland only through official channels, whereas their real size may probably be higher due to informal flows.

The results indicate that there is a need to design policies that ensure that remittances will support economic growth. A policy suggestion is that, an economy in order to grow needs investment and government should provide incentives to channel remittances into investment in local and regional production. A good solution would be to create entrepreneurship opportunities and improve the investment climate. Equally important is the need to encourage return of emigrants with accumulated capital, international contacts and knew knowledge to Poland. Government should provide support for returning emigrants willing to invest in home country.

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SOCIAL CAPITAL RESOURCES, ORGANISATIONAL TRUST AND SOCIAL NETWORKS AND THEIR MEDIATING ROLE IN THE DEVELOPMENT OF ENTERPRISES

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Purpose: The presented article focuses on illustrating the role of social capital components in the development of enterprises. The purpose of the article is to identify the relationships between the components of social capital and indicators of economic efficiency and development of enterprises.
Research methods: The research was carried out using the survey method, employing the CAWI technique. The survey frame was innovative industry enterprises employing more than 50 people. Based on the random selection method, a research sample was constructed consisting of 575 individuals employed in enterprises in innovative industries, i.e. pharmacy, energy, automotive and IT.
Main findings: As a result of the research, the scope of the components of social capital, i.e. its resources, social networks and organisational trust, was identified. According to the respondents, social capital resources and organisational trust are the most important. In addition to this, the results of the research confirmed the impact of social capital components on both the development of enterprises and their economic efficiency, thus it seems important for company managers to strengthen social capital.
Research limitations: The obtained research results in relation to their quantitative nature (surveys) constitute the basis for limited findings.
Practical implications: The research results indicate the important role of social capital components in the process of the development of enterprises in the market.
Social implications: Drawing attention to the importance of social capital in enterprises in innovative industries
Originality/value: In a cognitive sense, the research results show the relationship between the components of social capital and the economic efficiency and the development of enterprises.
Keywords: social capital, organisational trust, social networks, enterprise.
Category of the paper: Research article.

1. Introduction

In modern Business organisations, looking for opportunities to increase competitive potential on the market, increasingly pay attention to the need to develop interpersonal cooperation skills within employee groups and organisations in order to achieve common goals. This skill depends on the extent to which an organisation recognises and shares a set of social norms and values. Sharing them is the basis for building social capital that exists in relationships between people (Okoli, Oh, 2007). Social capital is understood in many ways, firstly as the resources that an individual has as a result of participation in diverse social networks, secondly, it is generally identified with the trust of people and institutions in each other and thirdly, capital can be talked about when social relations are governed by norms of reciprocity and fairness.

In general, social capital can be defined as the aggregate of social relations, connections, shared values and mutual trust that enable individuals and social groups to cooperate and achieve goals. In other words, they are the ability of human individuals to interact and cooperate within social groups, organisations, social institutions of various types to achieve common goals. The concepts of social capital in organisations were developed by many researchers (Leana, Van Buren, 1999; Coleman,1998; Nahapiet, Ghoshal, 1998; Lin, 2001; Adler, Kwon 2002).

An important structural component of social capital is social networks, which can be defined as a social network as an arrangement of nodes or actors (both people and organisations) connected by social relations or a special type of nodes (Granovetter, 1978). A network consists of a set of actors or nodes that are connected by ties of a certain type (e.g. friendship). The pattern of ties derives from the structure of the network and the nodes occupy positions within this structure (Borgatti, Halgin, 2011). In an organisation, a social network can provide valuable resources that enterprises need to acquire, including material resources and knowledge, advice and emotional support (Arregle et al., 2015). The social network is a key mechanism for collecting resources, information and assets (Peng et al., 2022).

For a social network to function efficiently, the trust of its participants is necessary. Trust can be defined as the willingness of an actor (i.e., the trustee) to become susceptible to the influence of another actor (i.e., the trustee). By taking this risk, the trustee assumes that the trustee will act in a way that promotes the trustee's well-being, even though the trustee's actions are beyond the trustee's control (Schilke et al., 2021). Trust plays an important role in an organisation. Research clearly indicates a relationship between high levels of employee trust and positive organisational-level variables such as improved job performance (Brown et al., 2015), job satisfaction (Yang, 2014), and employee engagement (Buckley, 2011).

In this article, the author analyses how social capital resources, organisational social networks and organisational trust relate to several key organisational factors associated with the development of enterprises in the innovative sector. The purpose of the article is to identify

the relationships between the components of social capital and indicators of economic efficiency and development of enterprises.

The author poses two research questions:

Q1: To what extent are there social capital resources, organisational trust and social networks in enterprises in the innovative industry?

Q2: What statistical relationships exist between the social capital resources, organisational trust and social networks and enterprise development indicators?

The research findings will contribute to the growing body of literature on social capital. They will also provide practical insights for managers on how to develop social capital resources, organisational trust and networks, upholding the values of authenticity, transparency and engagement.

2. Social capital in organisation – theoretical background

The analysis of numerous studies on organisational social capital indicates that it is difficult to formulate a clear definition of this concept. Some authors focus on its social function. For example, Coleman (1990), social capital refers to the social function of an organisation, such as trust, norms and networks, which can improve the effectiveness of society as well as the organisation by facilitating the coordinated action. Social capital increases when relationships between individuals face change, making it easier to act. In other words, social capital is the value generated by social relations used for personal, community, public and organisational benefits. Lean and van Buren (1999, p. 538), emphasise social relations in their definition. According to them, the social capital of an organisation can be defined as a resource reflecting the nature of social relations in the organisation. The nature of the relations is embodied by the level of orientation of the employees towards taking joint action and achieving common goals, and mutual trust. Other researchers view social capital in the context of resources. Inkpen and Tsang (2005, p. 151), put the emphasis on the resources of the organisation in the definition. According to them, social capital is "an aggregate of resources available and derived from the network of relations for an individual or an organisation. Members of an organisation can benefit from resources from the organisation's network of relations without necessarily participating in its development".

Due to the possibility of operationalisation, a resource theory was chosen for further research, according to which social capital is the social resources inherent in social structures and connections, in which individuals share a consensus on social norms and cultural values (Lu, Peng, 2019). Social capital as an organisational resource is based on social ties that connect employees and create the atmosphere of cooperation necessary for the effective implementation of collective goals by employees and the organisation. It refers to both the potential tangible

and intangible resources that an individual can acquire through their social connections in the organisation. (Spottswood, Wohn, 2020).

An employee most often acquires organisational resources by participating in social networks. In an organisation, a social network is a set of nodes and ties representing a relationship. Nodes define the spatial structure of the network (Yunyun, Gang, 2015). They may be created by people, social positions or other actors, including collective actors (Skolik, Kukowska, 2017). The specific content of the relationships occurring between nodes is diverse, and may include strategic alliances, cooperation, information flow (communication), friendship or camaraderie in the workplace, goods and services (workflow) and influence (advice) (Brass et al., 2004). Social networks in an organisation can be divided into a personal network, based on personal, often informal contacts, and an organisational network based on subject-related ties, which refers to the work team, the entrepreneurial team, etc. (Omri, Boujelben, 2015). To sum up, social networks in an organisation may have different structures, and their efficiency largely depends on the connections and channels of information and knowledge flow between network participants.

The key purpose of social networks is to transmit knowledge and useful information through interpersonal ties and social contacts (Zhou et al., 2007). Social networks facilitate "social relations" that can influence formal business relations (Tang, 2011). The basic assumption of network theory is that personal ties and connections play the role of an "infomediator" in facilitating the exchange of the most valuable information (Do et al., 2023).

Social networks have multiple functions in an organisation. They can positively influence employees' task performance. Hosseini et al. (2019), when investigating the impact of social network dimensions on employees' professional performance, found that participating in social networks had a positive and significant impact on improving performance (professional innovation and reducing burnout). Research by Mäntymäki and Riemer (2016), shows that participating in networks can help employees to solve problems, discuss ideas and work, manage tasks and have informal talks. Olfat et al. (2019), on the other hand, found a positive impact of networks on job satisfaction.

Social networks are beneficial for knowledge sharing and innovation. According to a research by Wu et al. (2021), participation in social networks is positively correlated with innovation, agility and efficiency. Qi and Chau (2018), found that social networks influence organisational learning and that knowledge management activities mediate the connections between them. In turn, Xiong and Sun (2023), based on research results, found that social networks within and between teams have a significant impact on exploratory innovation performance.

Organisational trust is an important complement to social networks, it means resources and benefits resulting from a specific location in trust networks (Sztompka, 2007). It is a multidimensional concept and is therefore defined in a number of ways in the literature. According to Ramos et al. (2022), it is a set of interdependent beliefs about ethical standards,

trustworthiness in communication, the economic strength of the organisation and its ability to reward employee performance, both financially and professionally. In contrast, Yucel (2006, p. 4), defines it as "expectation of individuals, groups, or organizations from groups or organizations with which they are in mutual interaction that they will make ethical decisions and will develop behaviors that are based on ethical principles". Thus, organisational trust is the belief of an individual or group as a whole that an individual or organisation will make a good faith effort, acting in accordance with its commitment to provide the best results, regardless of where it operates (Utomo et al., 2023).

From an analysis of the various approaches to organisational trust, it becomes apparent that it is a multi-level construct that derives from interactions at the colleague, team, organisational and inter-organisational levels. Its most important elements are the values of trustworthiness, benevolence and honesty. Tam and Lim (2009), when studying trust in an organisation, divided it into trust in colleagues (horizontal trust) and employees to superiors (vertical trust). In the first case, the researchers defined vertical trust as "an employee's willingness to be vulnerable to the actions of the organization, whose behavior and actions he or she cannot control" (p. 46). This trust is a variable in the relationship between superior and subordinate, it works reciprocally and includes both the subordinate's trust in his or her superior and vice versa (Özyilmaz, 2010). In contrast, trust in colleagues is defined as "the willingness of a person to be vulnerable to the actions of fellow coworkers whose behavior and actions that person cannot control" (Tan, Lim, 2009, p. 46). Horizontal trust is a useful factor for identifying employees with the organisation, for improving communication, for increasing job satisfaction and for building relationships between employees and organisations. It strengthens employee loyalty to the organisation (Hebo et al., 2022).

Institutional trust in organisations is the least frequently researched. The literature on trust has primarily focused on the study of how people trust others. While we can conceptualise institutional trust as a type of trust that relies on external factors, such as disciplinary or preventive mechanisms, to reduce the complexity of social interactions (Sabetzadeh, Chen, 2023). The institutional trust in an organisation can be understood as employees trust in the organisation. Maguire and Phillips (2008, p. 372), define trust as "an individual's expectation that some organised system will operate predictably and with good will. Employees' trust in the organisation is based on both trust in competence, which refers to expectations of skills, and trust in good will, which refers to expectations of honesty and harmless behaviour (Weibel et al., 2016).

To sum up, social capital brings many benefits to an enterprise. From the organisation's perspective, it can be used to build cooperation based on trust, faster information flow and the creation of knowledge and creativity, which results in a reduction in costs related to the coordination and control of employees. Social capital also benefits employees in terms of building a connection with the enterprise as an institution and with employees, and improving the psychological sense of being needed by others.

3. Methods and Sample

The purpose of the research is to identify the relationships between the components of social capital and indicators of economic efficiency and development of enterprises. The article compares the results of research on the components of social capital from 2017, 2019 and 2022. The study focuses primarily on the results of the research from 2022. The survey method was used in the research. The standardised survey questionnaire was used as the research tool. To survey employees of enterprises in innovative industries, a CATI (Computer Assisted Telephone Interview) technique was used. The survey was nationwide. The survey frame was innovative industry enterprises employing more than 50 people. Based on the random selection method, a research sample was constructed consisting of 575 individuals employed in enterprises in innovative industries, i.e. pharmacy (25.2%), energy (23.3%), automotive (26.4%) and IT (25%). The surveyed employees were white-collar (97.2%) and blue-collar (2.8%) workers, with work experience of 4-8 years (10.3%), 9-13 years (23.8%), 14-18 years (33.7) and 19 or more years (32.2%). Due to random sampling, the survey was performed on a representative sample using the following parameters: margin of error α 4%, confidence interval: 95%. The Kendall rank correlation coefficient was used to analyse the questions posed.

4. Results

The article compares the results of research on the components of social capital from 2017, 2019 and 2022.The level of social capital in an enterprise depends to a large extent on the extent to which its resources are present among employees. Based on Theiss (2005) classification, the dimensions of social capital – structural, regulatory, cognitive and behavioural – were distinguished within which their resources were identified, including cooperation, solidarity, participation, loyalty and values. Table 1 presents the results of research on social capital resources. The average rating of social capital resources in enterprises of the innovative sector was $\bar{x}$ = 4.02, SD = 0.887 and was higher than previously conducted research in 2016 ($\bar{x}$ = 3.40, , SD = 0.887) and in 2019 ($\bar{x}$ = 3.14, SD = 0.887).

Values are a resource included in the regulatory dimension of social capital. They are important because, when shared by members of the work team, they strengthen cooperation. The surveyed respondents rated this resource the highest, indicating that most employees respect norms and values ($\bar{x}$ = 4.05, SD = 0.867) and respect property rights ($\bar{x}$ = 4.02, SD = 0.887). Another resource included in this dimension of social capital is solidarity, based on informal social norms. Solidarity increases employees' confidence in taking risks in innovative activities. The surveyed respondents rated ethicality in relations with other

employees ($\bar{x}$ = 4.15, SD = 0.901) and solidarity with other colleagues as the highest ($\bar{x}$ = 4.01, SD = 0.849).

Another resource is cooperation, which is a behavioural component of social capital. The respondents rated highest the sharing of information, knowledge and learning one from the other ($\bar{x}$ = 4.19, SD = 0.814), employees' creativity in solving problems at work ($\bar{x}$ = 4.11, σ = 0.850) and having cooperation skills ($\bar{x}$ = 4.06, SD = 0.891).

Loyalty is a component of the cognitive dimension of social capital. It manifests itself in being loyal to the company and colleagues. The surveyed respondents rated highest the willingness to help other employees ($\bar{x}$ = 4.11, SD = 0.821) and the kindness and friendliness of employees towards each other ($\bar{x}$ = 4.06, SD = 0.895).

Among the resources of the structural dimension of social capital is participation, which includes, on the one hand, employees' membership in informal groups, mutual informal contacts in the workplace and taking part in team-building events and, on the other hand, trade union membership. Among the attributes of this resource, participation in team-building events ($\bar{x}$ = 4.11, SD = 0.927) and participation in informal groups based on cooperation ($\bar{x}$ = 4.05, SD = 0.921) were rated the highest.

Table 1.
Social capital resources in enterprises in innovative industries

Specification	2017 N = 149		2019 N = 179		2022 N = 576	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
SCC Cooperation resource	3.54	0,880	3,19	1,377	4,03	0,885
SCS Solidarity resource	3,28	0,987	3,05	1,306	4,08	0,891
SCP Participation resource	3,29	1,242	3.22	1,370	3,84	0,930
SCL Loyalty resource	3,27	0,902	3,10	1,342	4,05	0,963
SCV Value resource	3,38	0,868	3,14	1,358	4,09	0,911
Generalised social capital resources	3,40	1.001	3,14	1,349	4,02	0,915

*Scale of between 1 and 5.

Source: self-analysis.

A component of social capital is trust, understood as the belief that a partner will take our interests into account in the course of an exchange, when we have previously taken their interests into account in the course of our actions. In the surveys of employees of enterprises in innovative industries, the level of trust in colleagues, managers and organisations was identified (Table 2). The analysis of the 2022 survey results shows that the generalised level of trust in enterprises in innovative industries reached $\bar{x}$ = 4.03 on a scale of 1 to 5, where 1 meant very low trust and 5 meant very high trust, and was significantly higher than the results of the 2019 survey of large enterprises and the 2017 survey of small, medium and large enterprises.

The analysis of the 2022 survey results shows that employees place more trust in managers ($\bar{x}$ = 4.07) than in colleagues ($\bar{x}$ = 4.05). Employees have relatively the least trust in the enterprises they work in ($\bar{x}$ = 3.99). The detailed analysis of the attributes of the different types of trust helps to build a picture of organisational trust in enterprises in innovative industries.

Among the horizontal trust attributes, employees' belief that if they needed a replacement they could find someone to help them was rated highest ($\bar{x}$ = 4.19, SD = 0.802). This was followed highly by the willingness to share ideas and information with other colleagues ($\bar{x}$ = 4.17, SD = 0.827), the belief that if they share their work problems with other employees they are sure to get constructive advice ($\bar{x}$ = 4.14, SD = 0.820), confidence in receiving help from my work colleagues ($\bar{x}$ = 4.13, SD = 0.869) and being able to talk openly about what I don't like or how something should be changed ($\bar{x}$ = 4.10, SD = 0.802).

Among the attributes of vertical trust, the belief that managers keep their promises ($\bar{x}$ = 4.11, SD = 0.834) and fairly appraise employees ($\bar{x}$ = 4.11, SD = 0.867) was rated the highest. Other highly rated attributes were loyalty to one's manager ($\bar{x}$ = 4.10, SD = 0.880), the belief that in case of problems related to work, one can safely talk to one's superior ($\bar{x}$ = 4.08, SD = 0.853) and the belief that superiors play primarily the role of advisors and partners ($\bar{x}$ = 4.08, SD = 0.874).

The most important attributes of institutional trust are the belief that the company wants employees to know why certain decisions are made ($\bar{x}$ = 4.17, SD = 0.919) and the certainty that if something bad happens in the company, most employees would try to find a way to solve this problem ($\bar{x}$ = 4.10, SD = 0.934). Moreover, its level is influenced by the belief that the company cares about the interests of employees ($\bar{x}$ = 4.05, SD = 0.848), avoids gossip and does not participate in unfair criticism of other people ($\bar{x}$ = 4.05, SD = 0.929) and certainty that if something really bad is happening in the company, employees will be informed about it ($\bar{x}$ = 4.04, SD = 0.859).

Table 2.
Organisational trust in enterprises in innovative industries

Specification	2017 N=149		2019 N=179		2022 N=576	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
HT Horizonal trust	3,40	0,980	3,15	1,327	4.05	0,836
VT Vertical trust	3,60	0,881	3,21	1,325	4,07	0,873
IT Institutional trust	3,76	0,928	3,18	3,331	3,99	0,884
Generalised organization trust	3,61	0,911	3,19	1,342	4,03	0,849

Scale of between 1 and 5.

Source: Author's own elaboration.

Social networks are an essential component of organisations. Lin (2001) embedded them in social relations that improve performance. In order to identify the extent to which social networks exist in the surveyed enterprises, the indicators were constructed based on the frequency of mutual formal and informal relations between employees and between managers and employees and the closeness between employees and employees and the immediate manager (Table 3). The generalised networking indicator for the surveyed enterprises was $\bar{x}$ = 3.52 on a scale of 1 to 5 (where 1 means none and 5 means high frequency or closeness of connections).

The detailed analysis of network indicators in the surveyed enterprises indicates differences in the degree of occurrence of employee networks and networks of employees and managers. Indicators of the frequency of relations between employees forming the employee network, i.e. frequency of the employee's contacts with other employees with whom the employee cooperated in the last year ($\bar{x}$ = 3.76, SD = 0.817), frequency of the employee's contacts with other employees in professional matters ($\bar{x}$ = 3.58, SD = 0.948) and frequency of the employee's contacts with other employees after work, e.g. going out to a restaurant or a pub together ($\bar{x}$ = 3.22, SD = 0.106) achieved a higher value than the indicators of the frequency of relations in networks consisting of employees and a manager, i.e. frequency of relations with a direct manager to whom one can turn seeking help or advice in professional matters ($\bar{x}$ = 3.38, SD = 0.867) and frequency of relations with the direct manager after work (going out together for an informal lunch, dinner or to the pub) ($\bar{x}$ = 3.12, SD = 0.995). There were also differences in the closeness of connections indicator. The indicator of closeness of connections between employees from the same team ($\bar{x}$ = 3.94, SD = 0.867) was significantly higher than the indicator of closeness of employees from different teams ($\bar{x}$ = 3.19, SD = 0.828). Surprisingly, the indicator for the closeness of employees' relations with their immediate manager ($\bar{x}$ = 3.68, SD = 0.875) was lower than the indicator of the closeness of connections with other managers ($\bar{x}$ = 3.83, SD = 0.892).

Table 3.
Social network indicators in enterprises in innovative industries

Specification	2017 N = 149		2022 N = 576	
	$\bar{x}$	SD	$\bar{x}$	SD
FRE1 Frequency of employee relations	3.22	1,410	3.52	0,892
CCE1 Closeness of connections between employees	2.45	1,250	3.56	0,983
Total	3,03	1,320	3.54	0,022
FRM1 Frequency of employee relations with the manager	3.26	1,275	3.25	0,922
CCM1 Closeness of connections between employees and the manager	2.54	1,380	3.75	0,889
Total	2.89	1,374	3.50	
Generalised networking indicator	3,06	1,390	3.52	0,961

Scale of between 1 and 5.

Source: Author's own elaboration.

From the perspective of research questions, the analysis of indicators of economic efficiency and enterprise development is important. The results presented in Table 4 indicate that the economic efficiency of enterprises is at an average level. The highest ratings were given to the enterprise's increase in revenues compared to the previous year, the increase in market value, the increase in productivity and the positive financial result achieved in the enterprise. The increase in the value of equity and the increase in the value of our enterprise's assets were rated relatively low compared to the previous year.

Similarly, the rating of the indicators for enterprise development is at an average level. The emergence of new investments, the introduction of new products and the innovation of employees were rated highest. In contrast, the lowest ratings were given to the implementation of new technologies and increased product sales.

Table 4.
Rating of the economic efficiency (EE) of enterprises

Specification	$\bar{x}$	SD
EE1. In the last year the enterprise achieved a positive financial result	3.52	1.124
EE2. In the last year, the enterprise's revenues increased compared to the previous year	3.53	1.092
EE3. In the last year the enterprise saw an increase in the value of equity compared to the previous year	3.43	1.111
EE4. In the last year, the value of our enterprise's assets increased compared to the previous year	3.46	1.097
EE5. In the last year, the value of our enterprise's market value increased compared to the previous year	3.50	1.097
EE6. In recent years, the enterprise has been generating an increasing net profit	3.49	1.085
EE7. In recent years, productivity in the enterprise has been increasing	3.49	1.107
Total	3.49	1.198

Scale: 1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high.

Source: author's own elaboration.

Table 5.
Rating of the indicators for enterprise development (ED)

Specification	$\bar{x}$	SD
ED1 New products have been introduced	3.52	1.159
ED2 New investments have emerged	3.55	1.097
ED3 New technologies have been implemented	3.43	1.143
ED4 Product sales have increased	3.41	1.133
ED5 Enterprise's resources have increased	3.47	1.136
ED6 Customer portfolio has increased	3.48	1.131
ED7 Employee innovation has increased	3.52	1.103
ED8 Intensification of activities in the markets has increased	3.35	1.112
Total	3.47	1.126

Scale: 1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high.

Source: author's own elaboration.

In the next research step, the relationship between social capital resources and the economic efficiency of enterprises and their development indicators was analysed. The analysis of Table 6 shows that the strongest impact on the economic efficiency of the surveyed enterprises was exerted by the cooperation resource, in particular on positive financial results (EE1), increase in revenues (EE2) and increase in productivity (EE7). The participation resource is also important for the increase in economic efficiency, in particular it influences the increase in productivity (EE7), the increase in the equity value (EE3) and the increase in market value (EE5). In addition to this, the resource of loyalty is also important, influencing the increase in revenues (EE2), the increase in asset value (EE4) and the increase in market value (EE5).

A broader picture of the importance of social capital resources in enterprise development is provided by the analysis of its relationship with development indicators. The strongest impact was observed for the cooperation resource, which influences most of the development indicators, with the strongest impact on the increase in product sales (WR4), the increase in enterprise's resources (WR6) and the implementation of new technologies (WZ3).

Subsequently, the value resources have an impact on the indicators of enterprise development, in particular the increase in product sales (WR4), the implementation of new technologies (WR3) and the increase in enterprise's resources (WR5). In turn, the participation resources have the strongest impact on the increase in sales (WR4), the implementation of new technologies (WR3) and the increase in intensification of activities (WR8). In contrast, a weaker impact was observed for solidarity and loyalty resources.

In conclusion, social capital resources have an impact on both economic efficiency and enterprise development. With the strongest impact on the increase in the value of the enterprise, a positive financial result, an increase in product sales, the emergence of new investments and the introduction of new products. Thus, enterprises should pay more attention to creating a favourable environment for the development of social capital.

Table 6.
Kendall rank correlation coefficient between social capital resources (SC) and economic efficiency indicators (EE) and enterprise development indicators (ED)

	SCC	**SCS**	**SCP**	**SCL**	**SCV**
EE1	0,172*	0,157*	0,029	0,032	0,184*
EE2	0,183*	0,029	0,015	0,174*	0,007
EE3	0,045	0,039	0,178*	0,020	0,029
EE4	0,044	0,035	0,039	0,163*	0,042
EE5	0,154*	0,165*	0,165*	0,164*	0,068**
EE6	0,027	0,034	0,053**	0,028	0,018
EE7	0,172*	0,029	0,180*	0,051**	0,037
ED1	0,006	0,156*	0,042	0,032	0,023
ED2	0,166*	0,156*	0,045	0,173*	0,163*
ED3	0,181*	0,161*	0,180*	0,029	0,181*
ED4	0,208*	0,169*	0,196*	0,049	0,201*
ED5	0,156*	0,034	0,159*	0,014	0,180*
ED6	0,181*	0,030	0,049	0,050	0,052**
ED7	0,162*	0,020	0,015	0,048	0,172*
ED8	0,157*	0,028	0,171*	0,025	0,045

* $p < 0,01$, ** $p < 0,05$.

Source: own research.

It seems interesting to research the relationship between organisational trust and indicators of economic efficiency and enterprise development. The analysis of Table 7 shows that vertical trust (VT) has the greatest impact on economic efficiency, in particular the increase in equity value (EE3), a higher net profit (EE6) and the increase in productivity (EE7). In contrast, horizontal trust (HT) has the greatest impact on positive financial result (EE1), the increase in productivity (EE7) and the increase in market value (EE5). However, in the case of institutional

trust (IT), a relationship was noted with the achievement of a positive financial result (EE1) and an increase in equity value (EE3).

Slightly different results were obtained in the analysis of the relationship between organisational trust and enterprise development indicators. The most numerous relationships were observed in the case of horizontal trust. The strongest positive correlations were identified between horizontal trust (HT) and enterprise development indicators (ED), i.e. the introduction of new products (ED1), the emergence of new investments (ED2) and the increase in product sales (ED4). In turn, vertical trust has the greatest impact on the introduction of new products (ED1), the emergence of new investments (ED2) and the increase in product sales (ED4). The institutional trust has the least impact on enterprise development indicators. Its strongest impact was identified on increasing the enterprise's resources (ED5) and implementing new technologies (ED3).

To sum up, organisational trust primarily has an impact on the positive financial result, the increase in productivity, the emergence of new investments, the increase in product sales and the introduction of new products. Thus, enterprises should pay more attention to creating a favourable environment for the development of organisational trust.

Table 7.
Kendall rank correlation coefficient between horizontal trust (HT), vertical trust (VT) and institutional trust (IT) and economic efficiency indicators (EE) and enterprise development indicators (ED)

	HT	VT	IH
EE1	0,233*	0,057**	0,230*
EE2	0,190*	0,189*	0,048
EE3	0,061	0,193*	0,215*
EE4	0,079**	0,185*	0,057**
EE5	0,190*	0,185*	0,078**
EE6	0,183*	0,196*	0,048**
EE7	0,208*	0,191*	0,053**
ED1	0,232*	0,226*	0,241*
ED2	0,222*	0,223*	0,188*
ED3	0,191*	0,079**	0,260*
ED4	0,222*	0,223*	0,186*
ED5	0,191*	0,055	0,260*
ED6	0,183*	0,219*	0,049
ED7	0,208*	0,203*	0,071**
ED8	0,078**	0,098**	0,056

* $p < 0,01$, ** $p < 0,05$.

Source: own research.

The analysis of the Kendall rank correlation coefficient results between social network indicators and economic efficiency indicators and enterprise development indicators indicates the existence of various degrees of dependency between the variables (Table 8). The network indicator of the frequency of relations between employees (FRE) has the strongest positive impact on the increase in the value of the enterprise's assets (EE4), the increase in market value (EE5) and the achievement of increasing net profits (EE6), the introduction of new products

(ED1) and the increase in the enterprise's resources (ED5). In contrast, the frequency of relations between employees and the direct manager (ERM) is most strongly influenced by higher net profit (EE6), the implementation of new technologies (ED3) and the increase in enterprise's resources (ED5) and the increase in intensification of market activities (ED8).

The analysis of relationships between the closeness of connections between employees (CCE) and indicators of economic efficiency and enterprise development shows that there is a relationship only with positive financial result (EE1). However, the network indicator of the closeness of connections between employees and managers (CCM) is primarily strongly related to the positive financial result (EE1), the increase in the enterprise's revenues compared to the previous year (EE2), the increase in the equity value compared to the previous year (EE3) and the increase in the value of assets compared to the previous year (EE4).

Thus, the frequency of relations between employees significantly influences the economic efficiency, while the frequency of relations between employees and the manager influences the development of enterprises. The situation is different when it comes to the impact of closeness of connections on the economic efficiency and the development of the enterprise. The closeness of connections to the manager mainly affects the economic efficiency, and to a lesser extent the development of enterprises. In contrast, weak connections were identified between the closeness of connections between employees and the economic efficiency and the development of enterprises.

Table 8.
Kendall rank correlation coefficient between the frequency of relations (FR) and the closeness of connections (CC) and economic efficiency indicators (EE) and enterprise development indicators (ED)

	FRE	**CCE**	**FRM**	**CCM**
EE1	0,056**	0,079**	0,191*	0,296*
EE2	0,038	0,027	0,065**	0,294*
EE3	0,020	0,045	0,068**	0,282*
EE4	0,241*	0,049	0,047	0,270*
EE5	0,251*	0,017	0,043	0,036
EE6	0,335*	0,190*	0,021	0,164*
EE7	0,032	0,016	0,021	0,031
ED1	0,304*	0,043	0,036	0,031
ED2	0,043	0,022	0,013	0,048
ED3	0,027	0,303*	0,045	0,197*
ED4	0,016	0,051	0,027	0,018
ED5	0,306*	0,309*	0,038	0,197*
ED6	0,012	0,047	0,042	0,051
ED7	0,046	0,032	0,013	0,056
ED8	0,028	0,295*	0,034	0,005

* $p < 0,01$, ** $p < 0,05$.

Source: own research.

Discussion and summary

Social capital is an important factor in enhancing the innovativeness of enterprises, as it enables the effective use of the potential of employees and managers to create knowledge and new innovations. Social capital has a significant impact on innovativeness based on cooperation (Al-Omoush et al., 2022). In particular, it is important in enterprises in innovative industries. This research shows the scope of the components of social capital, i.e. its resources, organisational trust and social networks. The analysis of the empirical results shows that the generalised level of social capital resources is high in the surveyed enterprises in the innovation industry. Its strongest resource is its values in particular respect for norms, protection of property rights and solidarity manifested in ethical relations with other employees and solidarity with colleagues. These create a favourable environment for employees to take innovative action.

One of the important elements of social capital are networks that have a significantly positive impact on the innovation efficiency of the enterprise (Xuqian et al., 2024). The research found that organisational networks made up of employees themselves were characterised by a relatively high frequency of relations between employees resulting from frequent professional contacts in the workplace. Employees entered into informal relations with other employees relatively less often. However, networks composed of employees and managers were based on formal relations between employees and managers, with frequent contacts with managers to whom help or advice can be sought and a relatively high degree of closeness of connections between employees and the manager.

Knowledge about the nature of social networks can help managers stimulate pro-innovative actions of employees, which will increase the enterprise's competitiveness in the market. Therefore, they should focus more attention on learning their structure of functioning, which will allow them to optimally use their potential to act for the benefit of the organisation.

A component of social capital related to its resources is trust. It has an impact on the extent to which tangible and intangible resources can be accessed and used. The aggregated trust can lead to increasing mobilisation, activity, innovation (Sztompka, 2010). In the surveyed enterprises, the highest level of trust was recorded in the case of vertical trust, in particular its attributes, i.e. the belief that managers keep their promises and evaluate employees fairly, managers acting as advisors and intellectual partners towards subordinates and the conviction that if an employee had problems with anything related to work, they could safely talk to their superior about it. Horizontal trust, i.e. in employees, was significantly lower, with the highest ratings given to the employee's conviction that if they needed a replacement, they were confident they could find someone to help them, the sharing of ideas and information with other colleagues, employees keeping their promises and the employee's conviction that if they shared their work problems with other employees they would get constructive advice. The level of institutional trust was rated lowest.

When analysing the importance of organisational trust for the functioning of enterprises, it should be noted that it creates a favourable environment for cooperation both between employees and between the manager and employees.

An enterprise's position on the market depends, among other things, on the increase in economic efficiency and enterprise development indicators, such as the introduction of new products, the innovativeness of employees, the acquisition of new markets, the emergence of new investments. Research by Liu, Ghauri, Sinkovics (2010) shows that social capital positively influences the increase in a company's position in the market through the dissemination of knowledge between internal company actors.

The analysis of the Kendall rank correlation coefficient between elements of social capital and indicators of economic efficiency and enterprise development concluded that social capital resources and organisational trust have a greater impact on enterprise development than on economic efficiency of enterprises. When analysing the impact of social capital resources on enterprise development, it was shown that the value resource and the solidarity resource are important factors in its growth. In the case of organisational trust, on the other hand, horizontal and vertical trust were shown to have a significant impact on the development of the enterprise. In turn, institutional trust has the strongest impact on economic efficiency. The obtained research results confirmed the impact of social capital elements on both the development of enterprises and their economic efficiency, thus it seems important for company managers to strengthen social capital.

The author of the article would like to point out the limitations of using the results of research on social capital in enterprises resulting from the quantitative research method used. The presented research results were intended to outline the complex issue of social capital and constitute a starting point for broader research on its function in modern enterprises.

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IMPROVING STRATEGIC MANAGEMENT IN THE FOUNDRY INDUSTRY USING KPI

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Purpose: The goal was to develop a universal set of key performance indicators (KPIs) for evaluating production activities carried out at metals companies as part of a growth strategy.
Design/methodology/approach: An analysis of the literature on the subject was performed, and interviews and observations were conducted at foundry companies located in southeastern Poland.
Findings: Key objectives of the development strategies of foundry companies were identified in relation to which a set of KPIs was proposed to evaluate production activities. Within the framework of strategic development, the following key areas were highlighted: optimizing energy and water consumption, increasing customer satisfaction, increasing production flexibility, increasing productivity, and reducing waste and related costs.
Research limitations/implications: Future research directions will include the development of a universal set of KPIs for other key areas of foundry companies and the development of software that will allow monitoring and control of the indicators in real time.
Practical implications: The developed set can be successfully implemented in foundry companies that plan to imply a strategic scorecard, which is a tool for advanced strategic analysis, as part of management improvement. The proposed set of KPIs provides an excellent foundation for the construction of a strategic charter in foundries as part of the concern to raise their level of competitiveness.
Originality/value: Filling the research gap on how to conduct effective monitoring, control and analysis of the implementation of the objectives of key development strategies (production area) of foundry enterprises through the use of KPIs. The study and the proposed set of KPIs is addressed to the management of business entities.
Keywords: Mechanical engineering, management and quality, foundry industry, metal industry, Key Performance Indicators (KPI's).
Category of the paper: Research paper.

1. Introduction

A changing environment, dynamic globalization, increasing intensity of competition and the threat of crisis phenomena determine the creation, implementation, monitoring and improvement of innovative management systems. Maintaining a relatively stable competitive advantage means for enterprises to orient the production and management space to increase efficiency and innovation. Economic activity involves the creation of value that satisfies specific requirements and needs, or brings various benefits to the producers and stakeholders involved (Klimecka-Tatar et al., 2021; Ulewicz, Novy, 2019). For manufacturing companies, this value is a tangible product or, less frequently, a service, which shares many similarities related to value creation, meeting specific needs and generating benefits. However, it is distinguished by the conditions under which they are produced, offered or consumed. These conditions influence most design and production processes (Pietraszek et al., 2020; Gajdzik et al. 2022).

The development of foundry enterprises is determined mainly by the skillful use of emerging development opportunities and the search for innovative solutions, both technological, production and in the organizational and management areas (Luczak, Wolniak, 2016; Gawlik, 2016). Changes in the global economy and the situation in the local market, not infrequently indicate the direction of development of manufacturing enterprises. This is related to making developmental and improvement decisions at various levels of management, including the most important decisions - strategic ones (Pacana et al., 2024). The growing influence of end customers on the decisions made by companies has also contributed to the fact that in sectors related to metal processing, i.e. the manufacture of consumer items, the implementation of processes according to the achievement of key objectives (often in line with sustainable development) and their monitoring is gaining importance (Ksiazek, Ligarski, 2016). Manufacturers operating in the metalworking industry are constantly faced with numerous challenges related to ensuring adequate product quality and reducing adverse environmental impacts. These are the result of increasing customer demands and pressure to continuously improve business and environmental performance (Klimecka-Tatar, Ingaldi, 2020).

Among some of the most important management tools in organizations are key performance indicators (KPIs) (Tu et al., 2010; Pacana, Czerwinska, 2021). A key performance indicator in a manufacturing company is a carrier of information (often as an indicator, absolute measure or process statistic) for quantifying and communicating achievements (especially: efficiency, effectiveness, quality, performance, financial health) and identifying and indicating priority processes, activities and values that motivate effective strategy implementation (Parmenter, 2016; Czerwińska et al., 2020). These indicators make it possible to reduce complex information about the company and its performance to a small number of key data, providing

understandable results on the basis of which conclusions can be drawn and the course of action can be modified (Hollender, 2016; Czerwinska, Pacana, 2020). In this context, it becomes reasonable to define goals in the production space of metallurgical enterprises and, on this basis, develop a set of adequate key performance indicators.

The goal was to develop a universal set of key performance indicators (KPIs) for evaluating production activities implemented in metal industry companies as part of their development strategy. The proposed solution will increase the efficiency of implementation of strategic objectives and improve the control of strategy implementation and monitoring of environmental impact. Implication of the proposed model will allow identification of areas for improvement in the context of conducting so-called green production.

2. Foundry industry

The foundry industry is part of the metallurgical industry that produces metal products. Various plastics are used in the production of products (castings), which differ in chemical composition and physical properties, which determines the possibilities of their use. Casting plastics include: cast steel, cast iron (gray, ductile, malleable), as well as light metals (aluminum, lead, copper and zinc) (Malinowski, 2021; Gajdzik, 2013).

The customers of the foundry industry are many branches of production, which can be grouped as follows: the automotive industry, mechanical engineering and manufacturers of industrial fittings (e.g., municipal and sanitary appliances, household appliances, building structures, tools). Cast products are an intermediate link (components) of many chains, within which they serve as a subordinate link, which determines the need to accept standards and requirements set by the chain leaders (Grzybowska, Gajdzik, 2014). The significant level of customer diversity contributes to the foundry's dependence on demand for end products, with none of these customers being able to produce end products without the component parts - castings. This positioning lends great importance to this industry for the economy. An analysis of the current state of the global economy and development trends indicates an increasing increase in the share of foundry (a technique for processing and manufacturing metal products) (Bris et al., 2021; Pacana, Czerwinska, 2023a).

Suppliers to the foundry industry are: suppliers of scrap, foundry pig iron, coke, as well as other materials and technical solutions. The ties between foundry companies and their suppliers vary and depend on: the number of suppliers, the specifics of the supply market, the form of the supplier-customer relationship, and the pricing policy adopted (Miskinis, 2021).

The indicated features such as the diversity of technologies and materials used, products manufactured, target markets of customers, project the specificity and considerable heterogeneity of the foundry industry (Khan et al., 2023). This is revealed in the dominance of

cast products in a relatively narrow group of manufacturers, as well as the specificity of competition (competitiveness within such following strategic groups: large batch casting for the automotive industry, die casting of small castings in large batches, flexible foundries with a predominance of small and medium castings and large casting) (Ulewicz et al., 2023; Uyan, et al., 2023). The characteristics presented above influence the formation of the economic reality of foundry companies, which is also influenced by the fact that the foundry industry, despite tremendous modernization, is still perceived as a "dirty industry," which creates very difficult working conditions and which uses outdated technologies with negative environmental impact, which contributes to its low attractiveness (Kolmasiak, 2024; Shi et al., 2021). In addition, the foundry industry continues to be characterized by lower economic indicators (e.g., labor productivity and capital intensity of production) compared to those achieved in other industries. In addition, the foundry industry continues to be characterized by lower economic indicators (such as labor productivity and capital intensity of production) compared to those achieved in other industries (Sordan et al., 2024). The specifics of the industry outlined above require and generate the need to monitor and control the degree of implementation of key provisions of the strategy in foundry companies. In addition, there is considerable pressure to implement solutions to measure the degree of implementation of important strategic objectives and lead to the realization of provisions of sustainable development.

3. The essence and place of KPIs in strategic management

The decision-making process in manufacturing companies should be based on sound knowledge and analysis and on developed standards. However, it happens that reliance on business intuition is forced by the need to take quick action. Failure to manage by facts is a big mistake that results in a decrease in the efficiency of implemented activities and a greater risk of making costly mistakes (Wolniak, Grebski, 2018; Czerwińska, Pacana, 2022).

In order to improve the decision-making process in the enterprise, it is necessary to standardize the process, which will allow for the seamless use of necessary and verified information. It is essential to gather reliable data, or facts, at the very source (Ingaldi, Dziuba, 2020). They should then be analyzed, remembering to take into account the associated context. To this end, a system of KPIs adequate to the needs of the enterprise should be introduced, and constant monitoring and control should be carried out (Grycuk, 2010; Pacana, Czerwińska, 2023). A diagram of the essence of KPI implementation is shown in Figure 1.

Based on the information extracted from the data, knowledge is obtained, which allows to efficiently make a repeatable and right decision regardless of who has to make it and in what situation.

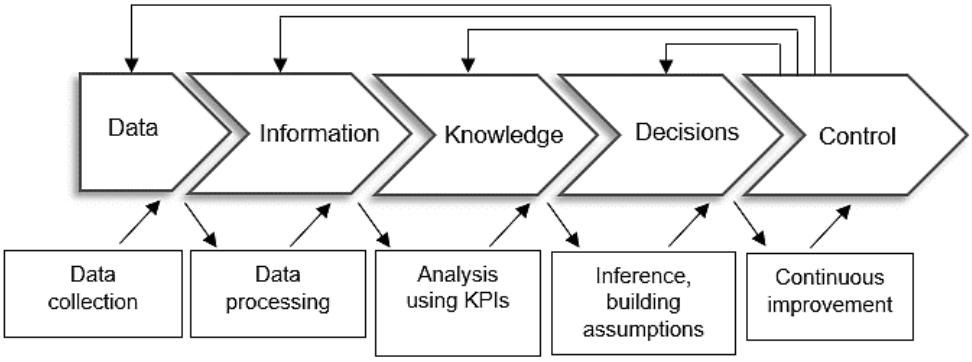

Figure 1. Implementation of KPIs in a manufacturing company with consideration of effective strategic decision-making.

A skillfully designed system of indicators is the basis for a well-functioning decision-making process that increases the likelihood of choosing the right solution for a given situation. It is very important that KPIs are defined in a way that makes it possible to understand how strategic goals are achieved (Beneliene, 2021; Czerwińska, Pacana, 2020a).

4. Linking KPI to the goals of foundry industry companies

Analysis of the literature on the subject, conducted research, interviews and observations in foundry companies located in the southeastern part of Poland made it possible to identify the key objectives of development strategies. The identified objectives were closely related to the main pillars of the strategy (Contini, Peruzzini, 2022; Malinowski, 2021; Shi et al., 2021; Chen et al., 2021; Pacana et al., 2022; Hajduk-Stelmachowicz, 2014, 2018, Hys, Hawrysz, 2012). The selected main objectives were:

- optimization of energy and water consumption,
- increase in customer satisfaction,
- increasing production flexibility,
- increasing productivity,
- reducing waste and associated costs.

The indicated goals should be monitored and subject to constant review. Regular monitoring of the progress in achieving the goals allows rapid identification of problems and making necessary adjustments, which is crucial in a dynamically changing market environment. Therefore, it was proposed to apply key performance indicators to manage the main aspects of the development strategies of foundry companies. A set of indicators for the identified areas was designed, which supports the supervision of the main aspects of strategy implementation, which will ultimately enable the enterprise to achieve global optimization and success. The set of indicators is presented in Table 1.

Table 1.
A set of KPIs relevant to the main pillars of the development strategy of foundry companies

Area	Key objective	KPI	Frequency use
Optimization of energy and water consumption	Reduce the level of energy and water consumption in the production space (improvements)	• Electricity consumption per unit of product (KPI_1), • Gas consumption per unit of product (KPI_2), • Fuel consumption per unit of product (KPI_3), • Water consumption per unit of product (KPI_4),	Once/month
	Reduce the level of energy and water consumption of labor resources (investments)	• Level of spending on energy-efficient machinery per unit of time (KPI_5), • Level of spending on energy-saving measures (improvements) per unit of time (KPI_6),	Per year
Increase in customer satisfaction	Reduction of non-compliance with customer requirements	• Percentage of quality-compliant products manufactured (KPI_7), • Percentage of inspected products after the casting process (KPI_8), • Percentage of inspected products after the pretreatment process (KPI_9), • Percentage of inspected products after the finishing process (KPI_{10}), • Percentage of finished products inspected (KPI_{11}),	Once/week/month
	Reduce lead time	• Percentage of time to prepare an order for production (KPI_{12}), • Percentage of finished product lead time (KPI_{13}),	Once/week/month
	Reliable lead time	• Percentage of orders with consistent planned and actual lead times (KPI_{14}), • Percentage of orders with delayed lead time (KPI_{15}), • Magnitude of delayed order fulfillment (KPI_{16}),	Once/week/month
	A reliable estimate of the cost of the contract	• Percentage of orders with the same planned and actual cost (KPI_{17}), • Percentage of orders with less actual cost than planned (KPI_{18}), • Percentage of orders with higher actual cost than planned (KPI_{19}),	Once/week/month
	Reduce response time to customer inquiries	• Lead Time Planning (KPI_{20}),	Once/week/month
Increase in manufacturing flexibility	Increase in the level of flexibility of employees	• Percentage of employees able to operate more than one workstation (KPI_{21}),	Once/month
	Increase in the level of flexibility of production lines	• Percentage of production lines able to change their production profile, (KPI_{22}),	Once/month

Cont. table 1.

Increasing productivity	Increase in productivity	• Profitability of finished goods (KPI_{23}), • Value of output produced per worker in a given period (KPI_{24}), • The ratio of the quantity of a good produced to the time required to produce it (KPI_{25}), • Percentage of machine capacity to work efficiently (KPI_{26}), • Percentage of production line capacity to work efficiently (KPI_{27}),	Once/week/month
Pro-environmental costs	Reduce post-production waste and emissions and their costs	• The volume of spending solutions that reduce gas emissions in the production unit (KPI_{28}), • The volume of spending on solutions that reduce wastewater in the production unit (KPI_{29}), • The volume of spending on solutions that use and/or reduce waste in the production unit (KPI_{30}), • The amount of spending on solutions that use and/or reduce noise per unit of time (KPI_{31}).	Once/month/quarter

Source: own study.

Determination of KPIs was the initial step to build the strategic scorecard template, so they were built with reference to the goals linked to the development strategies. The indicated set of KPIs should be used for: measuring the current state, comparisons (internal and external benchmarking), performance evaluation, diagnosis (analysis of strengths and weaknesses), planning improvements, monitoring change and progress, and motivating staff. The indicated areas in some way related to each other. Emphasizing the importance of the proposed set of indicators, it can be said that KPIs are metrics whose analysis will help management staff to make decisions more easily, and technical staff to better realize the operation of equipment and infrastructure.

However, it is important to remember that indicators are not something permanent. Not only do they change their values, but they can also change form. Along with any changes in the enterprise, information needs may also change. Therefore, when defining the indicators that will best reflect the effectiveness, one should be guided by the adopted mission, vision and goals of the enterprise.

5. Conclusion

Effective and flexible management of a foundry business in a dynamically changing environment is a key factor in achieving competitive advantage. Such an approach requires identifying the main areas to be measured, monitored and controlled. The purpose of the study was to draw up a universal set of key performance indicators (KPIs) for evaluating production activities carried out in foundry enterprises. The study shows that for foundry companies, five strategic areas can be identified within the production space: optimization of energy and water consumption, increase in customer satisfaction, increase in production flexibility, increase in productivity, and green costs. These areas should be measured using KPIs.

A modern instrument for defining goals and measuring their achievement in the form of results are key performance indicators, which provide an excellent foundation for building a strategic scorecard, which is a tool for advanced strategic analysis. As part of the study, a new proprietary system based on KPIs was drawn up. The system includes 31 indicators to monitor and control strategically relevant areas within the production space. The implication of the developed set of KPIs requires a mindset based on business values delivered to customers. A skillfully designed system of indicators is the basis for a well-functioning decision-making process that increases the likelihood of selecting the right solution for a given situation.

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SUSTAINABLE DEVELOPMENT CHALLENGES AND PRACTICES IN THE LOGISTICS INDUSTRY

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Purpose: The main aim of the article is to analyze the challenges and innovative solutions regarding ways of achieving sustainable development goals in the logistics industry.
Design/methodology/approach: To achieve the main objective of the article, a review of the literature on currently functioning solutions in the field of achieving sustainable development goals was conducted. First, the focus was on the analysis of approaches to defining the concept of sustainable development and ecology. To learn the perspective of companies representing the logistics industry, it was decided to use research using an interview questionnaire. Thanks to the applied methodology, the main challenges, and methods of achieving sustainable development goals in the logistics industry were identified.
Findings: The article presents a set of activities undertaken by the studied entities of the logistics industry in the context of realizing the goals of sustainable development. The research also focused on an attempt to identify the main challenges in the context of realizing these goals. According to the presented results, these challenges can be divided into: economic, technological, infrastructural, operational, organizational, regulatory and communication challenges.
Research limitations/implications: The main limitation was the number of companies that took part in the research. This limitation resulted from the necessity of conducting personal interviews in the companies. At the same time, it should be noted that in the future there is a possibility of expanding the research to include other companies in the logistics industry.
Practical implications: The research results may constitute an example of activities related to the environmental and social areas for enterprises in the logistics industry. In addition, they can be the basis for conducting further research on an attempt to eliminate the identified challenges.
Originality/value: The research presents the main actions that logistics companies can take to achieve sustainable development goals.
Keywords: Sustainable development, logistics industry, ecologistics.
Category of the paper: research paper.

1. Introduction

Sustainable development is becoming one of the most important challenges of the modern world. The popularity of these issues is particularly visible in the number of publications in both domestic and foreign literature. In the face of climate change, environmental degradation and limited natural resources, the need to take action to protect the planet is becoming particularly important. Both societies and governments increasingly expect companies to actively participate in building an economy based on the principles of sustainable development. These activities are aimed not only at protecting the environment, but also at long-term economic and social stability. In the context of these challenges, the logistics industry is under increasing pressure to adapt its operations. Due to its huge impact on the environment in terms of greenhouse gas emissions and fossil fuel consumption - this sector must face the need to introduce significant changes. Logistics companies recognize that traditional methods of operation are no longer sufficient, and changes are necessary to meet growing regulatory requirements and social expectations. More and more companies in the industry are realizing that implementing sustainable practices is no longer just an option, but a necessity to remain competitive and build a responsible image on the market. The main goal of this article is to analyze the challenges faced by companies in the logistics industry in terms of implementing the assumptions of the sustainable development goals.

2. Sustainable development in logistics activities

The concept of sustainable development appeared in the 1960s as a response to global challenges related to environmental degradation, depletion of natural resources and growing social inequalities. Its dissemination was mainly contributed to by the United Nations. However, the official definition was created only in 1987 in a report presented by the UN World Commission on Environment and Development, chaired by Norwegian Prime Minister Gro Harlem Brundtland (Bargieł, 2023). Sustainable development has been defined as „development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Elliot, 2013, p. 29).

In Polish law, the principle of sustainable development is regulated at the constitutional level. According to Article 5 of the Constitution of the Republic of Poland, "The Republic of Poland guards the independence and inviolability of its territory, ensures the freedoms and rights of man and citizen and the security of citizens, guards the national heritage and ensures environmental protection, guided by the principle of sustainable development" (Olejarczyk,

2016, p. 128). The inclusion of this provision in the highest-ranking legal act highlights the importance and significance of the concept of sustainable development.

At the 1992 United Nations Conference on Environment and Development held in Rio De Janeiro, 27 principles of sustainable development were established, which included social, economic and environmental issues. Regulations concerning society indicate that every person has the right to a healthy life and access to natural resources. The equality of all countries was emphasized, both the wealthy and highly developed ones, as well as those in the development phase. The assumptions also specify the necessity of cooperation between states at the level of exchange of information, knowledge and new technologies. In the event of a dispute, it should be resolved peacefully, while in the event of an armed conflict, states are obliged to protect the natural environment to prevent its degradation. The principles also emphasize the importance of maintaining the identity of national minorities and educating society. In the economic area, cooperation between states was provided for in order to promote the international economic system. Countries are obliged to inform each other about any disasters or threats that occur. It was also emphasized that the perpetrator of environmental pollution or its degradation must be punished. In addition, states should ensure that pollutants do not move beyond the area of contamination or environmental disaster (Universität Viadrina, 2002).

The concept is based on the 17 Sustainable Development Goals. The 17 Sustainable Development Goals are a common plan that aims to ensure peace, prosperity for people and the protection of our planet for current and future generations. These goals were set out in the 2030 Agenda for Sustainable Development, adopted by all UN member states in 2015. These assumptions are presented in figure 1.

Figure 1. Sustainable Development Goals.

Source: https://www.gov.pl/web/polishaid/sustainable-development-goals, 16.10.2024.

The Sustainable Development Goals address, among others: poverty, hunger, health and well-being, education, gender equality, water, energy, employment, economy, inequality, urbanization, responsible consumption, climate, life on land and under water, peace and partnership. The goals are universal and indivisible. They must be implemented together, because achieving progress in one area affects the implementation of another goal (Ratschka, 2021).

The aforementioned Agenda 2030 addresses the global community's commitment to achieve sustainable development in its three dimensions - economic, social and environmental - in a balanced and integrated manner. At the same time, it emphasizes the need to integrate the economic, social and environmental dimensions as the key to achieving sustainable development in the world (Integrating, 2015).

The Agenda focuses on three main areas of sustainable development (Transforming, 2015):

- Equality and social solidarity: equality of opportunity for people, including well-being, quality of life and sustainable social development – development should release individual abilities and meet human needs, which in turn will contribute to combating poverty and improving the quality of life of individuals. In the long term, this is to ensure a safe life, full of rights and freedoms, and promote social cohesion;
- Environmental responsibility: the ability to use natural resources in a way that does not disturb the balance and integrity of ecosystems, reducing the burden on the environment;
- Economic efficiency: efficiency of activities in the field of economy and technology, promotion of investment and efficiency, economic development, taking care of the potential of economic production.

In terms of business management, sustainable development means implementing ecological operating practices that simultaneously meet the expectations of all interested parties, including the financial requirements of owners and shareholders and the needs of safety and stability of employees and other stakeholders. Additionally, sustainable development in the context of management, in its simplest form, refers to the way an organization is managed in accordance with the principles and goals resulting from this idea (Grudzewski et al., 2015).

Nowadays, most economic activities require the transport of cargo and people, which is associated with increasing pressure related to the protection of the natural environment. In this situation, there is an urgent need to adapt the logistics sector, especially the quality and level of services provided, to the requirements of the surrounding environment (Bąk-Sokołowska, 2018).

2.1. Approach to defining ecologistics

Ecologistics is gaining importance in the logistics industry due to growing ecological awareness and the need to adapt to environmental protection requirements. In the face of global challenges such as climate change and the degradation of natural resources, ecologistics is

becoming not only a way to improve operational efficiency, but also a key element of a sustainable development strategy.

In recent years, many definitions of ecology have been created, however, according to Dr. A. Baraniecka, ecology can be defined as "the application of the concept of logistics to residues in order to limit their formation, including (which is very important) preventing their formation and causing their economically and ecologically effective flow, with simultaneous spatial and temporal transformation, including changing the quantity and species". This definition emphasizes the essence of preventive measures and the relationship between logistics and ecological issues (Baraniecka, 2019, p. 6). A summary of the remaining definitions of ecologistics is presented in Table 1.

Table 1.
Definitions of ecologistics

Definition	Source
Ecologistics is an integrated system that: is based on the concept of managing recirculating flows of waste material streams in the economy and the flows of information coupled with them	(Korzeń, 2001)
Eclogistics is a manifestation of the desire to develop tools that allow for the elimination or minimization of the pressure of the technosphere on the biosphere, focusing on the area controlled by the logistics sphere in the enterprise	(Piniecki, 2002)
Green logistics is the management of the flow of knowledge, materials and funds between institutions whose goal is to grow with an emphasis on sustainable social and environmental development, while paying attention to the requirements of all stakeholders	(Seuring i Müller, 2008)
Green logistics is green supply chain management, which can be defined as an organization's action that takes into account environmental issues and integrates them with supply chain management	(Lee i Klassen, 2008)
Actions in the field of green logistics include measuring the impact of various distribution strategies on the environment, reducing energy consumption in logistics activities, reducing the amount of waste and managing their processing	(Sibihi i Eglese, 2009)
Eclogistics is a field that primarily deals with eliminating the negative impact of companies' activities on the environment natural	(Michniewska, 2012)
The term "green logistics" is defined as supply chain management practices and strategies that reduce the environmental and energy footprint of goods distribution, which focuses on material handling, waste management, packaging and transportation	(Rodrigue et al., 2012, cf.: Seroka-Stolka, 2014)

Source: own study based on: Baraniecka, 2019, p. 7.

One of the components of ecology is reverse logistics, also known as waste or disposal logistics. It involves planning, implementing, and controlling the efficient and cost-effective flow of materials, in-process inventory, finished goods, and related information from the point of consumption to the point of creation to recover value or dispose of them in an appropriate manner (Merkisz-Guranowska, 2010).

Ecologistics used in various organizations includes two main goals, economic and ecological. The first one is directly related to logistics and concerns cost reduction and simultaneous improvement of logistics customer service. On the other hand, the ecological goal concerns protection of natural resources and reduction of pollution coming directly from

logistics processes. Ecologistics places greater emphasis on limiting waste generation than on appropriate management of existing waste.

The high rank of preventive actions in ecologistics is reflected in the creation of the ecologistics subsystem in the company. Its input includes other subsystems of the organization, including processes occurring in them and generated waste, while the output is economic and environmental benefits resulting from rational waste management. The ecologistics subsystem consists of the following stages: waste prevention, collection, transport and use of waste. The ecologistics subsystem is presented in figure 2.

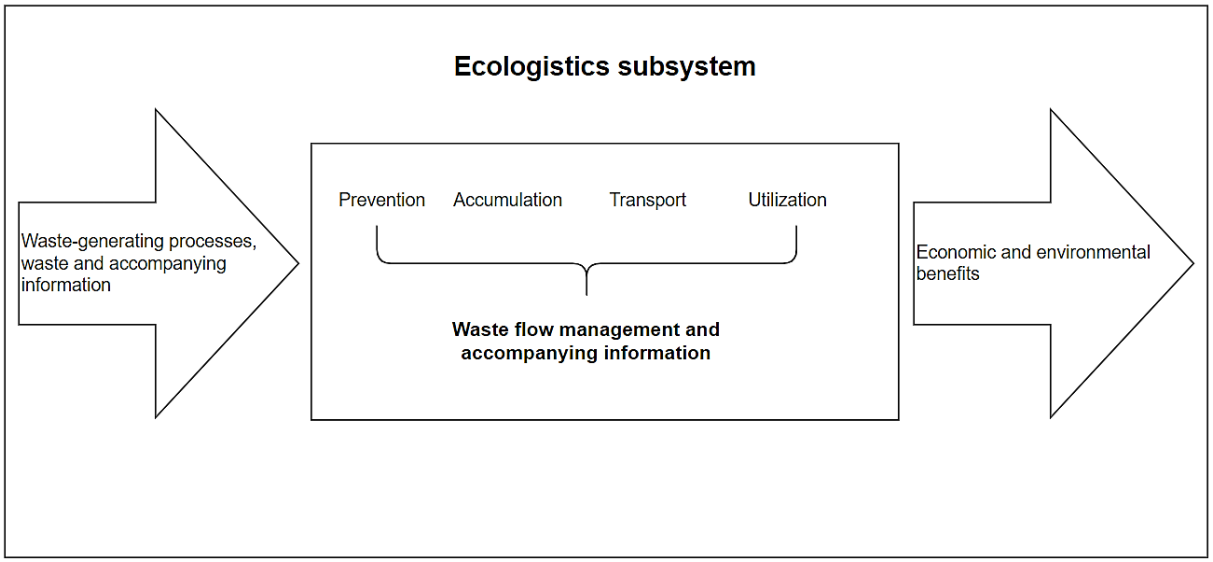

Figure 2. Ecologistics subsystem.

Source: own study based on: Baraniecka, 2019, p. 8.

A systems approach to ecology suggests that, like other subsystems (e.g. supply or distribution), it should be closely linked to the strategic goals of the organization and other areas of activity and coordinated by people responsible for achieving ecological goals (Baraniecka, 2019).

2.2. CSR strategy in logistics activities

More and more companies in the logistics sector are recognizing the need for pro-ecological activities, not only for the purpose of generating profits. Transport, considered a sector that degrades the environment, encourages European companies to compete by implementing CSR (Corporate Social Responsibility) goals, considering ecological aspects in their activities.

CSR is an effective strategy for managing an organization in order to strengthen its position on the market, increase its competitiveness while simultaneously achieving sustainable development goals. The definition proposed by Dr. Dyczkowska presents the CSR strategy as "the company's commitment to conduct such a social policy and make such decisions that are desirable from the point of view of the goals and values of society. According to the idea of

CSR, the company has not only economic and legal obligations, but also specific obligations in society that go beyond the first two limitations mentioned above" (Dyczkowska, 2015, p. 99).

It should be noted, however, that there are more definitions of CSR Strategy. Selected ones are presented in Table 2.

Table 2.
Selected definitions of CSR strategy

Definition	Source
The organisation's commitment to integrating social and environmental considerations into its decision-making process and taking responsibility for the impact of its decisions and activities on society and the environment.	International standard – ISO 26000
The concept whereby businesses voluntarily decide to contribute to a better society and a cleaner environment.	European Commission
The commitment of business to ethical behavior and to contribute to economic development by improving the quality of life of employees and their families, as well as local communities and society as a whole.	World Business Council for Sustainable Development
The management approach and response to social, environmental, broader economic and ethical issues and to the expectations of stakeholders on these issues to the extent to which the business can respond to them.	United Nations Development Programme (UNDP)
The extent to which social, environmental and ethical risks and benefits are managed to protect and increase shareholder value.	PWN

Source: own study based on: Wypych, 2013, p. 209.

The CSR strategy can therefore be understood as a message in which the organisation commits to considering social and environmental areas in the decision-making process so that they contribute to the implementation of the concept of sustainable development.

To systematize the knowledge about CSR strategy, the first international standard of social responsibility was created in 2010, known as the ISO 26000 Standard. The document contains seven key areas of the strategy, within which companies can gain benefits. These areas are: (Wypych, 2013, p. 210):

- organizational governance – the decision-making process in an organization;
- human rights – all inalienable rights that people are entitled to by virtue of being persons endowed with dignity;
- employee relations – all relationships that occur in the organization’s practice with employees who work for it, both inside and outside the organization;
- environment – the impact of the organization’s decisions and actions on the natural environment;
- fair market practices – ethical conduct of the organization towards all other entities;
- consumer relations – responsibility for goods and services offered to consumers;
- social involvement and development – the organization’s relations with other organizations present in its area of operations and contributing to improving the quality of life in all its dimensions.

To better present the above-mentioned areas, their key issues are presented in Table 3.

Table 3.
Key issues of CSR areas in ISO 26000

Id.	CSR areas in the meaning of ISO 26000	Key issues
1.	Organizational governance	– transparency and clarity of activities – responsibility, ethical conduct – dialogue and cooperation with stakeholders – compliance with the law
2.	Human rights	– the right of employees to free association – prohibition of child labour and elimination of forced labour – diversity and equal rights in the workplace (elimination of all forms of discrimination)
3.	Employee relations	– the right to fair remuneration, fair treatment and non-discrimination – the right to fair working conditions, safety and health of employees – employee development, training
4.	Environment	– reduction of raw material and energy consumption – reduction of hazardous waste and other pollutants production – undertaking initiatives for environmental protection – raising awareness of the impact of activities on the natural environment – considering environmental assumptions at the stage of designing innovative products and technologies
5.	Fair market practices	– combating corruption, fraud and money laundering – fair competition – respect for property rights – promotion of social responsibility
6.	Consumer relations	– fair and transparent marketing – access to information and to the contracting process – limiting risks resulting from the use of products and services – stimulating sustainable consumption
7.	Social involvement and development	– actions contributing to improving the quality of life of society – establishing partnerships for development – undertaking social investments – respecting the rights of members of local communities

Source: own study based on: Wypych, 2013, p. 210.

Examples of the application of Corporate Social Responsibility strategy are the activities of Raben Group Polska. This company has an extensive sector related to social activities, which includes, among others, activities such as providing help to children and people in difficult life situations through a noble package, organizing charity transport or volunteering. Raben is happy to share its knowledge at meetings organized in kindergartens, schools or universities. They also provide support for local communities through educational programs regarding, among others, road safety, ecology or raising awareness of the importance of transport and Logistics (Raben, 18.10.2024).

The application of the discussed strategy may also manifest itself as running a foundation. Inpost, as part of supporting the community of its enterprise, runs the Inpost foundation. Its aim is to provide assistance to employees and enable their further development. It also helps employees in difficult life situations and in conducting their own charitable activities (InPost, 18.10.2024).

The described examples of CSR strategy application are not the only ones. Many organizations are increasingly more willing to engage in pro-social activities.

2.3. Examples of ecological activities in the logistics industry

In response to the growing need to protect the environment logistics companies are introducing innovative, ecological solutions. These activities are aimed at both reducing the negative impact on the environment and improving economic efficiency. Below are examples of such pro-ecological initiatives in the logistics sector.

The concept of the Internet of Things is based on connecting various devices that collect, transmit and process data without the need for human intervention. InPost used this solution when introducing parcel lockers to its services. Thanks to this, couriers deliver a large amount of shipments to one place, without the need for additional travel. This prevents the formation of congestion, lower fuel consumption, shorter transport times, a decrease in the number of road accidents, and a reduction in the level of pollutant emissions and noise (Guzowski et al., 2024). Transporting a parcel through a parcel locker emits 98% less CO2 compared to home delivery (InPost, 25.10.2024). Another example of a company supporting sustainability using the Internet of Things is CarryPicker from Hamburg. It optimizes the payload of trucks, avoiding empty runs with AI using Big Data. This solution increases efficiency by reducing the number of vehicles on the road. The reduced use of high-emission tractors leads to lower fuel consumption and reduced emissions (Guzowski et al., 2024).

Intermodal transport, combining different means of transport, plays a key role in reducing pollutant emissions. Thanks to more efficient use of infrastructure and reduced fuel consumption, it is an ecological solution for the TSL industry, contributing to sustainable development. The use of intermodal transport can help relieve the overly congested road network of some freight transport and, as a consequence, increase traffic safety and reduce the negative effects and external costs caused by road transport on human health and life and the natural environment (Wronka, 2012). Pipeline transport, used to transport crude oil and its derivatives, takes up the least amount of space in relation to the transport work performed. Another form of transport that saves land is inland navigation, which largely uses natural waterways, not requiring significant use of land. Rail transport is characterized by an average level of occupied space in relation to the transport work performed, but its land consumption depends on the type of traction and the wagons used. Compared to road transport, rail and inland navigation emit significantly less pollutants into the atmosphere. Electric rail vehicles (electric locomotives) do not affect air quality, and diesel locomotives pollute it ten times less per ton of transported cargo than trucks. Similar effects can be observed in the case of river transport. In addition, the noise generated by trains is relatively low compared to other means of transport, which means that their acoustic impact on the environment is minimal (Pokusa, Ohijenko, 2023).

Electromobility is gaining importance not only in the passenger car sector, but also in the case of vans and trucks, in response to increasingly stringent emission standards. In 2019, the European Union institutions set emission targets for heavy-duty road transport for

the first time. The new regulations, which came into force on 14 August 2019, stipulate that from 2025 all manufacturers of trucks sold in the EU will have to reduce average CO2 emissions from new vehicles by 15% compared to the level from 1 July 2019 to 30 June 2020. In addition, a further 30% reduction in emissions will be required from 2030. In the years 2019-2024, a super-credit system will be introduced to support the development of zero- and low-emission cars. These EU regulations will certainly accelerate the popularisation of electric vehicles, which are characterised by numerous benefits for the environment. Both fully electric (BEV) and hydrogen (FCEV) models are virtually emission-free – they do not produce carbon dioxide, particulate matter, or nitrogen and sulfur oxides, which are typical for combustion vehicles. The introduction of these regulations and the development of electromobility will significantly contribute to improving air quality, reducing the emission of harmful gases and pollutants, which in the long term will have a positive impact on the natural environment and human health (Łęgownik, Jankiewicz, 2020).

3. Methods

To identify and analyze the actions that can be taken by logistics companies and to compare them with the results of literature research, it was decided to conduct research using an interview questionnaire. Representatives of 5 logistics companies in the Silesian Voivodeship participated in the study. It was decided to select companies of different sizes and specializing in other market areas to learn about different perspectives on the challenges and actions taken by companies. The companies participating in the research wished to remain anonymous and did not consent to the publication of their names in the article. The answers to the questions were provided by people holding managerial positions. The surveyed entities include: a 3PL and 4PL logistics service providers and three transport and forwarding companies. The research was conducted from July to September 2024. The average duration of the interview was from 30 to 60 minutes. The interview questionnaire consisted of 15 questions focusing on issues related to sustainable development, which are presented in Table 4. When creating the questionnaire, it was decided to focus on both issues related to the strategy of the companies themselves and technical aspects. Thanks to such a structure, the questionnaire provided qualitative data on the challenges and practices of sustainable development, relations with stakeholders, and social and ecological initiatives undertaken by companies in the industry.

Table 4.
Interview Questionnaire

Id.	Interview questions:
1.	Has the company implemented a sustainable development strategy?
2.	What key sustainability principles have been included in the company's strategy?
3.	What are the company's long-term sustainability goals, and how is their progress being monitored?
4.	What innovative sustainability solutions have been implemented to reduce environmental impact?
5.	What measures are being taken to reduce the consumption of resources and energy in logistics and transport operations?
6.	How does the company comply with legal regulations related to sustainability, such as greenhouse gas emissions or climate policies, and how are these addressed?
7.	Is the company using environmental certifications or standards to monitor and optimize logistics processes, and if so, which ones?
8.	What social initiatives are being undertaken as part of the company's sustainability strategy?
9.	What sustainability practices are applied in managing relationships with stakeholders?
10.	What role do employees play in the implementation of the sustainability strategy, and are training and educational programs on sustainability offered?
11.	What challenges are seen in reducing exhaust emissions and introducing low-emission transport solutions in the logistics industry?
12.	What difficulties are encountered in the process of implementing sustainable practices in the supply chain, especially in the context of optimizing the use of natural resources?
13.	What barriers are identified in the introduction of alternative energy sources in transport operations, as well as their impact on competitiveness and operating costs?
14.	What challenges are encountered when trying to introduce more ecological packaging?
15.	What difficulties are seen in cooperation with partners and suppliers to jointly achieve goals related to sustainable development throughout the supply chain?

Source: own elaboration.

4. Results

The collected answers from the interview questionnaire were used to analyze and identify activities and challenges related to sustainable development in the logistics industry. The analysis was divided into four parts in accordance with the issues in the questionnaire. The first part concerned the company's strategy, its assumptions, and goals (questions 1-3). The second part focused on identifying the activities undertaken by the company (questions 4-7). This part also included questions regarding the impact of legal aspects and certification methods. The third part concerned social aspects and activities undertaken by the company in this area (questions 8-10). The questions in the fourth part directly concerned the challenges that companies face in implementing activities related to sustainable development (questions 11-15). The entire analysis allowed for a better understanding of the perspectives of various companies on issues related to sustainable development and their comparison with the perspective included in the literature research.

Analyzing the answers from the first part of the interview questionnaire, it can be noticed that the companies that took part in the study presented different approaches to formulating a sustainable development strategy. It should be noted that the larger the size of the company,

the more precise and detailed the sustainable development strategy was. An example of such a relationship is particularly visible when comparing 3PL and 4PL logistics service providers with transport and forwarding companies. The LSP had much more detailed and measurable goals compared to carriers. However, it should be noted that each of the analyzed companies saw the need to consider aspects related to sustainable development in their activities and set specific goals, which are monitored using defined indicators. The goals set in the organization's strategies were divided in accordance with the three pillars of sustainable development presented in the literature part: environmental, social, and organizational aspects. The results indicate that all companies recognize the need to implement sustainable solutions, but their strategies differ in terms of ambition and scope.

The second part of the analysis focused on identifying specific actions taken by companies to implement their strategies. During the analysis of the results, it was decided to divide these activities into two main categories in accordance with the classification presented in the literature studies, which are presented in Table 5. It should be noted that the activities presented in the table are a collection of responses obtained from all companies. It is worth noting that there was a strong correlation between the size of the company and the number of initiatives that were implemented by it in the scope of achieving the goals of sustainable development. Regardless of the size and scope of the services provided, the largest number of activities was shown in the environmental category. This situation results mainly from the fact that legal regulations to a large extent force companies to take steps to reduce greenhouse gas emissions.

Environmental activities most often focused on reducing greenhouse gas emissions. All the entities surveyed took certain steps in this respect, which most often consisted of modernizing the fleet to a less emission-prone one and, in the case of having their own storage facilities, saving energy and solutions concerning renewable energy sources. The largest of the entities surveyed also conducted work and talks with clients on the implementation of the use of fully electrified trucks in the case of transport for a selected client. The questionnaire also asked a question about the measures used, which were divided according to the previous classification. The most frequently used environmental measures concerned the measurement of total greenhouse gas emissions expressed in CO2e (carbon dioxide equivalent), while in the case of measuring social activities, they most often concerned the number of social initiatives and, in the case of employees, the measurement of job satisfaction using surveys. The analyzed companies also had implemented standards - most often ISO 9001 and 14001. When indicating the motivation for implementing new solutions concerning the reduction of CO2e emissions, companies most often indicated legal regulations, but also the growing requirements in terms of the ecological awareness of their customers.

Table 5.
Activities undertaken by logistics enterprises in the context of sustainable development

Environmental activities	Social activities
low emission fleet	charitable activities
use of biofuels	social campaigns
implementation of an electric fleet	ensuring appropriate employee training
route optimization	ensuring compliance with occupational health and safety
elimination of empty runs	counteracting mobbing
use of recyclable packaging	health promotion activities
use of renewable energy sources	promoting gender equality in the workplace
minimization of energy consumption through appropriate management of lighting in warehouses	ensuring equal pay
	promoting work-life balance
increased share of intermodal transport	facilities for working parents
carbon credits (CO2 offset)	enabling student internships
emission reporting	implementing a stakeholder relationship management system
certification and standards	

Source: own elaboration.

During the analysis of the third part of the interview questionnaire, the focus was on the social activities undertaken by individual companies. Examples of activities mentioned by the companies are also presented in Table 5. In the case of social activities, companies with a significant position on the market were characterized by a much greater number of initiatives. The interviews conducted show that this dependence is determined by the fact of having separate departments directly involved in creating such initiatives. Among the social aspects, the activities could most often be divided into those focused on internal and external stakeholders. In the case of internal activities, the focus was mainly on ensuring appropriate working conditions and implementing actions aimed at integrating employees. In turn, logistics operators often had actions related to supporting diversity and equality in the workplace.

An example of an action aimed at internal stakeholders concerned one of the companies, which had an action promoting a healthy lifestyle among employees by participating in competitions organized by applications for measuring kilometers traveled. External activities most often concerned charitable activities. Examples of such activities included both direct financial support for non-profit organizations and organizing collections in kind. One of the logistics operators also began cooperation with an orphanage to provide young people with appropriate education and, if they wanted, easier job finding. However, regardless of the size of the company or the scope of services provided, it should be noted that companies see the need for social involvement and carry out certain initiatives in this step.

The last part of the analysis focused on identifying the main challenges in the implementation of the mentioned solutions concerning sustainable development. Even though companies in the logistics industry see the need to implement sustainable solutions, they encounter numerous challenges. In the environmental aspect, the biggest barrier to implementing new activities is most often the financial issue. According to most companies, the optimal solution to this problem is currently investment in low-emission vehicles. Investment in fully electric trucks at the moment incurs very high costs. In addition to the cost

barrier, one of the surveyed entities, which is working on the implementation of electric vehicles for one of its clients, emphasizes that, in addition to the cost barrier, an important issue is also the aspect related to the availability of infrastructure for charging vehicles. The challenge, which was emphasized in particular by smaller companies, concerned the uncertainty about future ecological standards, which additionally made it difficult to plan long-term investments. Numerous comments were also directed at the context of customer requirements, for which the priority is mostly the price and quality of the logistics services provided, and their impact on the environment is put in the background. Regardless of the approach to this problem, the main challenges related to the implementation of activities related to sustainable development were decided to be divided into 7 categories:

- Economic challenges;
- Technological challenges;
- Infrastructure challenges;
- Operational challenges;
- Organizational challenges;
- Regulatory challenges;
- Communication challenges.

All these factors together indicate that despite the growing environmental awareness, the path to full sustainability in the logistics industry requires overcoming numerous barriers. However, as research has shown, there is a strong desire on the part of both logistics companies and their customers to overcome these challenges together.

5. Discussion and Conclusion

According to the presented research results, issues related to sustainable development are currently an important aspect in logistics industry. The activities and challenges faced by enterprises may vary depending on their size and the scope of logistics services they provide, but the article made it possible to identify the general challenges faced by the entire industry, The literature research allowed us to get acquainted with the theoretical perspective on sustainable development and to develop an interview questionnaire that was used in the study. The main challenges that logistics companies should overcome were identified, including: economic, technological, infrastructural, operational, organizational, regulatory and communication barriers. According to the research results, economic barriers are the biggest obstacle and result from the high costs of investing in new technologies and ecological solutions. To solve the economic challenge, logistics companies should try to take advantage of subsidies or tax breaks for investments. Technological barriers are also an important aspect, concerning access to modern tools and their integration with current systems. Infrastructure

often does not fully support sustainable transport, such as the lack of electric vehicle charging stations. Operational challenges are related to the optimization of logistics processes in accordance with the principles of ecology. Organizational problems concern changes management and employee engagement. Legal regulations require constant monitoring and adaptation of logistics companies' activities to changing regulations. In turn, communication barriers include difficulties in transmitting information about pro-ecological activities inside and outside the company. Solving these challenges requires comprehensive actions and further research into building appropriate strategies to support sustainable development in the industry.

It should be noted that the research results also have practical significance for companies, indicating possible actions in the environmental and social area and providing a basis for further scientific analyses. The research indicates the need for further actions aimed at eliminating these barriers and introducing more ecological and effective processes. In the future, it is possible to extend the research to a larger group of companies from the logistics sector, which will contribute to a more comprehensive understanding of the issue.

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TRANSPORT COMPANY AND CHANGES TAKING PLACE IN LOGISTIC AREA

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Purpose: The factor driving development and change in every field are innovative activities. In times of dynamic market changes, the ability to adapt innovative solutions in the areas of management becomes an essential element of the functioning of an enterprise. The purpose of below text is indication benefits which can come from the use of integrated business management systems. The final part of the article describes the effects of using modern tools used in transport companies.
Design/methodology/approach: Creating the following study, the author tried to use general methodology in the field of management sciences as well as descriptive methodology in the area of issues related to logistics.
Findings: The introduction of modern solutions in transport entities brings not only benefits in the form of company expansion. There are noticeable changes in the new capabilities of the entity, starting from increasing market share, entering new markets, increasing resistance to changes in the environment, through increasing customer satisfaction, strengthening relationships with them, and ending with increasing the prestige of the company.
Practical implications: Indication possibility of more efficient management of the transport entity.
Originality/value: Indication and characterization of essential elements in the management of a transport entity. Focus on the obstacles faced by market participants. Below text is addressed to management staff or logistic areas scientist.
Keywords: management, transport company, logistic.
Category of the paper: General review, viewpoint.

1. Introduction

The driving force behind progress and transformation across all industries is innovation. In an era of rapid market fluctuations, the capacity to implement innovative solutions in managerial practices emerges as a crucial component of a company's success. Neglecting continuous refinement of surrounding managerial processes or the integration of novel technical

and technological advancements can lead to the obsolescence of a market entity's effective functioning.

The term innovation was first introduced to economic sciences by Joshep Schumpeter in 1911. According to Schumpeter, this concept refers to such components as: introducing a new product or a product with new properties to the market, introducing a new or improved production method or obtaining a new source raw materials or semi-finished products. Elements of innovation also include the introduction of a new organization of an industry and the opening of a new market (Schumpeter, 1960).

Schumpeter considered the introduction of a new solution into practice for the first time (not repeated before) as an innovation and assigned them very great importance, both in the process of cyclical development of the economy and in the development itself (cf. Dziekoński, Chwiećko, 2013).

It is worth mentioning that innovation cannot be limited only to technical or technological elements. Until recently, in the area of transport, innovation only meant changes in technical departments (e.g. implementation of intelligent telematics systems). Currently, we can also distinguish non-technical innovations, including the introduction of organizational or managerial changes (cf. CATI Raport).

2. Theoretical background

2.1. Innovation area

Running a business in an intensively changing market economy places high demands on decision-making units. Efficient management cannot function without modern tools. Nowadays, innovative implementations are a key factor in gaining and maintaining a competitive advantage on the market. Most often, this is due to the ability to offer goods and services at a higher level than those offered by other entities on the market, as well as to quickly respond to changes in the company's immediate and distant environment, and thus meet the needs and expectations expressed by customers (cf. Gąsowska, 2018).

Defining the word 'innovation' is quite difficult, and its meaning is very broad. It can be said that innovations are characterized by high interdisciplinarity, which can be considered in an extremely multidimensional manner (cf. Duraj, Papiernik-Wojdera, 2010). I. Allen considered innovation to be the introduction into wide use of new products, processes or ways of doing things; E. Mansfield - first application of the invention; R.W. Griffin - the directed effort of an organization to master new products and services or new applications of existing products and services; E.M. Rogers - an idea or object that is perceived as new by the receiving person or other entity; B. Fiedor - any change in given properties of the production

function; S. Kuznets - new application of old or new knowledge to production processes initiating the use of the invention; H.G. Burnett - any idea or thing that is new because it is qualitatively different from existing, known forms. A more simplified interpretation of innovation was introduced by Peter Ducker, who understood it as a tool for entrepreneurs who enable them to undertake new activities or provide new services (cf. Kisperska-Moroń, 2009; Zagożdżon, 2010; Białoń, 2010; Rogers, 2003; Drucker, 1992).

Innovation in enterprises is characterized by the ability to apply new ideas, concepts, inventions or research results. The aim of innovative applications is to achieve and maintain a leading position in the field of activity as well as to strengthen the technical capabilities of the enterprise (cf. Stawiasz, 2010).

The key message is the statement that innovation is one of the most important factors determining the development of enterprises, which should become the creative force of every entity, which should be included in the management system and organizational culture. It can be said that entities that follow innovative trends are characterized by many factors, which include the ability to create and use innovative potential, constantly create innovations, and the ability to predict the future, combined with forward-looking thinking. Additionally, such a unit should be characterized by creativity, development of staff competences and a motivation system that is able to activate entrepreneurship and innovation in connection with the creative skills of the staff in developing and applying innovative solutions, and have an appropriate pool of employees - innovators. We should also mention having an appropriate level of information about customers and the market, effective knowledge management, shaping an innovative culture among employees and maintaining relationships with customers in order to learn about their current and future needs and taking them into account in our activities (cf. Pichlak, 2012; Burniewicz, 2010; Dolińska, 2010).

2.2. Types of innovation

Dynamic changes in today's transport market mean that failure to undertake innovative activities can destroy the leadership position of many companies. The transport industry is currently facing a difficult task, as the strong development in logistics areas (both on the domestic and international markets) has recently been severely limited by administrative and legal barriers in many European Union countries (Neider, 2019).

Innovations in logistics processes are not perceived as introducing completely new solutions in the manner and type of services provided. Even small changes in services provided to customers constitute innovation (cf. Grzybowska, 2012).

The division into types of innovation in transport is quite difficult and it can be said that there is a multi-level approach to this issue. The first of the distinguished divisions is the division into product, process and service innovations. Product innovation concerns the introduction to the transport market of a product whose features or method of use are significantly different from those previously proposed, or the product itself has been

significantly improved and may provide the recipient with new or increased benefits. Process innovation is the use of new or significantly improved methods of operation - processes in broadly understood aspects of transport services, production of means of transport, transport management, etc. It may also concern changes in the organization, human resources, and work methods (cf. Chapman et al., 2003). Service innovation is the introduction to the market of a new logistics or transport service, or one that will be perceived as such. Such a service must offer a new benefit or greater value to the recipient.

Due to the thematic scope, the following areas of application of innovative mechanisms can be distinguished:

- technical and technological innovations in the field of transport,
- innovations in the organization and management of transport,
- innovations in the sales and marketing of transport services, infrastructure and rolling stock,
- financial innovations in the field of raising funds for the development of transport and logistics,
- transactional innovations regarding the organization, preparation and implementation of transport projects (cf. Flint et al., 2005).

Due to the reason for the occurrence of innovations, we can distinguish: routine innovations involving the introduction of changes to transport products or services to maintain their effectiveness and attractiveness; forced innovations, the introduction of which becomes necessary due to a critical situation, e.g. economic crisis; Opportunity innovations are introduced by entities that can allocate significant funds to research and development activities. Through these activities, companies or other entities can replace existing products, expand the scope of services provided, and improve the production process.

Innovations can also be divided according to the scale of changes they involve. There will be radical innovations that cause breakthrough changes in the entity dealing with transport and involve a complete transformation of the functioning of the transport system. A different approach is characterized by gradual innovations, which involve improving activities that are done well, i.e. minor modifications resulting from changes taking place in the environment. In the transportation sector, such changes are often called incremental adjustments. The next division distinguishes autonomous innovations, occurring when the solution was not the result of search, and induced innovations resulting from demand and being the result of research.

In terms of the effects that follow the introduction of innovative activities, there are strategic innovations covering long-term projects and tactical innovations regarding current changes in the transport services provided, technology and work organization allowing to improve the quality of logistics processes (Kordel, 2019).

Innovations can also be divided in terms of the level of complexity because they can be created by a group of people or institutions or by one person. We can distinguish: coupled innovations, which are the result of a group of people or organizations with the necessary

cooperation of the entire group, and uncoupled innovations, which are the result of one person and most often constitute rationalization activities.

Among the remaining divisions of transport innovations, we can mention continuous and discontinuous innovations (in terms of the stability of the process of introducing changes); creative - pioneering and adaptive - reproductive; due to the scale of occurrence, an innovation may be new in relation to: the whole world, a region, a country, a sector of the transport industry, a specific transport company; there are also innovations taking place inside and outside the enterprise (Janasz, Kozioł, 2007).

The introduction of innovations almost always generates a number of problems and barriers. In the literature can find barriers in structural, systemic, awareness and culture barriers, as well as competences in technology transfer (Barski et al., 2010). To overcome these challenges, promoting strong partnerships between academic institutions and private enterprises is crucial. Resolving structural obstacles requires the development of cohesive strategies and policies that synchronize the objectives of both parties. Tackling systemic challenges involves simplifying bureaucratic processes to foster growth and innovation, rather than stifling progress (Janasik et al., 2023).

3. Innovation in transport

Innovation in transport can be understood as activities consisting in improving and improving existing solutions or introducing completely new solutions or processes regarding all aspects of changes, contributing primarily to increasing the economic, financial, technical and technological efficiency of the natural environment of transport systems in order to maximize the effects social and economic results by the public and private sectors (CATI Raport).

Attempts to offer customers better logistics solutions are the foundation for innovation in this area. Logistics services cover the scope of activities and activities involving the flow of products and information, taking into account a wide range of systematization of these activities. There are four basic groups of activities that comprise the subject of logistics services:

- transport and handling of cargo,
- storage and inventory handling,
- market research and creation of an information system,
- financing of transactions, banking and insurance services for contracts (Gołembska, 1999).

The scope of enterprise activities may focus on individual groups of logistics services or cover them comprehensively. Logistics entities can provide a wide range of services including:

- transport and reloading functions, including: transport, organization and implementation of reloading, branch management,
- warehouse functions, including: entering and issuing goods, organizing storage, inventory management and selecting transport packaging, repacking, labeling,
- dispositional functions, including: analysis, planning and organizing transport, control, consulting,
- information functions, including: order processing, creation and management of information chains (Kisperska-Moroń, Krzyżniak, 2009; Zagożdżon, 2010).

The most important element of the above activities is transport and forwarding. Although companies providing logistics services deal with a number of other activities that complement the overall package of their offer, it is transportation and forwarding services that constitute the basis of their activities.

The introduction of innovations in the area of transport depends on factors such as: innovation in the enterprise, legal regulations, costs and availability of fuels, low efficiency of existing solutions, and the need for new functionalities. The purpose of implementing innovative solutions is primarily to increase the efficiency and functionality of transport systems, reduce energy demand, optimize logistics and meet the transport needs of natural and legal persons (Burniewicz, 2010).

In order to be able to create a knowledge-based enterprise in which decisions and planning are based on continuous improvement of the flow of data and information, it is necessary to conduct innovative activities. The basic ones include:

- better strategic planning,
- improving the decision-making process,
- increasing customer satisfaction,
- greater flexibility in adapting to market changes,
- increasing the efficiency of services provided,
- increased flexibility and speed of decision-making in supply chain management processes,
- increasing innovative capabilities (Dziekoński, Chwiećko, 2013; Chapman et al., 2003).

3.1. Integrated management systems

An element of modern management in an enterprise are tools supporting managerial staff in the decision-making process. These tools, introduced at all levels of the company's operations in an integrated manner, allow for an appropriate response to problems that arise in the entity's daily operations.

Dedicated management support tools are addressed to logistics entities. Their area of operation can cover all spheres of activity, which allows them to be called ERP (Enterprise Resource Planning) systems. The advantage of using this type of solutions is the use of a common database, which allows for the unification and integration of information and the possibility of using modular solutions. Modules may cover areas such as: logistics, finance, accounting, sales, warehousing, and many others (Gajdos, 2001).

Solutions of this type bring benefits both in terms of business management and savings in the introduction of innovative processes. We can talk here about an increase in the efficiency of economic processes, as well as: efficient business processes, a unified way of viewing data, a high level of customer service, an increase in the level of sales, a high level of human resources management, etc.

Entities offering the implementation of integrated management systems have multi-module programs that, despite differences in the user interface, allow for comprehensive coverage of departments in logistics entities and thus support management processes in a comprehensive manner. Companies that offer this type of solutions on the domestic market include: Soloplan, Interlan, PasCom, Logintegra, FireUp Software, Marcos.

Below are the solutions of Interlan as one of the leading companies implementing logistics solutions for customers. Interlan has been providing integrated IT solutions for 20 years, placing great emphasis on broadly understood development.

The main modules supporting enterprise management include InterLAN SPEED Forwarding and Transport FTL, which enables the improvement of virtually all departments in the company. Its key functions are:

- handling FTL orders,
- management of own and contracted fleet,
- handling road cards,
- delegations, advance payments, allowances,
- fuel settlements,
- vehicle liability insurance and damages and carrier liability insurance,
- tire management,
- invoicing,
- integration with financial and accounting systems,
- calculation of costs,
- internal settlements,
- complaints service,
- drivers' salaries,
- carrier settlements,
- integration with telematics systems,
- multidimensional reports and analyses,
- and many others.

The introduction of this module allows you to visibly improve logistics processes in the company (automation of order registration, invoicing, debt collection, salary calculation, cost registration). Using this solution allows you to easily and quickly estimate the profitability of individual orders through full integration with telematics solutions, the user is able to control the rolling stock in real time.

Another, one of the most important modules is interLAN SPEED Dispatcher, supporting the work of people managing the company's rolling stock. The skillful use of own or contracted vehicles often determines the company's success and competitiveness compared to other entities on the market.

This solution allows you to plan, designate and supervise the vehicle's route using communication with a telematics system or mobile application. The most important functions include:

- transport planning (taking into account arrival distances, vehicle profile, driver's working time),
- determining the vehicle's route using an appropriate digital map,
- exchange of data and messages with telematics solutions,
- sending the order to the vehicle terminal,
- tracking order statuses,
- alerts, messages, analyses, etc.

The basic tasks of this module include supporting the process of vehicle planning for existing orders in real time. It helps minimize vehicle downtime and also minimizes empty runs. It enables interactive supervision over the course of a given transport, in particular deviations from the designated route that the vehicle should follow, as well as possible delays in the collection/delivery of goods, reported automatically to the customer. Such solutions allow us to maintain the appropriate quality of customer service. An additional advantage that allows us to carry out transport orders at the highest level is efficient and appropriate communication with the driver. The Dispatcher module allows for two-way exchange of information between the driver and the user ordering the trip, and there are also a number of reports containing the status of the order (arrival for loading, loading, departure from loading, driving, traffic jam, etc.). Full integration with other modules is the basis for automating work and reducing errors.

The third module, which is a tool for handling general cargo processes, is interLAN SPEED General cargo. It supports the handling of shipments in domestic and international traffic. Thanks to its flexible structure, it can be used both by logistics operators and groupage networks, as well as by transport and forwarding companies. The key functions of the General cargo module include:

- shipment handling,
- shipment planning,
- price list configuration,

- status management (at the levels of: shipments, route points, routes),
- handling the forwarding warehouse,
- integration with logistics platforms,
- multidimensional analyzes and reports, and much more.

The use of this module allows you to supervise shipments at every stage of the process. Starting with offers, through registration, route planning, line transport, distribution, picking, pallet settlement, invoicing. The module enables full automation of the logistics process, improves customer service through a number of improvements (eSPEED solutions), allows full control of the process (integration with the mSPEED module), and is characterized by high flexibility, which allows it to be adapted to most solutions available on the market.

In order to complement the tools to support management in the enterprise, the modules that additionally support the work of operational, managerial and management departments include:

- interLAN SPEED Distribution - supporting domestic and international logistics processes in the field of order and delivery planning,
- interLAN SPEED Sea and Air Forwarding - handling container cargo, sea and air forwarding,
- interLAN SPEED Map - used for proper planning of vehicle routes (calculation of distances divided into loaded and empty km, calculation of route costs, current road load status),
- interLAN SPEED OptiPlaner - supporting route and loading planning,
- interLAN SPEED eSPEED - a website portal for customers and carriers (offers contact with the customer in the area of orders, transport documents and invoices),
- interLAN SPEED mSPEED - offering mobile solutions in logistics processes (used for communication between system users),
- interLAN intraSTAT - used to create intraSTAT statistical declarations (registration of documents in export and import, control of data correctness),
- ineterLAN Customs system - supporting comprehensive customs procedures.

The possibility of introducing this type of implementation in a modular way allows for the introduction of innovative solutions to logistics entities in stages. This is very important due to the moderate disruption of ongoing processes related to the company's current operations.

Most solutions offered on the market for integrated business management support are characterized by a similar structure and architecture of the implemented solutions. However, before introducing a specific solution for your company, you should familiarize yourself with the offers of leading entities and adapt the system to the resulting needs. This should probably be preceded by a thorough analysis of the structure and operation of the company - the so-called zero audit. This will enable finding and implementing the best solution for a given logistics entity.

4. Practical application of the implemented solutions

Implementing an integrated management system into an enterprise is a complicated process. Taking into account the multi-layered nature of running a business, organizational systematization at all levels of the company requires a lot of work. One may ask what purpose such radical changes can serve? Do the introduced changes actually improve the activities of operational, strategic and management departments?

The question that needs to be answered is how companies operate without integrated management systems. If such solutions are not implemented in a given entity, all information becomes blurred. We do not have one reliable database, which means that the same information is often duplicated and, moreover, inconsistent. Attempts at reporting and analysis become difficult and the results obtained are ineffective.

The integrity of the implemented solutions allows the information once entered to be used many times by subsequent system modules. In INTERLAN's solutions, in the Forwarding and Transport module, we can find many 'sub-modules' that operate independently of each other, but share a common database. The FTL Order Processing 'sub-module' allows for comprehensive entry of all data related to the order of a given freight into the system. The order contains all the necessary information enabling the vehicle to carry out a given transport (place of loading and unloading, type of goods, its weight, quantity, type of packaging, etc.), as well as data regarding the person ordering the transport, the amount for which the transport is carried out and many other additional information. Once the information is entered, it is used by the remaining 'submodules' to their full extent. The order entered in this way, as long as it is repeated, can be freely copied (with only minor corrections - date of transport, quantity of goods, etc.). The order must be assigned to the appropriate vehicle in order to be executed. There are further implications resulting from the introduction of integrated solutions. With the SPEED Dispatcher module, we are able to match the appropriate rolling stock to our order in real time. The size of the goods should be taken into account - i.e. the weight of the load, height, type of necessary trailer structure, etc. Additionally, a given transport is usually carried out in a strict time regime, which means that we are forced to have all information regarding the working time of individual drivers. This is where ICT solutions come in handy, allowing you to geolocate the managed fleet and accurately show information on the working time of individual drivers. Such solutions allow for full optimization of matching a given load - order to the fleet we currently have, with particular emphasis on the current position of the vehicle in relation to the loading place, driver's working time, and broadly understood planning. The SPEED Dispatcher module also allows you to determine the vehicle's route. Determining the appropriate vehicle 'corridor', taking into account road tolls, is another element of work optimization. With appropriate telematics solutions, we are able to send the necessary information to terminals located in vehicles, thus informing drivers about the transport order

they are currently supposed to perform. All necessary information entered in the transport order can be sent to the driver (additional information in the form of comments, messages, restrictions may also appear there). The solutions used enable two-way communication, which greatly improves the flow of information, which is a very important element in this area. Fleet management also involves subcontractors who can perform individual orders for us. It is not a problem to properly manage the contract fleet using the solutions used.

Contemporary enterprises are confronted with a compelling necessity to enhance operational effectiveness and satisfy the escalating demands of consumers who anticipate highly customized offerings at affordable costs. To achieve this, organizations must decrease expenses, elevate efficiency through heightened integration, communication, and cooperation among business processes, necessitating the adoption of innovative solutions (Zembski, Ulewicz, 2020).

The introduction of solutions in the form of a dedicated integrated transport company management system brings the expected benefits. The introduction of the above-mentioned system allowed the company to move onto new tracks. It became possible to implement the company's strategy in the form of continuous increase in the fleet of its own vehicles. This effect allowed for an increase in market share and allowed for entering new markets. Despite the large increase in employee productivity, such dynamic development of the company contributed to the creation of new jobs. The entity became more resistant to changes in the environment. The increase in the quality of work resulted in increased customer satisfaction, and thus relationships became stronger. Appropriate employee productivity also means maintaining costs at an appropriate level, which carries with it a satisfactory level of competitiveness. The introduction of the solutions described above also allowed for a better perception of the company and an increase in its prestige. All the described elements contributed to an increase in profits. The integrated solutions introduced cause a broadly understood optimization at individual levels of the company. With reliable, simple, clear information, and information obtained in a short time, we are able to effectively plan the managed fleet, increase its quantity accordingly and speed up decision-making processes.

Answering the question - what is the purpose of such radical changes - it can be stated that integrated management systems allow for efficient unification of processes occurring in enterprises. Taking logistics entities under the microscope, and focusing on a transport company, it can be assumed that the lack of appropriate system solutions will generate chaotic situations and disorder. Going further, if we wanted to focus on the development of a given entity, and without such an assumption we cannot talk about conducting any activity at all, it will not be possible to achieve even a satisfactory status-quo without having an appropriate integrated management system.

5. Summary – discussion

Running a business is burdened with a number of restrictions, regulations and, above all, constant changes that occur in the broadly understood environment of a business entity. Meeting the challenges that arise during the course of running a business requires introducing innovations. Innovation processes are essential, and their implementation should be carefully thought out, planned, controlled and analyzed. It can be said that it would be necessary to apply a policy of implementing innovations in the company, which could allow for a comprehensive approach to the issues discussed (ct. Janasik et al., 2023).

Introducing new solutions, both in the area of technology and the organization of the company, is classified as innovative activities. The lack of thoughtful activities in this area may result in the entity, despite its best efforts, being unable to cope with the dynamic changes that occur in the market environment. One of the most important elements of every enterprise are IT solutions. Currently, the best approach is integrated ERP management systems. They allow for comprehensive management of the market entity. The modular nature of the implemented solutions is an important factor that allows for the introduction of innovative solutions for a given company (ct. Flint et al., 2005).

The strong development of the transport industry in Poland (an increase in the number of business entities, an increase in the number of transports carried out, an increase in tonne-kilometres) both on the domestic and international markets, caused primarily by the high quality of services provided and lower labor costs, has made Polish companies a market leader in Europe. Unfortunately, the introduction of administrative and legal barriers, as well as the activities of interest groups aimed at limiting access to the European transport market, can significantly inhibit the development of domestic entrepreneurs. Innovative activities can probably eliminate emerging external threats to the company. However, it should be stated that in addition to their intensification, a policy of implementing innovations in the company should be introduced. In addition to the development of the entity itself, this could properly direct this development, and thus put the company on the right track.

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FISCAL INTERVENTIONS MITIGATING HIGH ENERGY PRICES AND THEIR IMPACT ON PUBLIC FINANCES IN THE EURO AREA COUNTRIES

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Purpose: The main aim of the article is to analyze and assess the impact of energy measures on the euro area countries' fiscal balances, from the perspective of the Stability and Growth Pact regulations.
Design/methodology/approach: Primarily, the method of study and critical analysis of the literature covering both the theoretical and legal determinants of fiscal policy and energy policy conduct within the euro area was employed. Subsequently, the data analysis method was used to examine the direct impact of the adopted interventions on the member countries' general government budget balance.
Findings: In response to the global energy crisis, the euro area countries undertook coordinated fiscal interventions in the form of energy measures. These measures were mainly reflected in the countries' budget balances, as energy regulations and fees are set at the national level. The largest share of the measures was adopted in 2022-2023, during which time they contributed to higher budget deficits in almost all member states. The states with exceeded the deficit reference values were not in breach of the fiscal rules, for the sudden increase in energy prices was specified as an *exceptional circumstance*. Although the interventions undertaken helped save many countries from significant drops in output, they often involved high budgetary costs and offered no incentive to reduce energy consumption. Most of the support was provided in untargeted form, thus it reached all consumers, regardless of wealth level or energy intensity. To prepare better for future energy price fluctuations, the eurozone countries should establish a monitoring and assessment system enabling implementation of targeted energy measures. Ideally, the system should be based on the principles of the "Green triple-T" criterion, which would enable these countries to recover from energy crises as a greener and more equitable union.
Originality/value: The paper describes the controversies arising from the adoption of energy measures by the eurozone countries, as well as presents recommendations, for the effective implementation of such support when needed.
Keywords: euro area; fiscal supervision; European energy crisis.
Category of the paper: Research paper.

1. Introduction

In the period of 2021-2022, electricity prices soared globally, including in the euro area (EA) member countries. The first record high was reached in the second half of 2021, when the demand for energy increased amid the waning severity of the health crisis sparked by the COVID-19 pandemic. Further tensions on the energy market ensued in early 2022, i.e., with Russia's invasion of Ukraine. The energy crisis intensified thereafter (Statista Research Department, 2024), taking on a global character (International Energy Agency, 2024). Russia made a unilateral decision at the time to cut off gas supplies to several member countries. This caused a sharp increase in the price of the commodity. It also weighed on the cost of electricity, the price of which in these countries is tied to the price of fossil fuels (European Council, Council of the European Union, 2023).

The global energy crisis has affected, albeit to varying degrees, all euro area countries. The sudden surge in energy prices contributed significantly to an increase in the overall inflation rate and an economic growth slowdown within the zone. To mitigate the effects of high energy prices, a rapid and coordinated response, at the supranational level, was imperative in the winter of 2022-2023 (Council Regulation (EU) 2022/1854; OECD, 2023). Accordingly, in 2022, the European Commission proposed a series of steps and measures, which were intended to gradually reduce the European monetary union's dependence on Russian fossil fuels, as well as to aid the union's states and citizens in coping with the rising energy prices. The Commission's proposals included, inter alia, coordinated fiscal emergency interventions (European Commission, 2023a), adopted in the form of energy measures (European Commission, 2022b, p. 51). The coordination of the interventions needed to be carried out with consideration of the member countries' public finance sustainability (Council Regulation (EU) 2022/1854), as these countries are bound by budgetary restrictions in the form of fiscal rules. One of such rules is the budget deficit limit (Rosati, 2017, p. 297). The emergency fiscal interventions were reflected mainly in the budget balances of these countries, as the energy regulations and fees are set at the national level in most of these states (see Sgaravatti et al., 2023b). The interventions were expected to remain in effect for a certain period of time only (European Commission, 2022b, p. 48).

Given the above, the main research hypothesis of the article was formulated as follows: the fiscal interventions undertaken to alleviate high energy prices in the euro area countries led to a breach of the budget deficit ratio rule in these states. The article is structured in five parts, with the first providing an introduction and the fifth presenting the main conclusions. The second part elaborates on the theoretical and legal aspects of fiscal policy and energy policy in the eurozone. This allowed to determine the essence of the energy sector's impact on maintaining fiscal discipline in the countries of the zone. The third part consists of two paragraphs. The first identifies the main causes of the 2021-2022 electricity price surge in the

EA, as well as briefly lays out the rationale behind the coordinated fiscal emergency interventions introduced in the member countries in response to the global energy crisis. The second presents an analysis and assessment of these interventions in the form of energy measures adopted in the EA member states, including the impact thereof on their budget balances, essentially from the perspective of the regulations contained in the Stability and Growth Pact (SGP), which is precisely the main objective of the article. The analysis covers the years 2021-2024, with emphasis on the period of 2022-2023, when the above-mentioned impact was the greatest. European Commission statistics, unless indicated otherwise, were used to compile part three. Part four, in turn, describes the controversies arising from the adoption of energy measures by the euro area countries, as well as presents recommendations for effective implementation of such support measures when needed. The article reflects the legal status as of March 31, 2024.

2. Fiscal discipline vs energy sector security in the euro area

With the creation of the Economic and Monetary Union (EMU), also known as the euro area, budgetary restrictions were imposed on its member countries, in the form of fiscal rules. One of such rules was the budget deficit limit (3% of GDP), i.e. the ban on excessive budget deficits (Giżyński, 2024, pp. 75-76). This rule has been inscribed in the 1992 Maastricht Treaty, otherwise known as the 2007 Treaty of Lisbon, which restated the provisions on the conduct of fiscal policy within the euro area. The Protocol on the Excessive Deficit Procedure included in the Treaty set the above deficit limit (Ferreiro, Serrano, 2021, p. 216). While the deficit rule itself is based on theoretical grounds (see e.g. Giżyński, Wierzba, 2015, pp. 14-15), the reference value of this quantity has been set arbitrarily. This rule was introduced mainly to safeguard the common euro currency against the risk of pursuing overly expansive fiscal policies by the EA countries, under the conditions of fiscal autonomy. The originators of the union were aware that the common currency needs to be supported by tighter fiscal discipline within its member states, if it is to grow strong and credible (Giżyński, 2024, pp. 75-76).

The provisions of the 1997 Stability and Growth Pact are of key significance from the perspective of fiscal discipline within the euro area countries. They include functional elaboration and detailing of the relevant provisions contained in the Treaty of Lisbon (Giżyński, 2013, pp. 63-68). In other words, the Pact comprises a set of fiscal rules, with procedures for the enforcement thereof in member countries. So far, the SGP has been subject to three reforms, introduced in 2005, in 2011 (the *Six-Pack*) and 2013 respectively (the *Two-Pack*). The first of these reforms relaxed the SGP rules and allowed for more flexibility, while the subsequent two tightened the regulations (Owsiak, 2017, p. 87; Giżyński, 2024, pp. 75-76). The Stability and Growth Pact provides, inter alia, for the occurrence of *exceptional*

circumstances. These circumstances are identified as events beyond the control of member governments, resulting in *severe economic downturns* - a typical example of which was the COVID-19 health crisis of 2020-2022 (see e.g. Giżyński, 2024, pp. 67-94). Accordingly, if such circumstances arise, a breach of the budget deficit rule by any euro area country is not to be treated as *excessive*. This provision is intended to safeguard the above countries against sanctions that may be imposed, should their policymakers violate fiscal rules (Ferreiro, Serrano, 2021, p. 216).

One of the factors posing a threat to maintaining fiscal discipline in the eurozone countries could be energy sector turmoil (see Redo et. al., 2022, pp. 20-24; see Tomaszewski, 2018, pp. 139-140). Worth recalling is that this sector is strategically vital to each country, which renders it subject to national regulations primarily. The political and economic aspects (the demand for energy), in turn, led to the inclusion of energy-sector references in two out of the three treaties instituting the European Communities (Barcz et al., 2016, p. 316; see Stachowiak, 2020, p. 69). Nonetheless, the process of developing the European energy policy regulations was characterized by a gradual increase in the political elite's awareness of the Community-wide significance of the energy sector (for more, see Kucharska, 2021, pp. 73-84). Ultimately, the Treaty of Lisbon, constituting the primary legislative act effective as of late 2009, for the first time provided a regulatory framework for energy policy, and laid the legal basis for the formulation thereof at the EMU level. None of the treaties signed prior to that had regulated these issues comprehensively. Among the secondary legislation for the implementation of energy policy, of particular significance are the relevant regulations and directives (see Ruszel, 2015, pp. 346-347; for more, see Ciucci, 2023). The main objectives of the current common energy policy, in turn, have been formulated in the 2015 Energy Union strategy (European Commission, 2015; Ciucci, 2023). The strategy has been based on five closely related and mutually reinforcive dimensions: 1) energy security, solidarity and trust; 2) a fully integrated European energy market; 3) energy efficiency leading to reduced energy demand; 4) decarbonization of the economy; as well as 5) scientific research, innovation and competitiveness (European Commission, 2015, p. 4). The Energy Union has been established to guarantee a secure, sustainable, competitive, as well as affordable energy supply for households and businesses (Ciucci, 2023).

Given the euro area countries' ambitious economic goals, sustainable functioning of the energy sector guarantees these countries development. Of particular significance in this regard is the international context of economic security, defined primarily as undisturbed functioning of national economies. The impact of the energy sector on the sustainability of public finances can, in turn, be conceptualized as the absence of threats from the energy sector, providing a solid foundation for efforts aimed at maintaining fiscal discipline (see Tomaszewski, 2018, pp. 139-140). The sudden increase in energy prices which hit eurozone countries in 2021 is a fitting example of a threat to the fiscal discipline of these countries.

3. Energy crisis vs fiscal interventions in euro area countries

3.1. Contributing causes of the energy crisis

In 2021, a significant increase in electricity prices hit the euro area countries (see figure 1). This was mainly due to the rising global demand for natural gas amid the economic recovery from the COVID-19 pandemic. The rising demand, however, was not accompanied by an increase in the supply of this commodity, the effects of which were evident not only within the euro area, but also in other parts of the world (European Commission, 2021, pp. 1-2). What is more, a reduction in gas supply ensued as a result of the measures taken by *Gazprom*, i.e., Russia's state-owned energy company. The corporation reduced its gas supplies to Europe ahead of the 2021-2022 heating season (Jakóbik, 2023). The lower supplies of the commodity were justified by the need to replenish the country's own stocks. This lower supply of gas, and the consequent sharp increase in its price[1], was rendered directly in the euro-area's 2021 electricity prices (see figure 1). Natural gas was, in fact, one of the EA's main sources of electricity generation[2] at the time (Garside, 2023).

In late February 2022, Russia's military invasion of Ukraine exacerbated the energy price volatility (European Council, Council of the European Union, 2023). The energy crisis intensified thereafter (Statista Research Department, 2024), taking on a global character (International Energy Agency, 2024). In the wake of the war, and Russia's continued and deliberate attempts to leverage energy as a political weapon, natural gas and electricity prices soared to record levels in 2022[3] (see figure 1) (European Commission, 2023a). Russia made a unilateral decision at the time to cut off gas supplies to many member countries, which led to a sharp increase in the price of this commodity, and affected the cost of electricity. This is because the price of this energy is tied there to the price of fossil fuels (European Council, Council of the European Union, 2023). What is more, the invasion raised uncertainties

[1] The difficulties emergent within the euro area natural gas market were reflected, inter alia, in the pan-European price benchmark, i.e., the Dutch TTF Natural Gas Futures (figure 1). The price under this contract represents the price of gas delivery for the following month (Garside, 2023). At the end of December 2021, the Dutch TTF price totaled €87.03 per MWh, while a year earlier it had been as low as €19.13. Over the course of 2021, therefore, a 355% increase in the contract's price ensued. The highest price, i.e., €180.27, in turn, was observed on December 21, when it increased by as much as nearly 23% (Yahoo, 2024).

[2] In 2021, natural gas represented the second largest source of EA's gross electricity production. The share of gas in this production was nearly 22% at that time. In contrast, the largest amount of electricity, i.e., 26.5%, was produced from nuclear heat. Wind energy, in turn, ranked third, with a share of nearly 14% (own calculations based on Eurostat, 2023).

[3] At the end of December 2021, the Dutch TTF price was still under €90 per MWh, only to hit a record high of nearly €340 at the end of August 2022, which translated into a 278% increase (Yahoo, 2024). This had impact on, inter alia, the increase in wholesale electricity prices in the EA countries. In the third quarter of 2022, the European Power Benchmark, reflecting this increase, averaged €339 per MWh, i.e., it was 222% higher than a year earlier (for more, see European Commission, 2023, p. 3). The price of electricity for household consumers, excluding taxes and levies, in the euro area as a whole, in turn, increased from €0.1577 (end of 2021) to €0.2483 per KWh (end of 2022), which was an increase by approximately 57% (Eurostat, 2024a), while for non-household entities it increased from €0.1061 to €0.2037 per KWh at the time, i.e., it was 91.99% higher (Eurostat, 2024b).

regarding the supply of other raw materials, such as coal and oil[4], which were used to produce energy. This caused an additional significant increase and volatility in the price of electricity. Simultaneously, unfavorable weather conditions, such as the heat waves recorded throughout Europe in the summer of 2022, added to the demand for cooling electricity, forcing the production of electrical energy (Council Regulation (EU) 2022/1854; European Council, Council of the European Union, 2023). The above-mentioned weather conditions, but also technical conditions, however, prevented, at the time, the production of electricity with the use of certain technologies, mainly nuclear or hydropower generation. For this reason, the volume of the energy generated by natural gas-fired power plants remained at a constant high level, which subsequently led to a sharp increase in the euro area's electricity prices (see figure 1).

The global energy crisis has affected, albeit to varying degrees, all member countries. The sudden 2021-2022 increase in energy prices contributed significantly to the overall inflation rate in the EA and the slowdown in its economic growth[5] (Council Regulation (EU) 2022/1854). It should be remembered that prices constitute one of the most salient factors capable of triggering crises. They may even, as the above discussion shows, become the direct cause thereof (Piech, 2012, p. 58). The circumstances thus called for a rapid and coordinated response at the supranational level. Such a response was primarily intended to temporarily reduce the risk of even more unsustainable levels of electricity prices and costs for end users in these countries. It was also intended to prevent those countries from adopting uncoordinated measures. There were fears that such measures would jeopardize the security of supply, at the supranational level, and impose additional burdens on both the industry and final energy consumers across the euro area. The eurozone countries had to therefore show unity (solidarity) in undertaking such coordinated measures as, inter alia, the fiscal emergency interventions during the winter season of 2022-2023. The disturbances on the energy market forced them to implement a series of urgent, temporary and exceptional economic measures (Council Regulation (EU) 2022/18 54). Those measures were aimed at mitigating the economic and social effects of the sudden energy price increase in these countries (European Commission, 2023h, p. 11), and were expected to be in effect for a period of time only (European Commission, 2022b, p. 48). The aim was also to preserve the sustainability of their public finances (Council Regulation (EU) 2022/1854).

[4] The surge in natural gas prices increased the demand for alternative fuels, i.e., coal or oil. As a result, prices for these raw materials soared (Council Regulation (EU) 2022/1854). The 2018-2023 evolution of average prices within the EU fossil fuel sector is presented in Table 1.

[5] Between 2022 and 2023, energy commodity prices, particularly natural gas, were expected to contribute significantly to consumer inflation in the euro area. In 2023, they were expected to add about 2.25 pp to the zone's projected inflation rate. Moreover, the rise in energy prices was expected to exert a negative impact on its terms of trade, resulting in a 0.5 pp decline in the 2023 GDP, after an already significant 1 pp decline in 2022 (European Commission, 2022b, p. 58).

3.2. The impact of fiscal interventions on budget balance

In early October 2022, the Council of the European Union adopted a Regulation[6] (Council Regulation (EU) 2022/1854), which enabled the adoption of emergency interventions in the member countries (Agencja Rynku Energii, 2023, pp. 3-7) during the winter season of 2022-2023 (Council Regulation (EU) 2022/1854). The first coordinated actions in the form of intervention mechanisms had, in turn, been introduced back in October 2021, based on a European Commission's Communication (for more, see European Commission, 2021, pp. 7-10; Agencja Rynku Energii, 2023, pp. 3-7). Table 2 summarizes the main categories of the fiscal measures adopted under the above interventions, starting September 2021. The categories listed were implemented at the national level. In most eurozone states, both the energy policy regulations as well as fees are established at this very level (see Sgaravatti et al., 2023b). As already emphasized, the above interventions have been determined as *energy measures*[7]. It should be mentioned that *energy measures* must meet several criteria, i.e., they ought to be: 1) credibly announced and adequately detailed; 2) narrowly and consistently defined; 3) directly linked to the budget, from the general government accounts perspective (European Commission, 2022b, p. 48).

As early as 2021, i.e., at the outset of the energy crisis, eight member countries launched fiscal support in the form of energy measures. The net budgetary cost of the energy measures, for the euro area as a whole, was much smaller, compared to the fiscal years of 2022-2023, and amounted to about 0.1% of GDP. The significant support, relative to GDP, was at the time allocated by Greece, Italy and Malta (see Table 3). The largest fiscal interventions to mitigate the effects of high energy prices, in turn, were undertaken in 2022-2023. The net budgetary cost of energy measures in the euro area as a whole was estimated around 0.9% of GDP in 2023, compared to 1.2% of GDP in 2022 (see Table 3) (European Commission, 2023e; 2023j, p. 18). The lower level of support results from the member states' withdrawal of part of the energy measures in 2023. What is more, owing to the drop in energy prices that year[8] (see figure 1), the need for certain fiscal measures eased (see e.g. Ferdinandusse, Delgado-Téllez, 2024, pp. 70-71). One example are the subsidies for energy suppliers (European Commission, 2023j, p. 18).

Analyzing the impact of energy support measures on individual 2022-2023 fiscal positions of euro area countries, significant differences can be observed in both the amount of this impact as well as the types of the measures applied. Five member countries, namely Belgium, Estonia,

[6] The legislative genesis of the Council Regulation can be found in Article 122 of the Treaty on the Functioning of the European Union (TFEU) (for more, see European Commission, 2023i, p. 1).

[7] For more on definitions (scope) of energy measures, see in European Commission (2022b, p. 51; 2023k, p. 21) and Castle et. al. (2023, pp. 85-87).

[8] The drop in the euro area's energy prices was driven mainly by the decline in wholesale gas prices (see Table 1 and figure 1), which in turn was caused by a variety of factors, such as mild weather conditions or the broad set of measures adopted by the EA countries to combat the energy crisis, including reduced electricity demand (Agencja Rynku Energii, 2023, p. 63).

Ireland, Greece and Finland, recorded a net impact of energy measures on their budget balances of less than 0.5% of GDP in 2023, versus only two countries, Slovakia and Finland, in 2022. Energy support equal to or exceeding 1.5% of GDP, in turn, was provided in 2023 by four EA countries, i.e. Croatia, Malta, Austria and Slovakia, versus six more countries, i.e., Greece, Croatia, Italy, Latvia, Malta and Portugal, a year earlier (see Table 3). Moreover, most of the euro area countries favored fiscal energy support in the form of untargeted measures at the time. This means that the support benefited the majority of households and/or enterprises, regardless of their income situation or the energy intensity of their production (see European Commission, 2023j, p. 18). Targeted measures, by contrast, targeting households and businesses most vulnerable to energy price increases (European Commission, 2022b, p. 51), were nearly three times lower in each of the two years (for more, see e.g. European Commission, 2023k, pp. 17, 55). The main reason for this difference is believed to lie in the EA states' imperative to adopt immediate mitigation measures at the peak of an energy crisis, and untargeted measures were fairly easy to implement. Furthermore, the effects of these measures were perceptible instantly by the beneficiaries thereof (e.g. Sgaravatti et al., 2023a).

It bears noting that the total number of the energy measures adopted in the euro area countries reveals no differentiation among the individual countries within the zone. This is because in smaller countries, such as Luxembourg, Slovenia and Portugal (for more, see e.g. European Commission, 2023k, pp. 17, 55), the support, especially in 2022, was to a greater extent provided in the form of targeted measures. Due to the low magnitude of these measures, however, they did not translate into aggregate data (Ferdinandusse, Delgado-Téllez, 2024, p. 72).

It is worth mentioning that approximately 65% of the measures adopted by the euro area countries in 2022-2023 were price related (European Commission, 2023j, p. 18). Moreover, nearly all euro area countries have adopted at least one price-distorting energy support measure. These mainly include such measures as caps on retail energy prices, lower VAT and other energy taxes, as well as reduced carbon taxes and fees (see Table 2). It needs to be noted that most of the price-distorting measures take an untargeted form (Arregui et al., 2022, p. 13). This indicates, as already emphasized, that most market players can receive energy support, regardless of the income level or specific needs (European Commission, 2022b, p. 51). What is more, many EA countries have adopted measures which are not disruptive to price signals, yet are untargeted. Examples include energy vouchers or bonuses, or lump-sum income tax credits[9]. Regardless of the type of the energy measures announced or adopted by the member countries during the period in question, those measures constituted a high burden on these countries' public budgets at the time.

[9] For more on the types of the energy support measures adopted in individual EA countries, see also the OECD Energy Support Measures Tracker (OECD, 2024) and the Bruegel think tank database (Sgaravatti et al., 2023b).

Based on the data presented in Table 3, it can be concluded that the fiscal interventions aimed at mitigating the effects of high energy prices during the period 2022-2023 did contribute to higher budget deficits in almost all EA countries. Nevertheless, the energy measures adopted by these countries in 2022 led directly to an overshoot of the budget deficit benchmark in two of those countries only, i.e., Belgium and Austria, and widened this overshoot in five other member states - Spain, France, Italy, Latvia and Malta. By contrast, in 2023, as a result of the adopted measures, the deficit ratio peaked above 3% of GDP in Latvia and Slovenia, while Belgium, Spain, France, Italy, Malta and Slovakia, i.e., six euro area countries exceeded this value. Although most member countries adopted no energy measures in amounts contributive to the 2022-2023 fiscal deficit overruns in these countries, the measures - considering the eurozone as a whole - did lead to direct overruns in both years. The deficit ratios for the zone amounted to 3.6% of GDP in 2022 and 3.2% of GDP in 2023, respectively (see Table 3). On the other hand, the eurozone states that exceeded the budget deficit benchmarks, due to the adopted *energy measures*, during the period 2022-2023, did not violate fiscal rules. This is because the sudden increase in energy prices, experienced by the EA countries in 2021-2022, was specified as an *exceptional circumstance*, independent of these countries, with significant impact on the condition of their public finances. Hence, the main research hypothesis has not been confirmed. The exceedance of the deficit reference value in these countries during the period under review was of exceptional nature. Moreover, apart from the energy measures, significant impact on the member states' fiscal balances in 2022 was exerted by the temporary emergency measures associated with the COVID-19 pandemic (European Commission, 2023h, p. 6). Taking the EA as a whole, these measures were estimated at 0.7% of GDP at the time (European Commission, 2023j, p. 16). Between 2020 and 2022, the euro area countries were allowed to undertake a substantial fiscal response to the COVID-19 pandemic, owing to the launch, in March 2020, of the general escape clause (see e.g. Giżyński, 2024, pp. 77-79). Contributive to the higher deficit rates in the EA member states was also the humanitarian assistance provided by these countries to those fleeing Ukraine in the wake of the Russian invasion. In 2022-2023, the volume of this aid, in a euro-area-wide perspective, was estimated at 0.1% of GDP each year (European Commission, 2023h, p. 11; 2023k, p. 56).

While the declining prices of energy supported the cost-cutting of existing energy measures in 2023, some member state authorities introduced new measures or expanded existing ones at that time (European Commission, 2023f, p. 4). In November 2023, the European Commission proposed a partial 12-month extension of the emergency measures (see European Commission, 2023a), reflected in some EA states' projected net budgetary costs. It is expected that in 2024, substantial energy support measures, i.e., exceeding 0.2% of GDP, will be continued in six countries - Germany, France, Croatia, Luxembourg, Malta and Portugal (Table 3) (European Commission, 2023b, p. 14). A neutral (0.0% of GDP) cost of these measures, on the other hand, is expected to ensue in eight EA countries in 2024, namely Belgium, Estonia, Italy, Cyprus, Latvia, the Netherlands, Slovenia and Finland. A noticeable reduction in the deficit caused by

these measures, i.e., 0.1% of GDP, is projected to be achieved by only two EA countries, i.e., Spain and Slovakia (see Table 3). The extent to which the member governments will leverage the drop in energy prices to withdraw the energy measures is what will determine the future course (direction) of their public finances (European Commission, 2023f, p. 10).

4. Controversies and recommendations

Despite the fact that the prompt fiscal interventions to mitigate the sudden rise in energy prices did help prevent significant output declines in many member countries (Castle et al., 2023, p. 10), these interventions, as the above analysis shows, often entailed high budgetary costs. A number of other controversies are also linked to these interventions.

First, they reduce consumers' incentive to save energy, simultaneously increasing energy demand, which may translate into an increase in energy market imbalances laying at the root of the energy crisis in question. Such conclusion is grounded in the fact that the policy of price caps counteracts the wholesale market price pass-through to the retail prices included in utility bills. Thereby, the price consumers pay for energy is not the real price, which becomes reflected in a lack of motivation to reduce energy consumption (Sgaravatti et al., 2023a).

Second, although considered necessary - both socially and politically - at the peak of an energy crisis, they do interfere with energy transformation commitments and the transition to cleaner energy sources, supporting traditional fossil fuels in the process (see International Energy Agency, 2023; Castle et al., 2023, p. 9; Sgaravatti et al., 2023a).

Third, albeit deployable within a very short timeframe, they constitute a heavy fiscal burden to be sustained over time. If the energy market prices turn out to remain at higher levels for a longer period of time, the actual cost of intervention may prove to be much higher than the original projections.

Fourth, they can hardly be considered equitable. When measures aimed at mitigating high energy prices are targeted at all actors, regardless of wealth level, they support consumers, inter alia, at the highest end of the income distribution, who are unlikely to be in need of financial assistance with energy bills. What is more, in some member states, part of the measures mitigating energy price increases may become regressive in nature (for more, see Sgaravatti et al., 2023a).

Fifth, adopted as *untargeted* - price distorting - measures, while they may lower the peak of the inflation rate, in the short term, they nevertheless generate conditions conducive to a prolonged period of elevated inflation, in the longer term. Moreover, a delayed withdrawal of these measures may disrupt the European Central Bank's medium-term objectives, causing the Bank to maintain a restrictive monetary policy for longer than necessary (Sgaravatti et al., 2023a; for more, see ECB, 2022, p. 46) - such a scenario would entail negative consequences

for the public and private sector financing conditions and the overall financial stability within the euro area countries (see European Commission, 2023f, p. 10) - untargeted price measures are therefore not a sustainable solution in curbing the high and volatile energy prices (Castle et al., 2023, p. 8).

Sixth, widespread elaboration and targeting of interventions to those most in need was hampered considerably. Although this resulted from technical determinants, most notably the lack of comprehensive and integrated databases combining income volumes with energy consumption, the energy crisis has shown that even if the authorities in euro area countries do possess the tools to develop and implement targeted measures, they are unlikely to undertake the task, should a very large portion of the population (and businesses) in these countries come under a sudden and severe shock (Castle et al., 2023, p. 8).

Seventh, they are difficult to roll back, from a political perspective. Indeed, the authorities may face strong public resistance as they transition away from these measures. One example are the protests in Italy in late January 2023 (see e.g. Bianchi, 2023), prompted by the decision to end the reduced excise taxes on diesel and gasoline.

Last but not least, they affect the global income distribution. This stems from the fact that the limiting of demand adjustments in countries at the upper end of this distribution prolongs the period of high energy prices on global markets, and in turn disadvantages the economies of poorer countries, which are dependent on energy import (Sgaravatti et al., 2023a).

The controversies arising from the fiscal interventions adopted leads to the conclusion that these interventions were not the first-best response to the energy crisis (Arregui et al., 2022, p. 13). To prepare more adequately for future price fluctuations on energy markets, euro area countries should set clear policy goals, policy levers and targeting methods, with regard to the energy measures. These countries should also establish an appropriate monitoring and evaluation system enabling effective development and implementation of targeted energy measures (Castle et al., 2023, p. 9). In order to reconcile fiscal affordability with the need to adequately protect the most vulnerable populations, and preserve appropriate energy transition incentives, member countries should take special care to ensure the quality of fiscal measures (European Commission, 2023j, p. 18). This can be facilitated through adoption of energy measures based on the so-called *triple-T* criterion.

The *triple-T* criterion states that the energy measures adopted ought to be *temporary*, *tailored* and *targeted*. The *temporariness* of the measures entails the incidentality and prudence thereof, for such measures are intended to prevent aggregate demand from rising too high over the medium term, allowing the inflation rate to remain at a stable level. *Tailored* measures, in turn, are those which are not intended to reduce the incentive to save energy. Lastly, *targeted* measures should act as a shield for those households, which are most vulnerable to a decline in purchasing power. Member countries should therefore prioritize targeted income transfers, as part of their fiscal interventions. After all, such transfers can be tailored to the size of energy consumers' incomes and the level of their exposure to price shocks. The level of this exposure

depends on the number of persons in the household, the type of housing and its location. Ideally, the above measures should be targeted towards citizens who are not covered by functioning social programs, and complementary to those already covered by such programs (Sgaravatti et al., 2023a). The design and implementation of targeted energy measures in member countries can be furthered by digitization of public administration in those countries. The idea is to introduce solutions that will speed up both the processing of payments and the process of identifying those most in need of such support. Improved energy system digitization, e.g., through the use of smart meters, in turn, can increase the incentive to save energy, by communicating up-to-date energy consumption data to consumers (Castle et al., 2023, p. 9).

It should be emphasized strongly, however, that the activities undertaken by the euro area countries need to extend beyond *extraordinary* fiscal measures. This essentially refers to structural changes within economies, to enable a more rapid phaseout of fossil fuels in favor of renewable energy sources (Sgaravatti et al., 2023a). This would, on the one hand, provide the member states with better (and longer-lasting) protection against fuel price volatility (see International Energy Agency, 2023), and improve the trade balance of the entire eurozone, on the other (for more, see Darvas et al., 2023). Moreover, replacement of fossil fuels with affordable, renewable energy sources would facilitate the restoration and maximization of the EA industry's competitiveness; for the industry has suffered significantly as a result of the surge in the energy prices, which has translated into a decline in its competitiveness on the global market (Sgaravatti et al., 2023a). In order to increase this competitiveness in the near term, however, member countries will first and foremost need to: a) reconfigure their industrial processes; b) significantly accelerate and increase the use of renewable energy; c) both improve the efficiency of energy consumption and reduce the demand for energy; as well as d) reskill and upgrade the competencies of those employed in this sector of the economy (European Commission, 2023c, p. 6; 2023d; Kamrat, 2023, p. 11). To boost the effectiveness of these measures, member countries should conduct their policies based on the so-called *Green triple-T* criterion constituting an extension of the *triple-T* criterion. This means that the measures undertaken by these countries should not only be *tailored* and *targeted*, but also *transition-proof*. In other words, they should promote *green* solutions, through a reduction of the economic costs and administrative burden associated with the transition to renewable energy sources, as well as by improving the efficiency of energy use. It is worth noting that in 2022-2023, some of the EA countries were already embarking on measures fitting the *Green triple-T* criterion (see Sgaravatti et al., 2023a). Nevertheless, in the near term, all euro area states should take faster steps to implement their energy transition commitments. If they opt to develop and implement regulations entailing the *Green triple-T* criterion, they will be able to build an opportunity to recover from the energy crisis as a greener and fairer group of countries.

5. Conclusion

The fiscal policies of the eurozone countries, although carried out independently by these countries, are subject to certain fiscal constraints (discipline). These were adopted in the form of fiscal rules, include a budget deficit limit of 3% of GDP, i.e., a ban on creating excessive deficits. In terms of fiscal discipline, the most crucial provisions have been contained in the Stability and Growth Pact. This pact elaborates on and details the relevant provisions of the Lisbon Treaty. In addition to budgetary restrictions, the provisions of the Pact stipulate the occurrence of so-called *exceptional circumstances*. Such circumstances can involve events beyond the control of member state governments. Should such circumstances occur, a violation of the deficit limit is not to be treated as *excessive*. It ought to be borne in mind that sustainance of fiscal discipline in the eurozone countries may be threatened in the event of an energy sector crisis. Since the sector is of strategic importance for each country, it is subject to national regulation primarily. On the other hand, the Lisbon Treaty regulated, for the first time, the common policy objectives, and provided a legal basis for policymaking at the Union level. The current main goals of this policy, in turn, have been contained in the Energy Union strategy. The union was established, inter alia, to guarantee secure and affordable energy supplies to member countries. Absence of threats from the energy sector provides a solid foundation for efforts to maintain fiscal discipline in these countries.

In the second half of 2021, the price of electricity had surged in the euro area member countries. This increase had resulted mainly from the growing global demand for natural gas sparked by the economic recovery from the COVID-19 pandemic. Further tensions followed in early 2022, i.e., with Russia's invasion of Ukraine. The energy crisis intensified at that point, taking on a global character. These disruptions called for the implementation of a series of immediate, temporary, exceptional and coordinated economic measures, including fiscal interventions, in the member countries. They were reflected mainly in the member countries' budget balances, as in most of these countries, energy regulations and fees are established at the national level. First interventions, in the form of energy support measures, were undertaken in 2021. They equaled 0.1% of GDP in the euro area as a whole. The most substantial interventions, in turn, were introduced in 2022-2023, amounting to 1.2% of GDP in 2022 and 0.9% of GDP in 2023, respectively. The lower level of support in 2023 followed from the member countries' withdrawal of part of the support. What is more, owing to the drop in energy prices that year, the demand for some of the energy measures declined in these countries. It should also be noted that significant differences in both the amount and the type of the measures adopted prevailed at the time. The overwhelming majority of euro area countries opted for untargeted energy measures, however. This means that they provided support to most households and/or businesses, regardless of the income situation or the energy intensity of production. Targeted measures, in turn, provided to those most vulnerable to energy price

increases, were adopted at a level nearly three times lower in each of the two years. The main reason for this is believed to lie in the fact that, at the peak of the energy crisis, the member states were forced to adopt immediate mitigation measures. Untargeted measures were, in turn, relatively easy to implement, and the effects could be felt immediately by the beneficiaries. Regardless of which energy measures the member countries adopted in 2022-2023, they did contribute to higher budget deficits in almost all of these countries at the time. Most of them, however, did not intervene heavily enough to cause a direct overshoot of the deficit reference value during the period under study. Such an overshoot did instead ensue at the level of the euro area as a whole. The deficit ratios for the zone amounted to 3.6% of GDP in 2022 and 3.2% of GDP in 2023, respectively. Nevertheless, the fiscal deficit rule remained not violated in all those member countries where the deficit benchmark was exceeded at the time. The sudden 2021-2022 surge in energy prices was in fact specified as an *exceptional circumstance*, independent of the countries in question, with a substantial impact on their public finances. Hence, the main research hypothesis has not been confirmed. As the energy prices in the euro area declined in 2023, a significant number of the member states intended to phase out the remaining energy measures by the end of that year. In 2024, the share of these measures in the budget deficit of the eurozone as a whole is expected to fall to 0.2% of GDP.

Although rapid fiscal interventions to mitigate high energy prices did help save many euro area states from significant output declines, these interventions were nevertheless in many cases controversial. Beside the fact that the energy measures often entailed high budgetary costs, they also provided no incentive to reduce energy consumption. While considered necessary, they did interfere with the energy transition commitments and supported traditional fossil fuels. Moreover, a significant portion of the interventions were adopted as untargeted price distorting measures. Such measures, although capable of lowering the peak of the inflation rate in the short term, create favorable conditions for an extended period of elevated inflation in the longer term. Untargeted price measures are therefore not a sustainable solution in curbing high and volatile energy prices within the euro area. What is more, the support often flowed to all consumers, regardless of their level of wealth. Hence, it could hardly be described as equitable. It can thus be concluded that the fiscal interventions have proven not to be the first-best reaction to the energy disruptions. To better prepare for future price fluctuations on energy markets, member countries should establish a system of monitoring and assessment, enabling preparation and effective implementation of targeted energy support measures. The system could be based on the so-called *triple-T* criterion, which specifies that the measures adopted should be *temporary*, *tailored* and *targeted*. Such measures include targeted income transfers in particular, adjusted to both the levels of energy consumers' incomes and exposure to price shocks. The actions on the part of the euro area countries should nevertheless extend beyond *emergency* fiscal measures. They should address structural changes within economies enabling a more rapid shift away from fossil fuels to renewable energy sources. A shift to renewables would help restore and maximize the competitiveness of the eurozone industry, which has

suffered significantly from the energy crisis. To improve this competitiveness, the euro area countries will need to, inter alia, substantially intensify the use of renewable energy or improve energy consumption efficiency in the near term. In order to increase the effectiveness of these measures, member countries could expand the *triple-T* criterion and pursue their policies based on the so-called *Green triple-T* criterion placing emphasis on supporting solutions of a *green* nature.

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Appendix

Table 1.
2018-2023 average prices in the EU fossil fuel sector

Average price	2018-2021 [1]	2022 [2]	% change[1]	2023[2] [3]	% change[3]
Gas Wholesale (EUR/MWh)	23	123	435	41	78
Gas Retail (EUR/MWh)	69	137	99	116	68
Coal (EUR/ton)	70	283	304	122	74
Oil (EUR/barrel)	54	97	80	77	43

Notes:
[1] Calculated using the formula: ([2]-[1]):[1]*100.
[2] Until 14 November 2023.
[3] Calculated using the formula: ([3]-[1]):[1]*100.

Source: Own preparation based on European Commission (2023i, p. 3).

Table 2.
Types of fiscal measures implemented since September 2021 by euro area countries in response to the energy crisis

Country / Policy	Reduced energy tax / VAT	Retail price regulation	Wholesale price regulation	Financial transfers to vulnerable groups	Mandate to State-owned companies	Windfall profits tax[1]	Business support	Other forms of support
BE	v	v		v		v	v	v
DE	v	v		v		v	v	
EE	v	v		v			v	
IE	v			v		v	v	v
EL	v	v		v	v	v	v	
ES	v	v	v	v		v	v	
FR	v	v	v	v	v	v	v	v
HR	v	v		v			v	
IT	v	v		v		v	v	
CY	v	v		v	v	v	v	
LV	v	v		v			v	
LT	v			v		v	v	v
LU	v	v		v		v	v	
MT		v	v		v		v	v
NL	v	v		v		v	v	
AT	v	v		v		v	v	v
PT	v	v	v	v	v	v	v	
SI	v	v	v	v		v	v	
SK		v		v	v	v	v	
FI	v			v		v	v	v

Notes:
Symbol "v" indicates a fiscal measure implemented, a blank field indicates no measure or not yet implemented measure.
[1] Revenues from new taxes or fees on windfall profits fall into a special category, as they are not support measures, but rather constitute a source of financing. This specific type of revenue is included in the estimate of *energy measures* due to its direct linkage with energy price increases (for more, see European Commission, 2022a, p. 22; 2022b, p. 51).

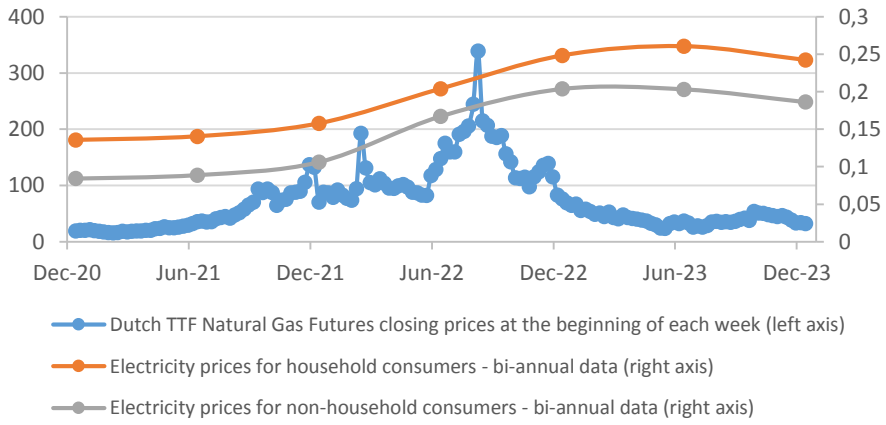
Source: Own preparation based on Sgaravatti et al. (2023b).

Table 3.
2021-2024 net budgetary cost of energy measures vs budget balance in euro area countries, in % of GDP

	Net budgetary cost of energy measures[1]				Budget balance, i.e. deficit (-) or surplus (+)			
State or organization	**2021[2]**	**2022**	**2023[3]**	**2024[3]**	**2021**	**2022**	**2023[3]**	**2024[3]**
BE	0.0	0.8	0.4	0.0	-5.4	-3.5	-4.9	-4.9
DE	0.0	1.2	1.4	0.3	-3.6	-2.5	-2.2	-1.6
EE	0.1	0.8	0.3	0.0	-2.5	-1.0	-2.9	-2.4
IE	0.0	0.5	0.4	0.2	-1.5	1.7	0.9	0.6
EL	0.3	2.6	0.0	0.1	-7.0	-2.4	-2.3	-0.9
ES	0.1	1.5	0.9	-0.1	-6.7	-4.7	-4.1	-3.2
FR	0.1	0.9	0.8	0.3	-6.5	-4.8	-4.8	-4.4
HR	0.0	1.5	1.8	0.5	-2.5	0.1	-0.1	-1.8
IT	0.3	2.4	1.0	0.0	-8.8	-8.0	-5.3	-4.4
CY	0.1	0.6	0.5	0.0	-1.9	2.4	2.3	2.1
LV	0.1	1.5	1.0	0.0	-7.2	-4.6	-3.2	-3.1
LT	0.0	1.3	0.4	0.1	-1.1	-0.7	-1.6	-2.3
LU	0.0	0.6	0.9	0.4	0.6	-0.3	-1.9	-2.1
MT	0.6	2.3	1.6	2.0	-7.5	-5.7	-5.1	-4.6
NL	0.0	0.7	1.0	0.0	-2.2	-0.1	-0.5	-1.8
AT	0.0	1.4	1.6	0.1	-5.8	-3.5	-2.6	-2.4
PT	0.0	1.9	1.3	0.7	-2.9	-0.3	0.8	0.1
SI	0.0	1.0	0.9	0.0	-4.6	-3.0	-3.7	-3.3
SK	0.0	0.2	2.1	-0.1	-5.2	-2.0	-5.7	-6.5
FI	0.0	0.1	0.3	0.0	-2.8	-0.8	-2.4	-3.2
EA	0.1	1.2	0.9	0.2	-5.2	-3.6	-3.2	-2.8

Notes:
[1] Net cost refers to energy support measures minus revenues from new taxes and levies on windfall profits by energy producers.
[2] This column of 2021 presents the change in the budgetary cost of energy measures.
[3] European Economic Forecast, Autumn 2023.

Source: Own preparation based on European Commission (2022c, pp. 3-138; 2022d, p. 7; 2023e, p. 187; 2023g, pp. 4-132).



Notes:
[1] Data on the left axis is in EUR per MWh.
[2] Data on the right axis is in EUR per KWh.

Figure 1. Natural gas and electricity prices in the euro area from end of December 2020 to end of December 2023.

Source: Own preparation based on Eurostat (2024a; 2024b), Yahoo (2024).

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HOTEL BRAND EQUITY AS A NEW DIMENSION OF HOSPITALITY BRANDING

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Purpose: Hospitality branding is an essential issue because of the increasing importance of the brand. The aim of this study was to identify the current state of research on hotel brand equity (HBE) as a new dimension of hospitality branding.
Design/methodology/approach: A bibliometric analysis was used with five stages: design, compilation, analysis, visualization, and interpretation. A total of 168 publications were obtained through an advanced search in the Scopus database. Performance analyses were applied with publication- and citation-related indicators and science mapping.
Findings: The first publication on HBE was published in 1994, since then a total of 168 publications have been published and cited 6683 times. These publications were mainly classified in business, management, and accounting. The United States and Spain are the most frequently affiliated countries with two main authors. Keyword analysis identified 696 items and science mapping with five clusters: HBE from a customer perspective, HBE and hospitality, including marketing, service quality and sustainability, HBE and its determinants, HBE and tourism, and HBE in Chinese hotels.
Research limitations/implications: HBE was analysed in relation to different hotels, but the division between individual hotels and hotel chains was not analysed. Secondly, science mappings were presented for all items in the period under study. However, changes in these issues over time have not been analyzed.
Practical implications: Practical implications point to recommendations for managers that can be formulated based on the bibliometric analysis. They concern practical guidelines related to the right decisions in HBE from the perspective of hotel guests and managers. Monitoring the image and associations of the hotel brand will help to better manage the hotel, meet the needs of hotel guests, and ensure their satisfaction. This will influence the choices of hotel guests, their recommendations, and their positive opinions.
Originality/value: This bibliometric analysis on HBE fills a research gap due to the lack of such studies available in the literature. This study indicates the importance of researchers, countries, and main topics in the development of the HBE research field.
Keywords: hotel brand equity, hospitality branding, bibliometric analysis.
Category of the paper: literature review.

1. Introduction

The significance of the brand makes branding a crucial topic for researchers and practitioners in hospitality. A brand is not just a name but a guarantee of certain benefits and quality (Ackovska et al., 2020; Halliburton, Bach, 2012; Valjaskova, Kral, 2019). It is a combination of tangible and intangible elements to build the reputation of a company, place, or person (Sammut-Bonnici, 2015). A brand allows for identification (Alnawas, Altarifi, 2015; Appiah et al., 2019) and differentiation of the offer to customers (Ishola, 2022; Marito et al., 2019). The researchers studied various aspects of brand in hospitality, including brand experience and attachment (Gómez-Suárez, Veloso, 2020), brand image (Manhas, Tukamushaba, 2015), loyalty (Guan et al., 2021; Martínez, Nishiyama, 2019; Rather, Camilleri, 2019), consumer-brand value congruity (Rather, Camilleri, 2019), and brand satisfaction (Rather, Sharma, 2016).

Brand equity has been present in the literature since the late 1980s. The first article dedicated to this issue was published in 1989 (Farquhar, 1989). Initially, publications discussed brand equity by defining it and identifying its dimensions and determinants. In the mid-1990s, researchers analyzed brand equity for various sectors and industries. For 30 years, they have conducted systematic literature reviews and bibliometric analyses related to brand equity (De, Verma, 2021; Rojas-Lamorena et al., 2022), brand equity in social media (Almestarihi et al., 2021), and high-tech development (Dropulić et al., 2022). Brand equity was also analyzed in the context of specific issues, e.g., city brand equity (Górska-Warsewicz, 2020) and green brand equity (Górska-Warsewicz et al., 2021).

This bibliometric analysis fills a gap in research on hotel brand equity. There are many other bibliometric analyses of tourism. They refer, for example, to sustainability and specific areas of tourism, i.e., smart tourism (Bastidas-Manzano et al., 2020; Johnson, Samakovlis, 2019), mountain tourism (del Río-Rama et al., 2019; Ng, 2022; Shekhar, 2023), or heritage tourism (Bhowmik, 2021; Zhang et al., 2022). There are also bibliometric analyses on tourism and hospitality in general and in the context of selected topics, i.e., management (Ülker et al., 2023), knowledge management (Fauzi, 2023), and human resource management (Fauzi, 2023). But there is only one bibliometric analysis on brand. It refers to strategic development related to the brand (López-Rodríguez et al., 2022). Among other types of analysis, there is a systematic literature review on hotel brand loyalty. However, this publication focuses only on hotel brand loyalty as a component of HBE and ignores non-brand loyalty studies (Górska-Warsewicz, Kulykovets, 2020).

Since there is a lack of bibliometric analysis in the field of HBE, the purpose of this paper was to identify the current state of research issues of brand equity in the hotel industry based on bibliometric analysis. The following research questions were formulated:

1. How is the state of growth of the knowledge field in HBE?
2. Which authors and countries are notable for the growth of HBE knowledge?
3. What research topics are being studied in the context of HBE as the dimension of hospitality branding?

2. Literature review

One of the earliest definitions describes brand equity in terms of the added value to the product resulting from the existing brand image. This shows the intangibles in everything related to the creation of a brand image (Farquhar, 1989). Since then, many definitions of brand equity have emerged. Two concepts are most often cited and are the basis for numerous empirical studies. The first is the definition by D.A. Aaker (1991), indicating that brand equity refers to the set of brand assets and liabilities associated with the name and the symbol of the company. They change certain product elements that affect its characteristics. Brand equity has four major components: brand loyalty, brand awareness, perceived quality, and brand associations. It also includes other brand assets such as patents, trademarks, and distribution channel relationships (Aaker, 1991). The second concept refers to 'consumer-based brand equity' defining the term as a brand's impact on consumer response because of brand marketing (Keller, 1993).

The consumer perspective points to attitudes and behaviors (Fong, Goh, 2021; Gómez et al., 2018; Khanta, Srinuan, 2019; Rehman, Al-Ghazali, 2022), preferences (Dam, 2020; Gómez-Rico et al., 2023; Gómez et al., 2018; Jiao, 2018; Özkoc, Cengiz, 2020; Tresna et al., 2020), satisfaction (Saputra et al., 2020), choices (Pina, Dias, 2021), value creation (Huynh et al., 2021; Uslu, Ergün, 2021), and brand associations (Dua et al., 2021; Ha, 2020).

The literature explores many aspects related to brand equity for many goods and services (Filieri et al., 2019; Husain et al., 2022; Masood et al., 2021; Ray et al., 2021), in the context of importance for the company and consumers (González-Mansilla et al., 2019; Nassar, 2017). Building brand equity is crucial for a company's image (Karbalaei et al., 2013), market position (Wong, Wickham, 2015), and financial performance (Grashuis, 2019).

Brand equity in hospitality, defined as hotel brand equity, has been subject to empirical studies to determine the determinants affecting HBE. The literature analyzed hotels varying by category, including five-star hotels (Ibrahim, Aljarah, 2018; Kayaman, Arasli, 2007; Liu et al., 2017; Surucu et al., 2019) and three- and four-star hotels (Suhartanto et al., 2013). HBE was also studied for different hotel segments, starting with the luxury segment (H.-B. Kim, Kim, 2005; C.-H. Liu, Jiang, 2020; Šerić et al., 2014; So et al., 2013) and middle-class hotels (Back, 2005; So et al., 2013).

Brand equity in the literature has been analyzed for hotels described as well known (Nam et al., 2011), as well as for hotels operating under specific brands, for example, Hilton (Back, 2005; Callarisa et al., 2012; Nam et al., 2011; So et al., 2013), Marriott (Back, 2005; Callarisa et al., 2012; Nam et al., 2011; So et al., 2013; Wong, Wickham, 2015), Westin (C.-H. Liu, Jiang, 2020), Sheraton (C.-H. Liu, Jiang, 2020; C.-R. Liu et al., 2015; Liu et al., 2017; So et al., 2013), InterContinental (Callarisa et al., 2012; C.-H. Liu, Jiang, 2020), Holiday Inn (Kim, Kim, 2007; Rather et al., 2018; So et al., 2013), and Accor (Callarisa et al., 2012). The study proved that determinants from the two main concepts of brand equity, i.e., D.A. Aaker (brand awareness, brand loyalty, perceived quality, and brand associations) and K.L. Keller (brand image, brand performance, and brand associations), appeared among the factors influencing HBE. A study on hotel brand loyalty found that brand image, associations, and quality also affected HBE. Important brand-related elements included satisfaction, identification, experience, knowledge, and trust. Integrated marketing communications, marketing, management, and guest perception factors also influenced HBE (Górska-Warsewicz, Kulykovets, 2020).

3. Methodology

This study aimed to analyse the current state of research on HBE using bibliometric analysis. It is a popular and increasingly used method of analysis (Donthu et al., 2021; Ellegaard, 2018; Moral-Muñoz et al., 2020). Bibliometric analysis was introduced in the 1960s (Donthu et al., 2021; Gan et al., 2022; Roig-Tierno et al., 2017) as a method for identifying the state of the field of research from a historical perspective and predicting future development trends (Gan et al., 2022). The bibliometric analysis was carried out according to Zupic & Čater (2015). In this procedure, the bibliometric analysis has five stages: design, compilation, analysis, visualization, and interpretation (Zupic, Čater, 2015).

In the first stage, the study was designed and research questions were formulated. In the second stage, bibliometric data in the form of 168 publications were obtained from the Scopus database. This is one of the largest collections of abstracts and citations (Soliman et al., 2021; Toker, Emir, 2023). The reason for choosing Scopus was also the extraordinary possibility for bibliometric research due to its various metrics (Toker, Emir, 2023) and additional details of publications (Fernández Bellver et al., 2023; Nascimento, Rodrigues, 2015). The literature indicates that exposure in the Scopus database is broader (Fernández Bellver et al., 2023; Paul et al., 2021). The search was conducted on August 25, 2024, with a time constraint applied, taking the state as of 31.12.2023. The following search path was used: (TITLE-ABS-KEY ("brand equity") AND TITLE-ABS-KEY (hotel) OR TITLE-ABS-KEY (hospitality) AND (LIMIT-TO (LANGUAGE, *"English"*)).

Performance analysis and science mapping were conducted as part of the data analysis in the third stage. Publication-related indicators, including the number of publications, lead authors, and citation-related indicators, including the number of total citations and average annual number of citations, were used (Donthu et al., 2021).

The bibliometric analysis examines the subject areas in Scopus and HBE publications by source. Science mapping using bibliometric counting comprises charts with the number of items and clusters. Authors with the highest number of publications were identified. Mapping as bibliometric counting of authors of HBE publications identified the number of clusters. The country analysis shows the countries with the highest number of affiliations.

Keyword analysis provided information on the total number of keywords and the ranking of the most frequent keywords. Mapping methods identified a co-occurrence analysis. A counting method covered a minimum number of keyword occurrences of 5. VOSviewer (Nees Jan van Eck and Ludo Waltman, Leiden University, version 1.6.17) was used to prepare bibliometric counting and co-occurrence analysis. This is common software for bibliometric analysis and bibliometric mapping (van Eck, Waltman, 2010). The bibliometric analysis ends by summarizing research question answers in the discussion section.

4. Results

4.1. Number of HBE publications and citations

By the end of 2023, there were 168 publications on HBE. The average annual number of publications was 5.6, with 4 studies published in the 1994-2000 period, 19 studies in 2001-2010, 94 studies in 2011-2020, and 51 studies in 2021-2023 (Figure 1).

The first publication indexed in the Scopus database is *An approach to assess the importance of brand equity in acquisition decision* published in the Journal of Product Innovation Management in 1994 (Mahajan et al., 1994). The purpose of this article was to determine the importance of brand equity for decision-making in the acquisition process for the all-suite hotel segments. The research method covered a survey of senior executives from five major hotel chains.

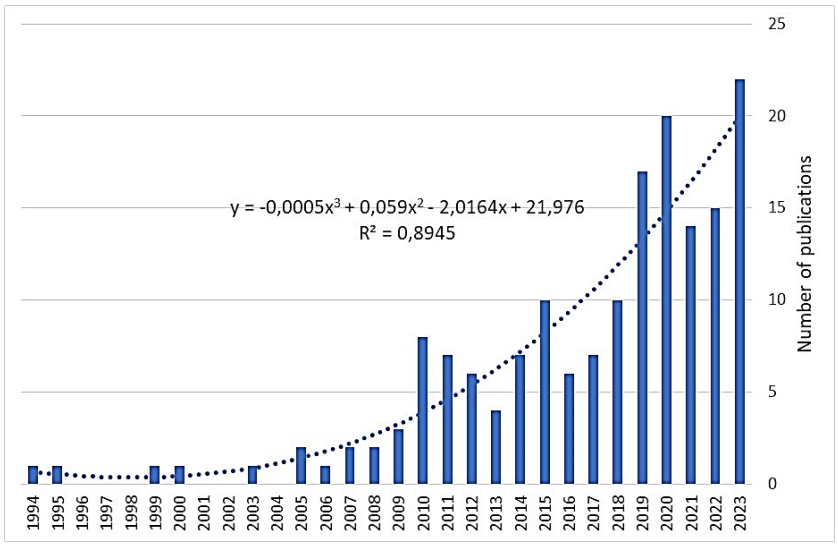

Figure 1. Number of HBE publications between 1994 and 2023.

Source: Scopus data with trend line, as of 31.12.2023.

The total number of citations of the HBE studies included in this bibliometric analysis is 6683. The average annual number of citations equals 238.68. In 1996-2000, the number of citations was 16, in 2001-2010, it was 348 citations, and in 2011-2020, it was 3655. In the subsequent 2021-2023 period, the studies received 2664 citations (Figure 2).

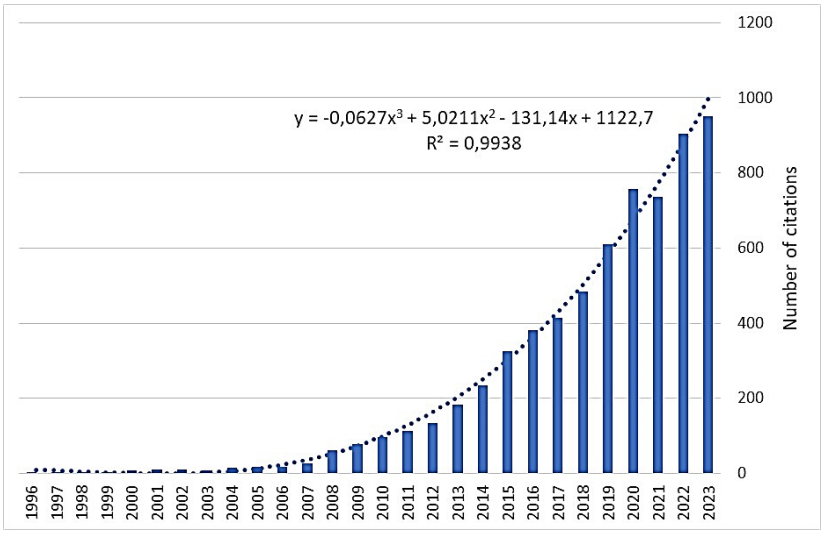

Figure 2. Number of HBE citations between 1996 and 2023.

Source: Scopus data with trend line, as of 31.12.2023.

The article with the highest number of citations was published in 1995 in the Journal of Advertising (Cobb-Walgren et al., 1995). By the end of 2023, this article had received 748 citations (Table 1). The purpose of this study was to determine the impact of brand equity on consumer preferences and purchase intentions in two categories. One category was hotels, as an example of a service category with high functional and financial risk. Household cleaning products were the second category for comparison as an example of low-risk products. In this study, consumers preferred brands with higher equity.

Table 1.
Most cited HBE publications

No.	Title	Authors	Journal	Year	Number of citations
1.	Brand equity, brand preference, and purchase intent	Cobb-Walgren, C.J., Ruble, C.A., Donthu, N.	Journal of Advertising, 24(3), pp. 25-40	1995	748
2.	Brand equity, brand loyalty and consumer satisfaction	Nam, J., Ekinci, Y., Whyatt, G.	Annals of Tourism Research, 38(3), pp. 1009-1030	2011	528
3.	The relationship between brand equity and firms' performance in luxury hotels and chain restaurants	Kim, H.-B., Kim, W.G.	Tourism Management, 26(4), pp. 549-560	2005	398
4.	Gen y customer loyalty in online shopping: An integrated model of trust, user experience and branding	Bilgihan, A.	Computers in Human Behavior, 61, pp. 103-113	2016	359
5.	The effect of consumer-based brand equity on firms' financial performance	Kim, H.-B., Kim, W.G., An, J.A.	Journal of Consumer Marketing, 20(4-5), pp. 335-351	2003	297
6.	Customer based brand equity: Evidence from the hotel industry	Kayaman, R., Arasli, H.	Managing Service Quality, 17(1), pp. 92-109	2007	253

Publications with the highest number of citations (above 200).

Source: Scopus data, as of 31.12.2023.

4.2. Subject areas of HBE publications

The largest number of publications were classified in the subject areas of *business, management, and accounting* and *social sciences* (Table 2). The next subject areas were *economics, econometrics, and finance*, *computer science*, and *environmental science*. Subject areas followed this, such as *mathematics, arts and humanities, engineering,* and *decision sciences.* Scopus classified seven or more publications under each of these subject areas. Based on the issues analyzed and the thematic scope of the research conducted, publications could fall into two or three subject areas.

Table 2.
Subject areas HBE publications

Subject areas	Frequencies
Business, management, and accounting	142
Social sciences	51
Economics, econometrics, and finance	20
Computer science	17
Environmental science	13
Mathematics	7
Arts and humanities	7
Decision sciences	7
Engineering	6
Energy	5

Source: Scopus data, as of 31.12.2023.

4.3. Authors of HBE publications

I. Gil-Saura published the largest number of HBE studies (Table 3). M. Šerić, who is the author or co-author of 11 publications, follows this. In third place with the number of publications at 5, is C. Hsu. Authors or co-authors of 4 studies follow this. Three authors or co-authors published four articles, while seven authors or co-authors have three studies each.

Table 3.
Main authors of HBE publications

Authors	Frequencies
Gil-Saura, I.	13
Šerić, M.	11
Hsu, C.H.C.	5
Wong, I.K.A.	4
Okumus, F.	4
Bilgihan, A.	4

Table does not include authors with 3 of fewer publications.

Source: Scopus data, as of 31.12.2023.

The cooperation networks as the bibliographic coupling allowed to identify 5 clusters (Figure 3). There were 23 items classified into the first cluster, five items in cluster No. 2, three items in clusters No. 3 and No. 4 each, and two items in cluster No. 5. The team of M. Šerić and I. Gil-Saura published together three studies. The first article, *ICT, IMC, and Brand Equity in High-Quality Hotels of Dalmatia: An Analysis from Guest Perceptions* was published in 2012 in the Journal of Hospitality Marketing and Management. The aim of the article was to analyse the impact of integrated marketing communication on HBE. The study was conducted in 13 hotels in Dalmatia, the largest region on the Croatian coast. The results confirmed that information and communication technology have a positive impact on integrated marketing communication (Šerić, Gil-Saura, 2012). The second article published in 2019 in the International Journal of Contemporary Hospitality Management deals with the relationship between HBE, customer satisfaction, and customer loyalty. Loyalty consisted of behavioural and attitudinal loyalty. The study conducted in Spain showed the impact of behavioural loyalty, attitudinal loyalty, and customer satisfaction on HBE (Šerić, Gil-Saura, 2019b). The third publication is a chapter in a book entitled *Perceptual and relational approaches to hotel brand equity. Measurement, criticism, and challenges* from 2018 (Šerić, Gil-Saura, 2018). It analyses different approaches to HBE, pointing out the relational nature of this concept.

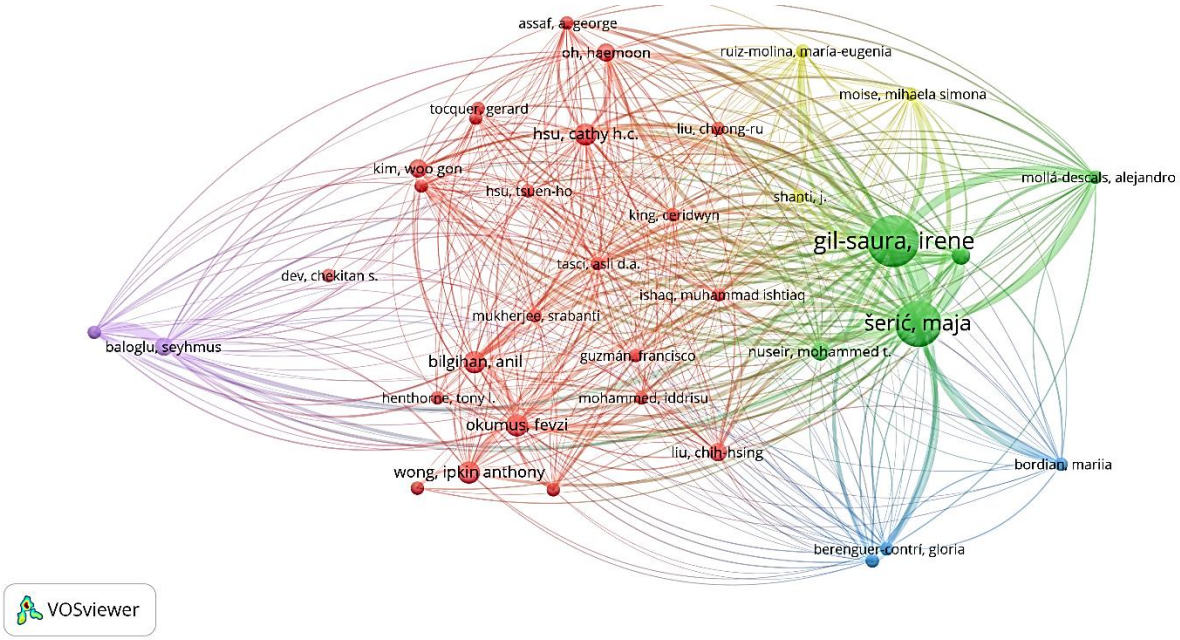

Figure 3. Cooperation networks as the bibliometric coupling of author teams of HBE publications.

Source: VOSviewer based on Scopus data, as of 31.12.2023.

4.4. Countries of HBE publications

The largest group of authors was affiliated with the United States, followed by Spain (Table 4). Other countries were affiliated less than 20 times, including China, Taiwan, Australia, and Hong Kong. European countries, apart from Spain, were represented by the UK and Turkey.

Table 4.

Affiliate countries of authors of HBE publications

Countries	Frequencies
United States	39
Spain	26
China	15
Taiwan	13
Australia	12
Hong Kong	11
United Kingdom	10
India	10
Turkey	8
South Korea	7
South Africa	5
Macao	6
United Arab Emirates	5

Table does not include countries that have been affiliated 4 times or less.

Source: Scopus data, as of 31.12.2023.

This bibliographic coupling of countries yielded 7 clusters (Figure 4). Seven countries were classified into the first cluster, six countries in cluster No. 6, five countries in cluster No. 3, four countries in clusters No. 4 and 5, two countries in cluster No. 2, and one country in cluster No. 7.

Publications affiliated in the United States and Spain had the highest number of citations. Studies from Spain analyzed how HBE affects customer behavioural attitudes (Álvarez-García et al., 2020), how value co-creation affects HBE and customer satisfaction (González-Mansilla et al., 2019), and how CSR affects HBE (Martínez, Nishiyama, 2019). US-affiliated publications referred, for example, to the impact of brand image, brand awareness, employee behaviour and physical quality (Sürücü et al., 2019), the impact of co-branding (Tasci, Guillet, 2016), the impact of cultural aspects (Oh, Hsu, 2014), and the impact of negative opinions and reviews published online (Ahmad, Guzmán, 2021) on HBE.

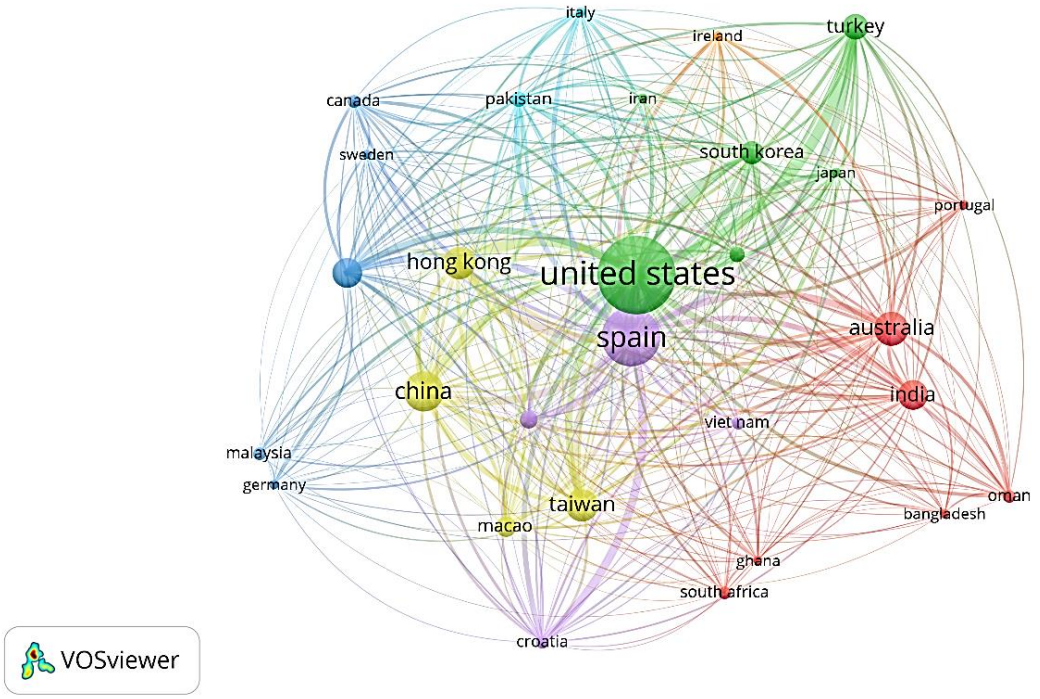

Figure 4. Bibliometric coupling of countries for authors' affiliations of HBE publications.
Source: VOSviewer based on Scopus data, as of 31.12.2023.

4.5. Keywords of HBE publications

The keyword analysis identified 696 items. The most frequently occurring word was *brand equity* (Table 5). Other keywords occurred much less frequently, including *brand loyalty* and *hotels*. The keywords *perceived quality* and *brand awareness* as determinants of brand equity appeared in 15 publications. Over 10 publications also mentioned *customer-based brand equity*, *brand image*, *marketing*, and *hotel industry*. Other keywords appeared in fewer than 10 publications.

Table 5.
The most frequently occurring keywords in HBE publications

Keywords	Frequencies	Keywords	Frequencies
Brand equity	79	Hotel	7
Brand loyalty	22	Service quality	7
Hotels	16	Sustainability	6
Perceived quality	15	Hotel brand equity	6
Brand awareness	15	CBBE	6
Customer-based brand equity	13	Customer experience	6
Brand image	13	Customer loyalty	5
Marketing	13	Consumer-based brand equity	5
Hotel industry	11	China	5
Equity	9	Branding	5
Hospitality	9	Tourism	5
Hospitality industry	8	Tourism management	5
Customer satisfaction	8	Sales, social media	5

Table does not include countries that have been affiliated 4 times or less.

Source: Scopus data, as of 31.12.2023.

Keyword co-occurrence analysis using the full counting method identified five clusters, as shown in Figure 5.

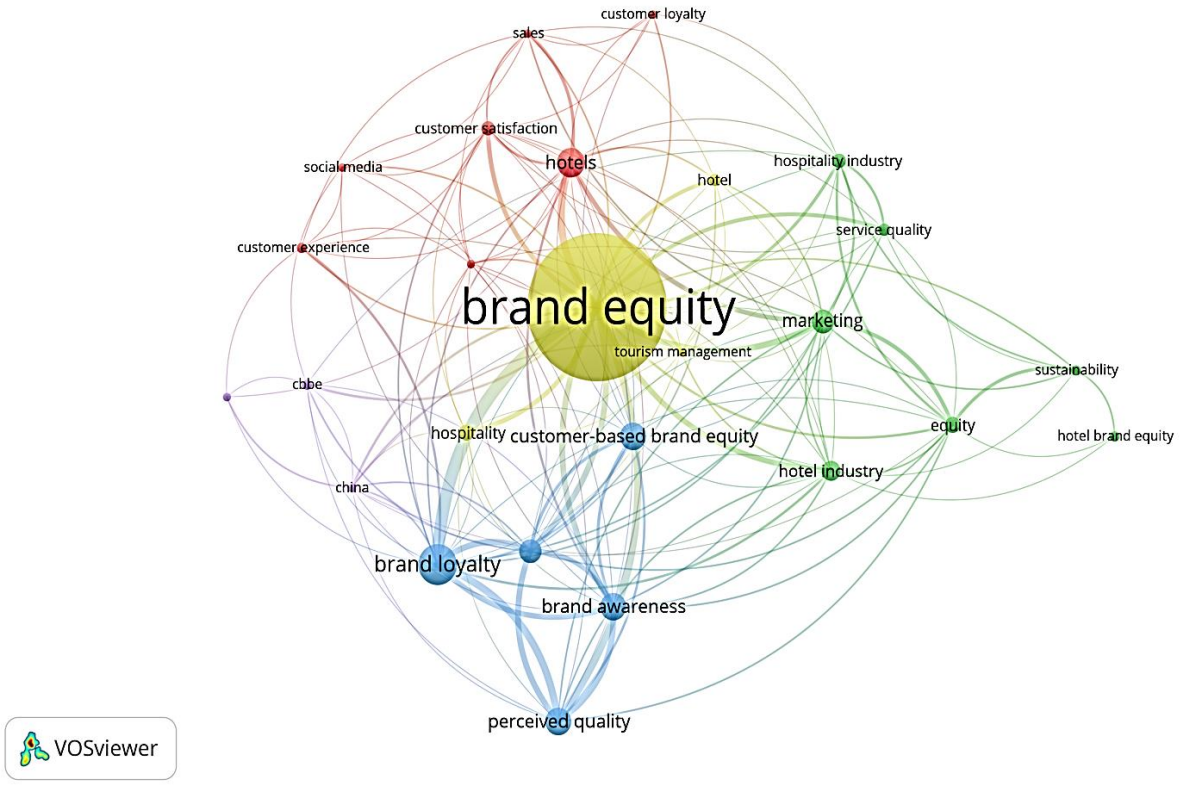

Figure 5. Bibliometric mapping of keyword co-occurrence in HBE publications.

Source: VOSviewer based on Scopus data, as of 31.12.2023.

Cluster No. 1 contains seven keywords: *customer satisfaction, customer loyalty, customer experience, hotels, sales, social media,* and *tourism.* This cluster could be entitled *hotel brand equity from a customer perspective.* Adopting a customer perspective means shaping the customer experience to achieve customer satisfaction, which leads to customer loyalty.

This requires offering a certain value and fosters value co-creation, which social media can serve. At the same time, such value creation for the hotel industry should take into account a broader aspect, including value creation in tourism.

Cluster No. 2 includes seven items: *equity, hospitality industry, hotel industry, hotel brand equity, marketing, service quality,* and *sustainability.* This cluster can be entitled *hotel brand equity and hospitality, including marketing, service quality and sustainability*. Hotel brand equity depends on service quality, implemented to a different extent depending on the type of hotel. The range of marketing activities carried out, including promotion, pricing, and distribution of services, have an impact on guest ratings. Similarly, undertaking sustainability measures are important for individual hotels as well as the hospitality industry.

Cluster No. 3 contains five keywords: *brand awareness, brand image, brand loyalty, customer-based brand equity,* and *perceived quality*. This cluster can be defined as *hotel brand equity and its determinants*. Several determinants determine hotel brand equity, including brand awareness, brand image, brand loyalty, and perceived quality. These have a different impact on hotel brand equity depending on the hotel category, hotel chain affiliation, location, and also on the size of the hotel and the range of basic and hotel services.

Cluster No. 4 contains four keywords: *brand equity, hospitality, hotel,* and *tourism management.* This cluster can be defined as *hotel brand equity and tourism.* An important factor in creating brand equity is hospitality, with its various aspects relating to the operation of the hotel, but also includes tourism management. This means pointing to specific hotel and tourism management strategies in the context of shaping brands and their equity for a coherent offer.

Cluster No. 5 with three items: *consumer-based brand equity, cbbe, and China,* and can be titled *hotel brand equity in Chinese hotels.* This approach to the topics of branding and hotel brand equity addresses the specificity of hotel management in China on the one hand, while on the other hand, it points to different branding strategies in the Asian hotel industry.

5. Discussion of results and implications

The study aimed to analyse the hotel brand equity as the new dimension of hospitality branding. Three research questions were planned, and the discussion of the results is conducted below according to these questions.

The first research question relates to the state of the development of the HBE research area, as presented in terms of the number of publications and citations. The first publication on HBE appeared in 1994, and the first citation of HBE publications dates to 1996. Researchers had published 168 studies on HBE by the end of 2023, with 6683 citations. In terms of the number of publications and citations, the period since 2016 is the most significant. Both the number of publications and citations show an upward trend, as evidenced by the trend lines.

The second research question relates to determining the importance of authors in the development of the HBE as a dimension of hospitality branding. The authors of the largest number of HBE publications are researchers from the University of Valencia in Spain: I. Gil-Saura and M. Šerić. Considering the number of publications coming from each country, the United States ranked first and Spain second. Considering both criteria in the development of HBE as a new dimension of hospitality branding, the United States and Spain lead the way. For example, one of these publications presents the results of a study on the impact of integrated marketing communication on HBE in Croatia, taking into account brand image, perceived quality, and brand loyalty (Šerić, Gil-Saura, 2012). Also analyzed were the practical aspects of branding in the hotel industry (Šerić, Gil-Saura, 2018) and the relationship between HBE, customer satisfaction, and loyalty (Šerić, Gil-Saura, 2019a).

Answering the third research question, five clusters were identified, considering mapping as the co-occurrence of keywords. This signifies key research areas while indicating what is important in hospitality branding. The first cluster shows customer satisfaction, experience, and loyalty, as a result of value creation and perception of this value (Moise et al., 2019; Šerić, Gil-Saura, 2019a; Sürücü et al., 2019). This issue is analyzed not only in the hotel industry but also in other areas of tourism (Assiouras et al., 2019; Buhalis, Foerste, 2015). The second cluster referred to hospitality, including marketing, service quality, and sustainability. For example, the marketing aspects relevant to HBE include integrated marketing communications (Kushwaha et al., 2020), service marketing (Hilal, 2019; Shanti, 2016), and influencer marketing (Ali, Alqudah, 2022). The third cluster concerns HBE and its determinants, including brand awareness, brand loyalty, brand image, and perceived quality (Phong et al., 2021; Šerić et al., 2016, 2018). The third cluster concerns HBE in marketing and branding in two dimensions. Hotel branding was analyzed in terms of destinations (Kotsi et al., 2018; Séraphin et al., 2019), service (Sevel et al., 2018; Wu et al., 2020), corporate (Sevel et al., 2018), and internal aspects (Huang, Lai, 2021). Another two clusters analysed HBE in the context of tourism management, including regional aspects relating to the operation of Asian hotels. An important issue necessary to mention in the discussion of the results is the issues of HBE and sustainability. Green practices and sustainable development influenced the HBE, which has been the subject of much research (Gede Eka Arinatha et al., 2020; Hussain et al., 2020; Shanti, Joshi, 2022).

Analysing the theoretical implications, bibliometric analysis on HBE fills a research gap due to the lack of such studies available in the literature. This study indicates the importance of researchers and countries in the development of the HBE research field. Practical implications point to recommendations for managers that can be formulated based on the bibliometric analysis. They concern practical guidelines related to the right decisions in HBE from the perspective of hotel guests and managers. Monitoring the image and associations of the hotel brand will help to better manage the hotel, meet the needs of hotel guests, and ensure their

satisfaction. This will influence the choices of hotel guests, their recommendations, and their positive opinions.

6. Conclusions, limitations, and future research

HBE is an important issue for individual hotels and the hospitality industry. The increase in publication intensity in this area shows interest in identifying factors determining and increasing HBE. Aspects related to brand image, brand awareness, and brand loyalty, as well as marketing, branding, and sustainability, indicate the need for a holistic approach to the hotel brand and hotel brand equity. The bibliometric analysis proved the importance of HBE, showing a quantitative increase in the number of publications and citations, outstanding authors, countries, and research areas. Above all, however, this study shows the research areas related to HBE, identifying HBE determinants, the relationship between HBE and customer satisfaction, loyalty, marketing, and branding, as well as environmental and sustainable development issues.

Despite these strengths, this study has its limitations. Firstly, HBE was analysed in relation to different hotel and accommodation services, but the division between individual hotels and hotel chains was not analysed. Secondly, mappings of authors, countries, journals, and keywords were presented for all items corresponding to the period under study, i.e., 1994-2023. However, changes in these issues over time have not been analyzed.

As directions for future research, it is worth pointing to other areas of the tourism market in terms of brand equity, e.g., destination brand equity. It is also worth paying attention to the brands of other services used by tourists, e.g., restaurant brand equity or airline brand equity. Another direction of research should be social media marketing in tourism branding, influencer marketing, and brand placement concerning brands of cities, countries, and tourist destinations. Brand equity should also be analysed in areas such as digital brand equity, hospital brand equity, university brand equity, or retail brand equity.

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THE ROLE OF CLUSTERS IN ENHANCING BUSINESS COMPETITIVENESS AND INNOVATION

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Purpose: The purpose of this article is to analyze the role of industrial clusters in enhancing the competitiveness and innovativeness of enterprises, with particular emphasis on collaboration mechanisms and knowledge exchange. The paper describes the cluster concept, outlining its significance from the perspective of classical economics as well as more recent theories, including Michael Porter's theory of competitive advantage.
Design/methodology/approach: The article is based on a literature review and an analysis of cluster theories in the context of their economic functions. The analysis considers aspects related to both the national economy and regional innovation systems.
Findings: Research indicates that clusters play a crucial role in creating an environment conducive to collaboration, allowing enterprises to enhance innovation and efficiency through easier access to resources, knowledge, and technology. The synergy effect resulting from the concentration of businesses and research and development institutions in a single region contributes to intensifying innovative activities and increasing the region's attractiveness to investors. In Poland, grassroots clusters predominate, demonstrating particular effectiveness in the context of local development.
Research limitations/implications: The presented research is theoretical and based on literature analysis. The lack of direct empirical studies limits a full understanding of the specific characteristics of Polish clusters, suggesting the need for further qualitative and quantitative research.
Originality/value: This article provides new insights into the importance of industrial clusters as a tool to strengthen the innovativeness and competitiveness of enterprises. It is aimed at researchers in economics and management, as well as practitioners and policymakers interested in regional and innovative development.
Keywords: business competitiveness, clusters, innovation, regional clusters.
Category of the paper: Literature review.

1. Introduction

Some researchers trace the origins of the cluster concept to the works of Adam Smith (1776). His idea of labor specialization became the foundation for the theory of absolute

advantage in international trade. This theory was further developed by D. Ricardo, who proposed the theory of comparative costs (Ricardo, 1817). Among the representatives of classical economics, A. Smith and D. Ricardo are considered pioneers of cluster theory. However, in the context of neoclassical economics, the figure of A. Marshall—creator of the model of perfect competition—stands out. Marshall's concept of the industrial district explains the benefits of forming clusters. In his 1890 book Principles of Economics, A. Marshall also highlights the importance of the concentration of specialized industries in specific locations (Marshall, 1890). Observations of British industrial districts showed that clusters of firms engaged in a continuous exchange of ideas between the creators and users of machinery. According to A. Marshall, the industrial power of Great Britain was built precisely due to the development of these industrial districts (Martin, Sunley, 2001, p. 7). Through this process, firms benefited not only from favorable location and geographical proximity but also from cooperative and competitive relationships. Marshall's discussion on the significance of location for access to production factors sparked significant interest in this area within industrial economics. Key reasons for the close geographical location of firms include easy access to specialized labor, availability of specialized suppliers, faster information and knowledge flow, and economies of scale. The cluster concept gained popularity through Michael E. Porter, who published The Competitive Advantage of Nations in 1990 (Porter, 1990). Porter focused on clusters and networks of business connections, examining their competitiveness and utility (Skawińska, Zalewski, 2009, p. 19).

Today's economic environment is characterized by increasing complexity and dynamism, posing new challenges for enterprises in maintaining competitiveness and fostering innovation. In response to these challenges, the concept of industrial clusters has gained importance, becoming a key element of development strategies at both regional and national levels (Horzela, 2019, p. 65). Clusters not only enable enterprises to leverage local resources and competencies but also create a platform for collaboration between various entities, including academic institutions, public organizations, and the private sector. Consequently, clusters have the potential to generate innovative solutions and promote sustainable economic development. This phenomenon is particularly evident in knowledge-based sectors, where interactions among cluster participants contribute to intensified research and development processes and technology transfer.

This article aims to examine the role of clusters in enhancing enterprise competitiveness and innovation, with particular attention to the mechanisms of collaboration and knowledge exchange within these structures. The paper discusses competitiveness and innovation from the perspective of cluster definitions and analyzes the role that clusters play in enterprise development.

2. Methods

The study follows a literature review-based qualitative research design, which is appropriate for exploring theoretical frameworks and synthesizing existing knowledge about industrial clusters. This approach was chosen to examine the role of clusters in enhancing business competitiveness and innovation, emphasizing the interplay between collaboration, knowledge exchange, and regional economic development. The article draws upon classical economic theories (e.g., those of Adam Smith and Alfred Marshall) and contemporary frameworks (e.g., Michael Porter's competitive advantage theory) to explore clusters impact. This theoretical grounding ensures a robust analytical framework for understanding clusters functions within local, national, and global contexts. The research relies exclusively on secondary data sources, including: academic articles and books detailing the theoretical underpinnings of cluster formation, reports and policy documents from organizations such as the European Commission on cluster policies and innovation, case studies and empirical findings related to clusters in Poland and other international contexts. Key areas of focus for the literature review included: definitions and types of clusters, the economic benefits of geographic proximity and specialized collaboration, the role of policy and institutional frameworks in supporting clusters.

The author of the paper puts forward several research hypotheses:

H1: Businesses participating in industrial clusters exhibit higher levels of innovation compared to those operating independently.

H2: Geographic proximity of cluster participants enhances knowledge sharing, leading to improved business competitiveness.

H3: Synergistic effects from cluster interactions reduce transaction costs and enhance operational efficiency.

H4: The involvement of academic and research institutions in clusters significantly contributes to the innovation capacity of member businesses.

3. Results

3.1. Competitiveness and innovation in the context of the definition of a cluster

A century after Marshall, M.E. Porter introduced the theory of competitive advantage based on location and the formation of business clusters. Porter's research focused on the international competitiveness of national economies as well as sectoral competitiveness, leading to the development of the "competitive diamond" concept and the territorially rooted industrial cluster. In this model, proximity and the spatial nature of interactions between entities play

a crucial role in achieving sustainable competitive advantage (Brodzicki, Kuczewska, 2012, p. 15). In the context of the aforementioned theories, it is important to highlight that Porter's cluster concept significantly expanded the conceptual framework and provided essential analytical tools for studying market economic structures. This approach underscores the roles of companies, authorities, and other institutions in strengthening competitiveness. The existence of clusters suggests that competitive advantage is influenced by various factors external to a specific firm and even to a given sector. For Porter, the location of enterprises is critical, as it substantially impacts the competitiveness of both the cluster itself and the surrounding region.

According to M.E. Porter, clusters are defined as "geographical concentrations of interconnected businesses, final product manufacturers, specialized suppliers, service providers, firms in related industries, and associated institutions in specific fields that both compete and cooperate" (Porter, 2001, p. 246). This cluster concept allows for the formation and dissolution of clusters depending on the competitive positioning of the sectors they support. Clusters form informally around particular technologies and within specific locations, without relying on formal structures (Margiel, 2014, p. 12). For Porter, clusters represent an industrial complex focused on particular sales and procurement linkages between companies, aiming to reduce transaction costs and enhance competitiveness (Porter, 1998, pp. 213-218). The key determinants of clusters in this framework include: cluster competitiveness, the development of competitive technologies, industry specialization within the cluster, and the synergy effect from collaboration. The most critical aspects of Porter’s cluster concept can be summarized as follows (Porter, 2001, pp. 246-256):

- The presence of clusters characterizes nearly every national economy, particularly in developed countries.
- Clusters achieve critical mass and are competitive within their specialized fields.
- The existence of clusters necessitates new managerial practices, as the overall condition of the entire cluster significantly impacts the development of each entity within it.
- Clusters impose a new role and policy direction on authorities.
- Clusters also serve as a forum for dialogue between companies, government agencies, and institutions.
- Clusters are a driving force for exports and a determinant in attracting foreign investors.
- The firms, sectors, and institutions within a cluster are interconnected vertically, horizontally, or institutionally.
- Cluster boundaries represent a new method of organizing economic data, as clusters extend beyond traditional sectors, encompassing significant linkages, complementarities, and flows of technology, information, skills, marketing, and consumer needs that transcend the boundaries of individual firms and sectors.

The multitude of cluster definitions highlights the complexity of this concept, as well as its diverse nature and approaches. According to R. Martin and P. Sunley, the pragmatic functioning of clusters is currently described through networks of simultaneous causes and effects (Martin, Sunley, 2003, pp. 5-35). Business clusters are one of the many forms of network structures among enterprises, distinguished by geographical concentration, or their embedding within a specific local environment. According to M.E. Porter's definition, achieving competitive advantage for businesses within a cluster is possible due to the local environment, which fosters opportunities and capacities for entrepreneurship, specialization, innovation development, and a distinct strategy based on trust, coordination, and repeated exchanges. These factors, in turn, depend on the social structure of clusters and network relationships within local communities. This concept assumes that the source of competitive advantage for firms derives from benefits available in the local environment, rather than being created by the cluster members themselves. According to Porter's cluster model, five essential conditions must coexist (Skawińska, Zalewski, 2009, p. 173):

- Spatial concentration of entities competing within the region.
- Concentration of enterprises within a single sector or several related sectors.
- Formal and informal collaboration among firms and local institutions, organized both vertically and horizontally.
- Specialization of entities within the cluster.
- Flow of innovation, knowledge, and technology between entities within the cluster.

The key attribute of clusters is the systemic nature of connections linking cluster entities, which allows them to achieve significant external benefits (such as increased competitive potential, investment attractiveness, and economic development) or internal benefits (internalized by individual cluster entities, like lower production costs, improved productivity and profitability, and reduced transaction costs) (Plawgo, 2014, p. 9). It is important to note that not every territorial concentration of industry or agglomeration can be classified as a cluster. Characteristic features of a cluster also include long-standing traditions (rooted in the specific regional environment), substantial social capital (signifying trust and collaboration within a triple-helix structure between businesses, the R&D sector, and local governments) (Etzkowitz, Leydesdorff, 2000, pp. 109-123), cross-sectoral integration, an established market for specialized labor, a concentration of specialized suppliers and subcontractors, and efficient diffusion of tacit knowledge (Brodzicki, Kuczewska, 2012, p. 17). Generally, the benefits and costs of clusters should be considered from the perspective of the firm (micro level), the industry (meso level), and the regional or national economy (macro level) (Brodzicki, Kuczewska, 2012, p. 17).

M.E. Porter identified several main components of a cluster, illustrated in Figure 1 (Lis, Lis, 2011, p. 196). He grouped these components into four main categories of cluster entities, assigning each a specific role. The primary task of each group is to bring innovations to the market. In addition to conducting research, these entities should develop mutual cooperation,

promote the cluster, and lobby for its interests. These tasks also aim to expand the activities and development of all cluster participants (Porter, 2001a, p. 54). According to this framework, the cluster entities include:

- Companies with the objectives of joint research, collective lobbying, social initiatives, and collaboration.
- Government agencies aimed at recruitment, promotion, lobbying, supporting R&D, and providing funding.
- Academic institutions focused on specialized training, targeted educational programs, commercialization, and R&D.
- Informal networks dedicated to lobbying, financing, and commercialization.

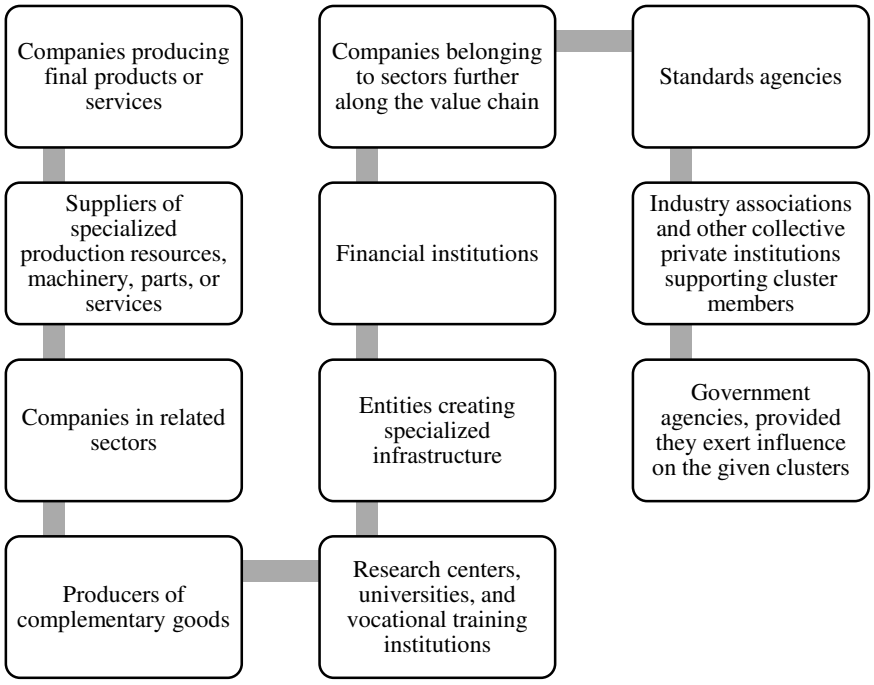

Figure 1. The main components of a cluster according to M.E. Porter.

Source: Own study based on: Porter, 2001, p. 248.

The classification by S. Iammarino and P. McCann suggests that clusters can also be understood as a social network (or "club" model) oriented around social ties and trust, which facilitate cooperation and innovation (Iammarino, McCann, 2006, pp. 1018-1036). This approach to the cluster concept emphasizes the activities of various organizations, with particular attention to civil society (Castells, Hall, 1994, p. 231; Chow, Chan, 2008, pp. 458-465). Key indicators of a cluster in this sense include interdependence, social capital, trust, and relationships. According to I.R. Gordon and P. McCann, a cluster can also be considered a knowledge hub (knowledge cluster) (Gordon, McCann, 2005, pp. 523-543), which is based on the collaboration between academic and research institutions and businesses (Maskell, 2001, pp. 921-943). The objective of such a cluster is to create new knowledge and breakthrough innovations. Key indicators in this approach to defining a cluster are the cluster's values, knowledge management, and resource configuration within the cluster.

Clusters are often also defined by network linkages or specifically as an innovation network (Bucka, 2007, p. 194). In this case, it is assumed that the connection of entities located within the same region through a network of formal and informal interactions facilitates joint R&D activities, sharing of information and knowledge (Olko, 2017, p. 58), as well as the intensive diffusion of innovation and exchange of advanced technological solutions (Kowalski, 2010, p. 318). M. Gancarczyk observes that, despite many positive aspects of networks, there are also negative effects for enterprise innovation, such as the internalization of benefits by individual enterprises, potentially leading to monopolization, the widespread adoption of suboptimal technologies due to network influence on consumer choices, or the formation of networks that generate shared innovations, thereby eliminating competition in the development of new solutions (inviting competitors into collaborative innovation to prevent independent innovative activity) (Gancarczyk, 2005, p. 81).

The role of science is also crucial in the definition of a cluster. L. Mytelka and F. Farinelli emphasize the importance of science, as well as investments and connections between cluster participants, which enhance cluster innovativeness (Mytelka, Farinelli, 2000; Drelich-Skulska et al., 2014, p. 24). Ö. Sölvell adds that clusters are created not only by companies involved in the flow of goods and services but are also oriented toward knowledge creation, innovation, and broader profitability (Sölvell, 2009, p. 15). According to these assumptions, a cluster can include not only enterprises (large firms and SMEs) but also financial institutions (banks, venture capital), media (responsible for providing information about cluster activities and building the cluster's brand), higher education institutions (including technology parks, industrial laboratories, etc.), and public institutions (regional authorities and regional agencies) (Sölvell, 2009, p. 15).

B. Asheim and L. Coenen in their research highlight the connections between theoretical cluster concepts, the innovation system, and the specificity of knowledge as an economic good (Asheim, Coenen, 2005, pp. 1173-1190). In sectors where activity is based on synthetic knowledge, clusters are surrounded by supporting innovation institutions that contribute to the regional innovation system. In contrast, for sectors relying on analytical knowledge, regional innovation systems constitute an integral part of the cluster.

The broad variety of cluster definitions may reflect the rapid pace of change characterizing this phenomenon. It is worth noting that each successive definition aims to explain new cluster models and principles of operation within a given economy. Considering the Polish context, an example is the definition provided in the Regulation of the Minister of Economy, where a cluster is defined as: "a spatial and sectoral concentration of entities working toward economic development or innovation, including at least ten businesses conducting economic activity within one or more neighboring provinces, competing and collaborating in both formal and informal ways, with at least half of the entities in the cluster being businesses" (Regulation of the Minister of Economy, 2006). As seen here, Polish legislation specifies the operational area and the number of entities comprising the cluster. The presence of a cluster in a particular region

is conditioned by a high concentration of businesses and their skilled, experienced workforce. Companies invest their capital locally and leverage their resources—human, financial, technological—as well as infrastructure and industry-related environmental regulations, focusing on supply and export-oriented industries (Drelich-Skulska et al., 2014, pp. 25-26).

A. Bąkowski's glossary of terms describes a cluster as "a spatial concentration of enterprises, institutions, and organizations interconnected by a broad network of formal or informal relationships, based on a shared developmental trajectory (e.g., technological, shared target markets, marketing strategy, etc.), simultaneously competing and cooperating in certain aspects of operations" (Bąkowski, 2005, pp. 81-82). According to this definition, a cluster is not merely a simple sum of individual entities; rather, it is a spatial form of production organization that arises from interaction and synergy, enhancing flexibility and competitiveness.

In summary, the concept of the industrial cluster, initiated by M.E. Porter, emphasizes the importance of local concentrations of interconnected economic units in terms of competitiveness and innovation. A key element in cluster operations is the synergistic impact of participants, which supports technological development, efficiency growth, and reduction of transaction costs. Collaboration among businesses, academic institutions, and local authorities forms the foundation for innovation, allowing firms to gain competitive advantage. Social capital and trust also play an essential role, facilitating cooperation and knowledge sharing, which are crucial in a dynamically changing economic environment (Horzela, Olko, 2021, p. 460). In the Polish legal context, cluster definitions reflect the need to formalize cooperation in regions where the concentration of businesses and resources contributes to increased innovation and economic growth. Consequently, clusters serve not only as an organizational form but also as a dynamic system in which competition and cooperation coexist, generating added value for participants and the regions in which they operate.

3.2. Role of clusters in enhancing business competitiveness and innovation

The impact of a cluster on the innovativeness of enterprises depends on numerous determinants. One of these is the method of cluster formation—whether it is a bottom-up initiative driven by businesses that are prospective cluster members or a top-down approach. In Poland, bottom-up initiatives prevail and are found to be the most effective. An initiating group, predominantly led by businesses, identifies areas, goals, and tasks whose achievement, through the participation and collaboration of various entities, can yield tangible economic benefits—outcomes that would be difficult for a single enterprise to accomplish independently. An additional reinforcing element for these initiatives is the synergy effect, which can manifest in various areas of cooperation and economic activity within the cluster (Stanienda, 2014, p. 198).

Cluster policies and programs have been evolving within the European Union member states for nearly two decades. Today, both program agencies and policymakers agree that cluster development extends beyond simply establishing cluster organizations; it also encompasses the development of world-class cluster organizations that are internationally competitive and impactful on national economies. In 2008, the European Commission proposed the concept of the "World Class Cluster" to maintain and further develop Europe's global competitiveness through improved cluster policies, enhanced transnational cooperation, excellence in cluster management, and better integration of innovative SMEs within clusters (European Commission, 2008, p. 2). Highly developed clusters can transform into world-class clusters, becoming centers of innovation and business known worldwide (Europa InterCluster, 2010, p. 39). Such world-class clusters are characterized by a dynamic innovation system based on high-quality R&D and educational systems, as well as a critical mass of dynamic cluster participants, including market and technology leaders (Ahlqvist, 2014, pp. 1724-1726). They also focus on integration with global business, supporting breakthrough technologies, and providing an optimal environment for fostering emerging industries (Büscher, Schierenbeck, 2012, p. 40). Cluster excellence contributes to regional prosperity, enhanced business competitiveness, and a higher return on investment for investors (Meier zu Köcker et al., 2010, p. 1).

According to M.E. Porter's principles, a defining factor distinguishing a cluster from other types of networks is geographic proximity. Such spatial closeness promotes competitiveness while also facilitating cooperation (Klemens, 2016, p. 42). Business linkages within a cluster may be vertical, involving collaboration between suppliers and buyers within the value chain, or horizontal, involving shared clients, distribution channels, and technology. The vertical dimension primarily concerns cooperation, while the horizontal dimension reflects competition (Baran, 2008, p. 38). Businesses benefit from cooperation through activities such as fulfilling joint orders, sharing technological or commercial information, conducting joint training, or implementing technological improvements. M. Szewczuk-Stępień identifies cooperation benefits as increased access to knowledge and new opportunities to leverage effective, proven solutions, which in turn fosters idea generation and strengthens competitiveness on the international stage (Szewczuk-Stępień, 2014, p. 176).

Companies in competitive industries (operating in international markets) are typically geographically concentrated and surrounded by specialized suppliers, clients, and R&D institutions. This concentration stimulates efficiency, accelerates innovation processes, and encourages specialization. Furthermore, proximity to the R&D sector facilitates access to advanced technologies and allows companies to quickly acquire new partners for addressing technological challenges. Geographic concentration and the recognized reputation of the region attract skilled workers and international companies specializing in modern technologies. Additionally, interactions among entities and the progressing specialization of the region create highly favorable conditions for industrial development.

M.E. Porter identifies two main categories of benefits for enterprises operating within a cluster: improved efficiency and increased innovation. This article will focus on the latter aspect. The rise in innovation primarily stems from the following factors (Porter, 2001, pp. 267-268):

- Companies within a cluster are able to detect new customer needs more quickly and effectively.
- Close collaboration among businesses provides greater flexibility for innovation.
- The cluster environment enables companies to gain an advantage in recognizing new operational, technical, and supply opportunities.
- The proximity of companies in the same industry creates competitive pressure, which in turn motivates innovative processes and encourages firms to differentiate themselves creatively.
- Companies can experiment and delay financial commitments, allowing for a more flexible approach to innovation.

Cluster structures emerge across all economic sectors in numerous countries worldwide. Empirical research demonstrates that they can be regarded as drivers of entrepreneurship, supporters of innovation, enablers of export activity, and attractors of foreign capital. B. Drelich-Skulska et al. (2014, pp. 9-10) present several arguments for viewing clusters as stimulators of innovation, both within their structures and in the local business environment in which they operate (Drelich-Skulska et al., 2014, pp. 46-47). The key arguments include:

1. A cluster fosters both collaboration and competition. The presence of many competitors within a cluster encourages companies to distinguish themselves creatively, which sustains innovation processes.
2. Entities within a cluster establish relationships in an environment characterized by a pro-innovation atmosphere, resulting from the accumulation of skills, knowledge, and new ideas derived from shared experiences.
3. Companies within a cluster have the opportunity for direct and continuous market observation, enabling a faster response to buyer needs compared to large, isolated enterprises.
4. Clusters include specialized and experienced workers who have the ability to influence curricula at local universities and higher education institutions, which helps address skill gaps.
5. Cluster firms are adept at meeting new demands. Local partners are highly engaged in innovation processes, striving for the rapid commercialization of their inventions. The proximity of partners facilitates mutual knowledge and experience exchange in the implementation of innovations.

The presence of strong scientific institutions within a cluster is essential, as they directly influence the cluster's innovativeness, manifesting in new products, services, processes, or business models. While the cluster is responsible for all innovations, science drives them

across all levels. Entities collaborating within a cluster can undertake joint investments and share the same distribution network (Drelich-Skulska et al., 2014, pp. 46-47). Joint procurement can lead to reduced production or administrative costs. Through joint marketing efforts, entities build the brand of the entire cluster and each individual unit with a lower financial outlay. Participation in a cluster enables companies to benefit from synergies and focus on the activities in which they are most effective. Cooperation and competition can act as motivating factors (Horzela, 2019a, p. 99). Intense competition stimulates or even compels firms and entrepreneurs to explore new market opportunities (Bengtsson et al., 2005, p. 49). Companies operating within a cluster are able to generate more value than they would independently, and their products often become more competitive, both technologically and in terms of price. The positive aspects of cluster participation can be divided into soft and hard benefits. Soft benefits include the continuous learning process, business improvement (e.g., benchmarking), which contributes to increased innovation. Hard benefits primarily encompass efficient business transactions, more strategic investment, reduced costs while maintaining or increasing employment, and higher profits (Rosenfeld, 2002, pp. 15-25).

There are also strong assertions in academic literature that operating within a cluster is essential for innovativeness. Ch. Le Bas argues that cluster formation is a systematic element of innovation, as companies are unable to innovate independently. He believes that innovations can only occur with complementary innovations that reinforce each other (Żminda, 2011, pp. 145-146). However, most scholars do not share this view, as noted by M. Portugal Ferreira and F.A. Ribeiro Serra, who cite Philips and Xerox as examples of highly innovative companies in their sectors despite not being located in clusters (Ferreira, Ribeiro Serra, 2008, p. 6). J.M. Shaver and F. Flyer contend that highly innovative companies that succeed in the market and maintain close relationships with customers and suppliers may derive minimal benefits from operating in a cluster (Shaver, Flyer, 2000, pp. 1175-1193). This is because operating within a cluster may expose companies to the risk of having their innovative ideas, technological solutions, methods of collaboration with partners, or even employees copied or poached. The authors argue that clusters serve more as an integrative framework for companies with lower levels of innovation, which have a greater tendency toward agglomeration. A. Świadek, referencing research by C. Beaudry and S. Breschi (2003, p. 339), noted ambiguities in this area, indicating that the propensity for innovation is high when a company is located among other innovative firms within the same industry, but declines when low-innovation companies dominate the cluster (Świadek, 2005, p. 57).

Although innovativeness is a characteristic of clusters, it is not always a direct result of their activities. The European Commission outlines three main cluster concepts to define the relationship between clusters and innovativeness: the regional cluster (at the base of the hierarchy), the regional innovation network, and the regional innovation system (European Commission, 2002, p. 14). In this context, the mere establishment of a cluster does not equate to creating a regional innovation system, which is the most advanced form. According to the

European Commission, cluster policy focused solely on identifying clusters and supporting their operation will not increase the innovativeness and competitiveness of enterprises. The main task of cluster policy is to transform identified clusters into regional innovation systems, which involves supporting a specific development goal for the cluster (Żminda, 2011, pp. 146-147).

Intense competition drives companies to continually seek new innovation strategies that can provide a competitive market advantage over rivals. Consequently, novel concepts for enterprise innovation strategies have recently gained popularity, applicable both to large multinational corporations with developed R&D departments and to small and medium-sized enterprises (SMEs), which base their innovative potential on the creativity of their owners and employees (Łobejko, 2017, p. 77). These new concepts include strategies such as the Blue Ocean Strategy, innovation niches, open innovation, and innovation networks. A particular type of new innovation strategy is the innovation network. Collaboration within networks has become an integral component of the contemporary global economy. Increasingly, networks form the foundation for conducting economic tasks and achieving strategic goals, such as R&D activities, which SMEs can accomplish through innovation networks. Network innovations relate to transformations in both people and organizations (Albinsson et al., 2007, p. 1). Through network collaboration, companies can achieve success by joining forces with other entities. This collaboration can evolve into multilateral strategic alliances, in which a dominant company (the "hub partner") creates a network based on agreements with several independent partners to achieve common goals (Doz, Hamel, 2006, p. 25).

J. Tidd also uses the innovation criterion in his research, identifying several types of global innovation networks based on the radicalness of innovation and the similarity of companies within the network (Tidd, 2006, p. 10). In his classification, Tidd distinguishes types of innovation networks such as strategic alliances, sectoral forums, innovation networks, and regional clusters (Knop, Odlanicka-Poczobutt, 2016, p. 480). Moreover, the network concept is applied in policy-making by organizations or as a basis for introducing innovations and new management approaches (Brzóska, 2014, p. 10). A literature review reveals an increasing number of publications referencing network approaches, including various forms of organizational networks (Stańczyk-Hugiet, 2013; Barczak, 2016). P. Trott highlights different types of inter-organizational networks where innovation develops, such as R&D consortia, innovation networks, sectoral clusters, and other alliances that facilitate knowledge transfer (Trott, 2017, pp. 264-302).

Synthesizing P. Trott's findings, it can be concluded that the existence of inter-organizational networks brings significant benefits to the entities involved. Key factors contributing to cluster success include network partnerships, innovative technologies, human capital, corporate entrepreneurship, infrastructure, the presence of large firms, specialized services, and access to funding sources (Staszewska, Foltys, 2021, pp. 15-16). Technology acts as an accelerator for organizational network formation, taking the form of the Fourth Industrial

Revolution (Industry 4.0) in the global economy (Barczak, 2020, p. 25). Today, technology and innovation form the foundation of competitiveness for businesses, regions, and nations. Inter-organizational networks have become highly popular in management practices, especially in fast-paced industries such as IT, aerospace, and biotechnology, as well as in sectors with complex technologies and large-scale operations, such as the automotive and construction industries (Lichtarski, 2016, p. 51). Industry 4.0 is seen as an innovative approach to production management, enabling companies to achieve efficiency and enhance competitiveness (Pawłyszyn et al., 2020, pp. 1-2).

The concept of Industry 4.0 encompasses new organizational methods, management practices, work styles, and competencies, which are manifested through the use of intelligent machines, simulations, autonomous robots, augmented reality, and other technologies essential for product design and production processes (Szum, Magruk, 2019, pp. 73-74). In the context of Industry 4.0, collaboration and networks among businesses involved in economic processes are particularly crucial (Ślusarczyk, 2019, p. 7). It is posited that individual company actions yield isolated solutions, preventing the full potential of these transformations from being realized (Schneider, 2018, pp. 1-46). Digitalization, networked operations, and the shift toward an innovation-based economy pose challenges that are difficult for a single enterprise to overcome (Brakman, Van Marrewijk, 2013, pp. 217-231). In this sense, industrial clusters are evolving from their traditional role as collaboration platforms into innovation hubs for Industry 4.0 (Tsakalerou, Akhmadi, 2021, p. 319). Negative aspects of participating in inter-organizational networks, though less frequently identified, include limited contact with external environments, opportunistic behavior, competition for resources and influence, or a decline in internal innovativeness (Lichtarski, 2017, pp. 65-66).

Research by I. Pawłyszyn's team has shown that companies within Marshallian clusters, by collaborating, contribute to the diffusion of knowledge and the spread of new Industry 4.0 solutions (Pawłyszyn et al., 2020, p. 22). Clusters, with their advantages such as a knowledge base, agglomeration benefits, and labor resources, foster an environment of trust and collaboration, which facilitates digital transformation, particularly during the introduction and testing phases (Götz, Jankowska, 2017, p. 1633). It is beneficial for an innovator within the cluster to be a medium or large enterprise, as this significantly accelerates these processes. At the cluster level, it is essential to cultivate a culture of collaboration and encourage organizations to share knowledge about innovation and technological development to create a competitive and future-ready region. Furthermore, cluster coordinators should work to establish learning and knowledge-sharing conditions on Industry 4.0 among the management of cluster member entities, while also seeking new communication channels (Pawłyszyn et al., 2020, p. 23). B. Bembenek emphasizes that most resources essential for implementing radical and comprehensive economic changes are under the control of ICT clusters and their partners (Bembenek, 2017, pp. 41-42).

Supporting regional clusters is a key action within the state's innovation policy (Kowalski, Mackiewicz, 2019, p. 272). Mutual cooperation primarily enables the flow of knowledge, information, and technology, while the presence of companies from the same industry stimulates innovation (Osarenkhoe, 2010, pp. 344-347). Clusters contribute to economic growth, stimulate local entrepreneurship, and positively influence the regional labor market (Żabińska, 2013, p. 177). Scientific units within clusters gain the opportunity to conduct research, secure project funding, and find markets for the technologies they develop. Clusters create better avenues for linking the worlds of science and business, enabling the identification of mutual needs and capacities, which fosters more effective collaboration (Machnik-Słomka, 2011, p. 96). The scale of benefits for companies, research units, and regions is substantial, which explains the prevalent tendency to develop cluster-based policies (Drelich-Skulska et al., 2014, p. 50). The presence of innovative clusters in a region enhances its attractiveness and competitiveness. In the global economy, the most successful regions are those based on knowledge and focused on fostering innovation (Mackiewicz, Namyślak, 2021, p. 1295). Research conducted on nearly four thousand Portuguese enterprises found that companies within industrial clusters and engaged in innovative activities tend to enter the market faster. This trend further encourages companies with lower technological advancement, who face market entry or internationalization challenges, to participate in industrial clusters (Mendes et al., 2021, pp. 623-624). Economic growth is largely driven by innovation, making clusters an integral part of this process as carriers of innovation and knowledge transfer.

4. Conclusion and discussion

This article underscores the pivotal role of industrial clusters in enhancing business competitiveness and innovation. Through the hypotheses presented, the study demonstrates that clusters serve as dynamic ecosystems fostering innovation, efficiency, and collaboration. Key conclusions can be drawn based on the explored hypotheses. Businesses participating in clusters exhibit significantly higher levels of innovation compared to independent entities. The clustering environment, characterized by resource sharing, knowledge diffusion, and intense collaboration, creates a fertile ground for innovation. This finding aligns with empirical evidence suggesting that proximity and shared goals among businesses accelerate the adoption of cutting-edge technologies and innovative practices. Geographic proximity within clusters enhances knowledge exchange among participants, contributing to improved competitiveness. The physical closeness of firms and institutions within clusters facilitates both formal and informal interactions, enabling the rapid diffusion of ideas and best practices. This interconnectedness not only enhances operational efficiencies but also strengthens regional innovation systems. The synergistic interactions inherent to clusters reduce transaction costs and enhance operational efficiency. The collaborative environment enables businesses to

leverage collective resources, pool investments, and access specialized suppliers. Such synergies are instrumental in achieving economies of scale and scope, further reinforcing the economic viability of cluster participation. The involvement of academic and research institutions is a critical driver of innovation within clusters. These institutions provide the intellectual capital and technological expertise required to sustain innovation cycles. Their active participation fosters the development of advanced solutions, supports commercialization efforts, and bridges gaps between scientific research and market needs.

The presence of clusters in the Polish regional economy reflects not only the level of its development but also, more importantly, indicates the potential of Polish regions and their future development prospects. Clusters have become a permanent and essential component of both developed and developing economies (Miszczak, 2010, pp. 9-10). They are often regarded as a simultaneous manifestation of globalization and regionalization. At the regional level, clusters contribute to the economic development of local communities (stimulating the regional economy by providing essential goods and services), the development of regional businesses (clusters and highly specialized firms in networks drive metropolitan area activity), and local development (by improving infrastructure and increasing regional wealth levels). Clusters are economic structures that enhance both the competitiveness and innovativeness of regions.

This article analyzes the role of industrial clusters in building the competitiveness and innovation of enterprises, particularly in the context of collaboration and knowledge exchange. Research highlights that clusters are a critical component of regional economies, providing businesses with access to specialized knowledge and resources and facilitating the rapid flow of information. The geographical proximity of firms and R&D institutions supports innovation development and efficiency gains, positively impacting the competitiveness of both clusters and their regions. Findings suggest that clusters have the potential to generate added value through collaboration among various economic entities, the scientific sector, and public institutions. Their development fosters regional entrepreneurship, attracts investors, and facilitates adaptation to global innovation standards.

The analysis confirms the importance of clusters as structures that strengthen both competition and cooperation. It is established that clusters play a dual role—they provide direct benefits to companies by offering access to new markets, technologies, and collaborators, and serve as a tool for supporting economic development at the macro level by increasing employment, social capital, and the overall innovativeness of a region. However, the literature also points to potential risks associated with operating within a cluster. These include the risk of competitors replicating innovative solutions or limiting interactions with firms outside the cluster, which could weaken innovativeness. Future research should focus on optimizing collaboration strategies and intellectual property protection within clusters to maximize innovative efficiency, particularly in rapidly evolving sectors like IT and Industry 4.0. Additionally, in the Polish context, exploring cluster policy in conjunction with infrastructure development and human capital resources may provide further tools to enhance local competitiveness and support sustainable development.

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AVAILABILITY CONDITIONS AS A CRITICAL FACTOR IN PRODUCT CATEGORY MANAGEMENT IN SHAPING THE OFFER OF NON-ALCOHOLIC EQUIVALENTS OF ALCOHOLIC BEVERAGES

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Purpose: To determine the availability of non-alcoholic wines and spirit substitutes in various distribution channels and understand the factors shaping store assortments to identify potential product strategies in category management.
Design/methodology/approach: A literature review using desk research and a two-part study on the availability of non-alcoholic substitutes, utilizing observation and interview methods.
Findings: The highest availability of non-alcoholic equivalents of alcoholic beverages is in large-format stores, while the lowest is in small-format stores. Based on the analysis of the conditions for shaping the assortment of these products, it can be concluded that when shaping the offer, representatives of selected stores apply specific strategies towards this group of products, including competitiveness of the offer or size of the assortment.
Research limitations/implications: A limitation of the research is the relatively short implementation time and the subjective nature of the responses of store employees, which may result in an incomplete picture of reality. For a more complete verification of the results, it is advisable to conduct the survey on a larger sample.
Practical implications: The results can guide organizations that want to increase flexibility by introducing a more comprehensive range of non-alcoholic beverages.
Social implications: The analysis can also be used to identify priorities for manufacturers and retailers in the context of managing this product category, and can be used by companies in the implementation of ESG (Environment, Social, Governance) areas related to responsible consumption and promoting safety.
Originality/value: Defining product category management strategies in this emerging market can enhance a company's competitiveness in non-alcoholic beverage equivalents.
Keywords: non-alcoholic equivalents of alcoholic beverages, product availability, product range development, product category management.
Category of the paper: Research paper.

1. Introduction

Effective product category management is one way for a company to improve its product sourcing strategy, and thus, consolidating sourcing activities within a specific product category rather than a brand for increasing profits. Skillful product category management also considers customer satisfaction, which plays an essential role in the era of ongoing changes in the behavior and attitudes of modern consumers. In the context of these challenges, accessibility issues understood as the possibility for consumers to purchase a specific product in a specific location, play a key role in creating and delivering the values expected by potential buyers. In accordance with generally accepted assumptions of product category management, low availability of given products may encourage consumers to look for other alternative products, or in the worst-case scenario for the company, completely discourage them from choosing a given product and taking advantage of the competition's offer. The intriguing part is that the issues of product availability for many companies are an indispensable element of the marketing mix, also called 5P marketing, which helps to determine and develop the best marketing tactics to identify and meet market needs (Yandug et al., 2023). As part of product category management, a company can implement various strategies for its products, including the offer's competitiveness or the assortment's size. In this context, consideration of the above issues is critical in the case of new, developing markets, where limited availability may constitute a potential purchase barrier for consumers.

An example of a market with huge development potential in Poland and worldwide is the market for non-alcoholic equivalents of alcoholic beverages[1,2]. Its development is mainly related to changes in alcohol consumption trends. Therefore, more and more partially or entirely alcohol-free products have appeared on store shelves (ZPPP - Browary Polskie, 2022; Kokole et al., 2022; Anderson, Kokole, 2023). Currently, non-alcoholic beers, wines[3], and drinks that are an alternative to spirits are available on the market.

The dynamic development of this market segment poses new challenges for the industry, especially for sellers of non-alcoholic equivalents of alcoholic beverages, in terms of product category management. An unexplored area - but essential from this process's point of view- are the conditions shaping the range of these products on the Polish market. Therefore, the article aims to determine the availability of non-alcoholic wines and substitutes for high proof alcoholic beverages in selected distribution channels and to learn about the conditions

[1] In the current legal situation in Poland, according to the Act on Upbringing in Sobriety and Counteracting Alcoholism, a non-alcoholic equivalent of an alcoholic drink is considered to be a drink containing up to 0.5% vol. alcohol. Due to this definition, non-alcoholic drinks include both products completely free of alcohol, i.e., 0.0%, and containing it in a small amount (up to 0.5% alcohol by volume) (Kamińska, Dmowski, 2023).

[2] In this article, the term "non-alcoholic equivalents of alcoholic beverages" is used by the authors interchangeably with the term "substitutes for alcoholic beverages".

[3] In this article, the terms "de-alcoholized wines" and "alcohol-free wines" are also used to refer to non-alcoholic wines.

influencing the formation of the assortment in stores in the context of challenges related to category management of this market segment.

2. The sector of non-alcoholic equivalents of alcoholic beverages in Poland compared to the EU and global markets

In Poland, alcohol categories have been the most significant part of the FMCG grocery basket for years. In 2020, they accounted for almost one-third of its value. During this period, Poles spent PLN 39.2 billion on alcohol, 7% higher than in 2019 (Wiadomości Handlowe, 2021). In turn, in 2021, Polish consumers' spending on alcohol amounted to PLN 40.2 billion (2.5% more compared to the previous year) (Fal, 2023), and two years later, in 2023, almost PLN 50 billion (Książek, 2024). According to data from 2016, Poles spend, on average, over 3.5% of their household budget on alcoholic beverages (Szafranowicz, 2019), which is a value close to the EU and global average (Table 1).

Table 1.
Shares of expenditure on alcoholic beverages in households in various regions of the world in 2010-2014

Region	Region Share of spending on alcohol in households [%]
World	3.46
Eastern Europe	5.87
Western Europe	3.88
Asia	4.29
Australasia	3.49
North America	1.94
Latin America	4.22
Africa/Middle East	2.49

Source: source: own study based on: Anderson et al. (2018).

It is worth emphasizing that there have been changes in the structure of global alcohol consumption in recent decades. Since the 1960s, there has been a decline in the share of wine in global alcohol consumption from 34% to 13%, with a simultaneous significant increase in the share of beer (from 28% to 36%) and spirits (from 38% to 51%) (Anderson et al., 2018). In Poland, alcohol consumption does not differ significantly from the global structure (Figure 1) (Klimkiewicz et al., 2021).

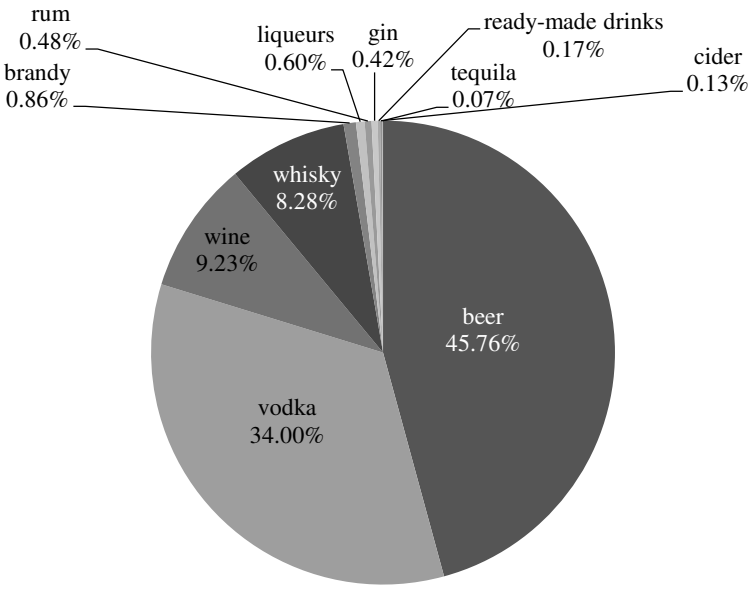

Figure 1. Share of individual product categories in the value of sales of alcoholic beverages in Poland in 2020.

Source: own study based on Klimkiewicz et al. (2021).

The largest share of sales in the market was recorded in the following categories: beer (value PLN 17.96 billion) and vodka (value PLN 13.35 billion), whose total market share was approximately 80%. The remaining 20% was allocated to other alcoholic beverages, which included wine and whiskey with a share of PLN 3.62 billion and PLN 3.25 billion in value terms, as well as brandy (value: PLN 338 million), liqueurs (value: PLN 236 million), rum (value: PLN 190 million), gin (value: PLN 165 million), ready-made drinks (value: PLN 64.9 million), cider (value: PLN 49.4 million), and tequila (value: PLN 27, PLN 3 million) (Bartoszewicz, Obłąkowska, 2021).

What is worth emphasizing are the changes in the structure of alcohol consumption in Poland. In recent years, there has been a clear trend of premiumization. This trend involves the increasing consumption of more expensive alcohols, often identified with higher quality (premium) products and guaranteeing a sense of belonging to a specific social group (Fal, 2023). The second significant trend is the increase in the consumption of substitutes for alcoholic beverages. The sale mainly includes non-alcoholic beers, sparkling wines, and non alcoholic drinks referring to spirits such as whiskey, gin, rum, or vodka. Of these products, the most popular and most readily available on the Polish market are beers.

In Poland, before 2016, the non-alcoholic beer segment practically did not exist; selected breweries offered customers single products from the non-alcoholic beer group, which were not wholly dealcoholized, usually containing up to 0.5% vol. alcohol (ZPPP – Browary Polskie, 2022). However, in 2017, there was a significant increase of as much as 22% in the value of the beer segment (Fal, 2020). Another significant, as much as 80% increase in the value and 85% increase in the sales volume of non-alcoholic beers was recorded in 2018. Among this group of

products, the dominant position is held by beers from the 0.0% beer category. In 2020, 0.0% beers already accounted for 89% of the volume of the entire non-alcoholic beer segment, while in 2017, it was approximately 45%. Currently, 9 out of 10 beers sold are entirely alcohol-free. It is this product category that has contributed to the dynamic development of the non-alcoholic beer segment (zero percent segment) over the last five years (Figure 2) (ZPPP - Browary Polskie, 2022; Kompania Piwowarska, 2020; Fal, 2023; Jackowski, Trusek, 2018).

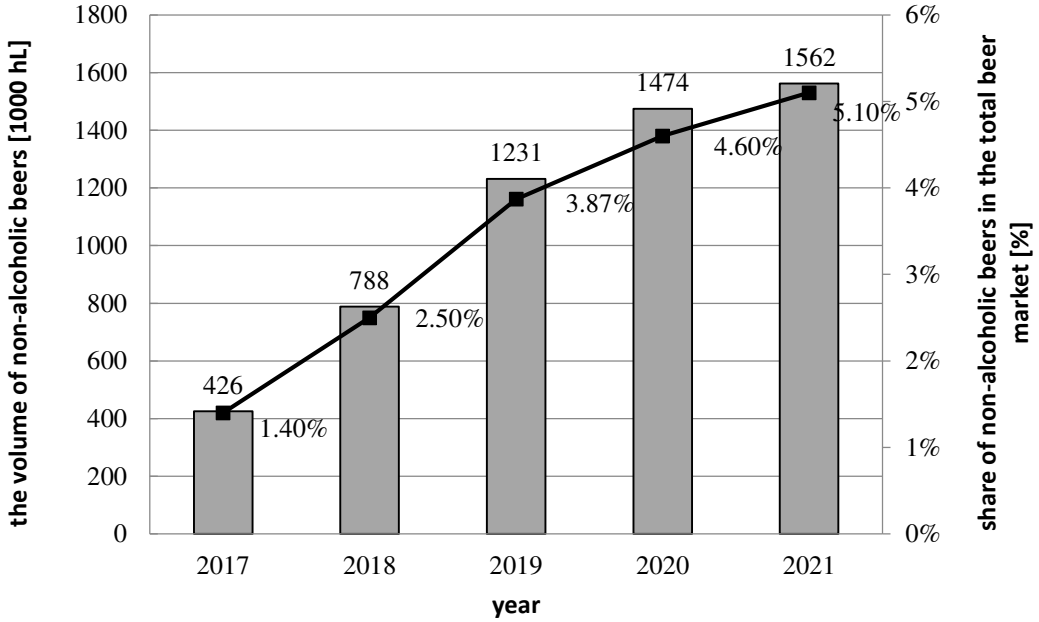

Figure 2. Increase in the volume of non-alcoholic beers and the share of non-alcoholic beers in the entire beer market in 2017-2021.

Source: own study based on Kompania Piwowarska (2020).

Alcohol-free beers are widely available, among others, in supermarkets and hypermarkets, as well as small-format and specialist stores. Currently, on the beer market, one can find not only 0% lagers, i.e., full-bodied lagers and flavored beers without alcohol, but also beer specialties such as non-alcoholic wheat beers, APA (American Pale Ale) or IPA (Indian Pale Ale) style beers.

Poland stands out in the non-alcoholic beverage market, ranking fourth in the EU in terms of non-alcoholic beer production, trailing only Germany, Spain, and the Netherlands (Kokole et al., 2022). These three countries account for nearly 75% of the EU's non-alcoholic beer production (Fal, 2023). In terms of exports, Poland is a global leader. In 2022, it was the fourth-largest exporter of non-alcoholic beer, with a value of USD 36.1 million, following the Netherlands ($166 million), Germany ($96.6 million), and Belgium ($44.4 million) (OEC, 2024).

Wines also have their non-alcoholic substitutes sold in Poland. The category of dealcoholized wines, similarly to beers, is developing at an equally dynamic pace. This segment records a double-digit increase in sales value year on year, reaching even more than 40%.

Dealcoholized wines, like their alcoholic counterparts, appear in a whole range of wine categories. Non-alcoholic red, white, pink, and sparkling wines are available on the market (Kinasiewicz, 2022). Sparkling wines are top-rated among consumers, with a 1178% increase in sales value recorded between August 2018 and August 2019 (Florencka, 2019). Equally high increases in sales value, although not as spectacular, were also recorded in subsequent years. From March 2021 to February 2022, there was another 64% increase in sales. Currently, this product category accounts for approximately 3% of the sales value in the non alcoholic wine segment (Górka, 2022). Undoubtedly, this product category's dynamic increase in sales value is due to the appearance of a dealcoholized version of sparkling wine - prosecco.

Producers in Poland are responding to changing consumer preferences by introducing non-alcoholic versions of high-proof alcoholic beverages (Mazurkiewicz, 2022). These alternative products, including non-alcoholic whisky, gin, rum, and vodka, are now available on the market. While these products are currently niche and lack comprehensive market statistics, their presence indicates a potential shift in the market.

The alcoholic beverage substitutes segment is developing dynamically and recording excellent sales results yearly. Growing consumer interest influences changes in the category management strategies used, which affects the increasing diversity of products offered by producers. Thus, to the customer's benefit, these activities result in expanding the store's assortment offer and increasing the availability of these products in individual distribution channels.

3. Research Methodology

In order to verify the current state of knowledge, an analysis of existing (secondary) data was carried out, including an analysis of content and available statistical data. By the methodology proposed by Bednarowska (2015), a cross-sectional analysis and comparison of historical data was carried out.

In a two-part study on the availability of substitutes for alcoholic beverages and its determinants, observation and interview methods were used (Lisiński, Szarucki, 2020). Interviews, as a method that allows for obtaining meaningful material documenting participants' experiences, knowledge, ideas, and impressions, should be combined with other data acquisition techniques, such as observation. This provides better-founded data and a more multilateral view of the situation (Glinka, Czakon, 2021).

Therefore, the research model included two main parts. In the first one, to determine the availability of non-alcoholic equivalents of alcoholic beverages, the hidden observation method, categorized by the photographic observation technique, was used. A research site was selected where it was possible to achieve the assumed goals. In this study, these were stores in

the Tricity area offering non-alcoholic equivalents of alcoholic beverages. The study on the availability of non-alcoholic equivalents of alcoholic beverages was carried out from December 2022 - March 2023. The Tricity market was selected for the study due to its size and structure. According to literature data, the Tricity agglomeration is highly saturated with retail space, mainly due to shopping malls with a wide range of various stores (Polish Council of Shopping Centers, 2023).

Seventy-five stores were selected to analyze the availability of products that are substitutes for alcoholic beverages, including 25 large-format stores, 25 small-format stores, and 25 specialist stores. Most surveyed stores belong to nationwide chains of stores with branches throughout Poland. These stores intend to offer the same range of products in each branch. Due to the size of the Tri-City market as well as the presence of stores belonging to the largest nationwide chains, it can be assumed that the Tri-City market reflects and is representative of the domestic market to a large extent. After selecting the retail outlets, further steps were taken for the observational study, such as perception, collection, and recording of the data obtained from the observation places using the photographic observation technique. Then, the obtained data were analyzed and interpreted, and appropriate conclusions were formulated. The availability analysis focused on determining the availability of non-alcoholic wines and substitutes for spirits. In contrast, non-alcoholic beers were omitted due to their widespread availability in all types of stores.

In the second part of the study, interviews were conducted with representatives of selected Tri-City specialist stores to identify the conditions for shaping the store assortment in managing the category of non-alcoholic equivalents of alcoholic beverages. Specialized stores were selected for the study because they are small-format stores (up to 300 sq m) that play an essential role in the sale of alcohol. In the long term, they are the most crucial distribution channel - they generate as much as 77% of the transactions and 67% of the sales value (Książek 2024). The study was conducted from November to December 2023. Sampling according to the criterion of homogeneous cases was used to identify potential study participants. Following Glinka and Czakon (2021), the study used an individual, direct, standardized, and semi-structured interview technique. An interview scenario was prepared, containing open questions regarding the reasons for introducing non-alcoholic equivalents of alcoholic beverages to the assortment, factors shaping the offer, potential plans to expand the assortment, and noticeable barriers to purchasing this type of product. Then, after arranging an interview and obtaining the interviewees' consent to be recorded, the interviews were conducted and recorded using a recording device. The next stage of this part of the study included independent transcription of the respondents' statements to prepare material for further analysis. The analysis of the collected material consisted of coding the text event by event. It was decided to use this method because it was found to be consistent with our everyday perception of the obtained text, and it also allows for the comparison of events within one text and between the transcripts of different interviews. After initial coding, thematic analysis was performed, and data interpretation began (Glinka, Czakon, 2021).

4. Results and discussion

The market availability analysis has uncovered a total of 141 non-alcoholic wines. Among these, a significant 66% are completely dealcoholized wines, meaning they contain 0.0% alcohol. The remaining products, while described as alcohol-free, do contain a small amount of alcohol, up to 0.5% vol. It's worth noting that the majority of these products are imported, with a strong representation from European Union countries. This suggests a potential market trend towards non-alcoholic wines in these regions (Figure 3).

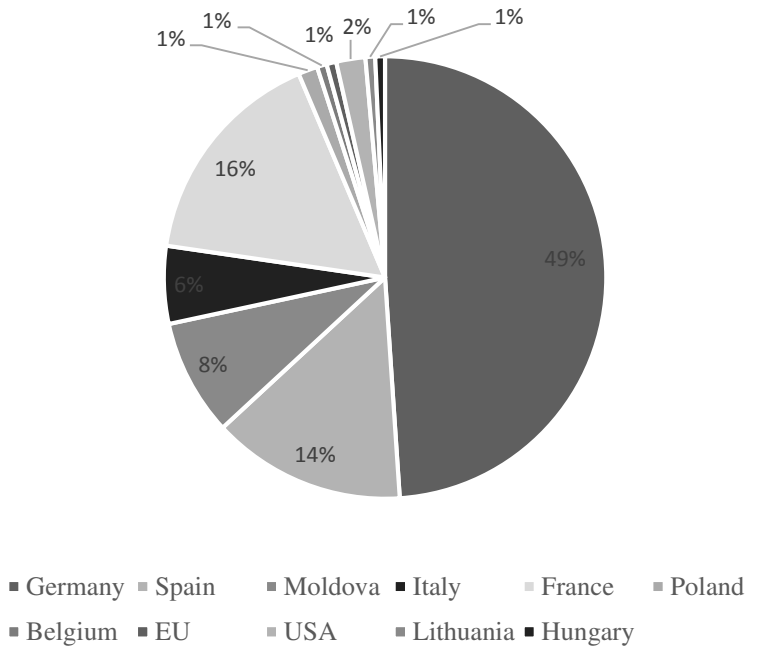

Figure 3. Percentage distribution of non-alcoholic wines by country of origin.

Source: own work.

Almost half of the identified products were produced in Germany, and many respondents included French and Spanish wines. Non-alcoholic wines are available on the Polish market in the entire spectrum of wine categories. The surveyed stores' assortment includes sparkling wines (30%) and still wines (70%). More than half of the tested products are white wines (56%), red wines constitute 29% of the identified goods, while the smallest group on the market is rosé wines (15%). Large-format stores have the highest availability of non-alcoholic wines, while small-format stores have the lowest availability.

Table 2.
Availability of various types of non-alcoholic wines in particular types of stores

Type of non-alcoholic wine	large-scale	small-scale	specialized
all types of wines	**108**	**12**	**64**
calm	78 (72.2%)	7 (58.3%)	42 (65.6%)
sparkling	30 (27.8%)	5 (41.7%)	22 (34.4%)
white	59 (54.6%)	8 (66.7%)	38 (59.4%)
red	31 (28.7%)	3 (25.0%)	20 (31.3%)
rose	18 (16.7%)	1 (8.3%)	6 (9.4%)

Source: own work.

Analyzing the data obtained (Table 1), it should be stated that in each type of the surveyed stores, calm wines (non-fermenting in the bottle after closing) still dominate, constituting approximately 60-70% of the assortment. However, when analyzing the availability of wine color, the surveyed stores are dominated by white wines, which constitute from 55 to 67% of the assortment.

The data obtained are mainly consistent with the data obtained by Bonin and Czernecki (2021), who, in their research conducted on the capital market at the end of 2020, showed the highest availability of non-alcoholic wines in large-format and specialized stores, while the lowest in small-format stores. Then as of now, the market offers mainly non alcoholic, calm, white wines from Germany. Importantly, however, at that time (November-December 2020), a total of 73 different non-alcoholic wines were available in 60 different stores (Bonin, Czarnecki, 2021), which is almost half as many as the authors of this article identified on the market two years later (December 2022 - March 2023). This proves the continuous development of the segment of these products in Poland in recent years.

When assessing the state of the offer of non-alcoholic wines, it should be stated that the availability of non-alcoholic products is relatively high compared to that of their alcoholic counterparts. According to data posted on the polish Hurt & Detal website, customers can find about 30 variants of wine on store shelves in small-format stores and in larger stores (supermarkets or discount stores) up to 100 variants of various alcoholic wines (Książek, 2024).

In turn, when analyzing the availability of substitutes for spirits on the Polish market, only nine products were identified. More than half of the examined goods are non-alcoholic equivalents referring to the name of gin (56%), while 1/3 (33%) are whiskey substitutes (Table 2). Most analyzed products (89%) are drinks completely free of alcohol, i.e., 0.0%, imported mainly from EU countries such as Spain, Great Britain, Italy, and Belgium.

Table 3.
Availability of various types of substitutes for spirits in particular types of stores

Product Type	Types of stores		
	large-scale	small-scale	specialized
all types of substitutes for high-proof alcoholic beverages	**5**	**1**	**7**
gin substitute	3	1	4
whisky substitute	1	0	3
rum substitute	1	0	0

Source: own work.

In the case of substitutes for spirits, the highest availability is in specialist stores, and the lowest is in small-format stores, where only one product has been identified as an alternative to gin.

Additional information on the conditions for shaping the assortment in stores, in the context of category management of these products, including the product strategies used, was provided by a survey conducted by interviews among representatives of specialist stores.

According to the interviewees, the first substitutes for alcoholic beverages, equivalent to wines or spirits, appeared in most of these stores relatively recently, about 1.5-3 years ago; for some respondents, it was the beginning of their stores' operations on the market.

We have been practically (...) on the market for three years, (...), so we have been practically from the very beginning because it was already a moment when non-alcoholic wines, obviously looking at the wines, had already been on the market for several years, so we have had wines on offer from the very beginning [R5].

Well, I think alcohol other than beer, I think about one and a half, two years ago [R2].

Most interviewees point to the market need or the growing segment of non-alcoholic products as the reason for introducing non-alcoholic wines or other substitutes for alcoholic beverages.

There is a market need; we did not have any in our assortment (...) [R3].

Market demand and the growing segment of non-alcoholic products [R4].

Some respondents also indicated that introducing non-alcoholic products was to meet customer expectations, including specific consumer groups such as pregnant women, drivers, people who want to lead a healthy lifestyle, and women for whom non-alcoholic wine is a more exciting alternative than beer. For some respondents, an important reason was observing market or consumer trends and the desire to stay updated with these trends.

Referring to the factors determining the assortment in their stores, the interviewees pointed out that, to a large extent, the customer and his expectations are taken into account when shaping the offer. Some respondents respond to customers' needs and adjust the assortment to their needs in response to customers' questions about non-alcoholic products.

(...) and I also see that if a customer wants something in the store and I see that there is one customer, a second, a third person, then it is in the store because I know that the customer needs it and I also meet this customer's needs (...) [R1].

If there is something that I do not have in my offer, and I know that it would be good for me to have at least one customer, we try to meet the expectations and organize such an assortment for the store [R5].

The approach mentioned above is consistent with the product strategy called market segmentation strategy in the literature. According to this strategy, an individual buyer is considered a market segment, trying to consider his needs and requirements (Walas-Trębacz, 2002; Dietl, 1985).

In response to the question about the impact of the assortment available in large format stores, including large stores and hypermarkets, on creating the offer in their stores, some interviewees replied that they shape the assortment as an alternative to large-format stores.

In my store, I try to have products that are not available in supermarkets. Because most of these non-alcoholic products are really of low quality [R1].

It seems that, on the contrary, we try to have products that are not there [in large-format stores (author's note)] [R2].

In turn, this type of activity of specialist stores, which involves creating assortments in opposition to large-format stores, is consistent with the assumptions of a strategy that fills market niches and involves investing in market areas that competitors do not dominate. Such a strategy allows sellers to avoid competition and gives hope of achieving benefits with a significantly reduced operating risk (Walas-Trębacz, 2002; Mruk, Rutkowski, 1994).

However, some respondents claimed that a specific part of the assortment of non alcoholic wines in their store overlaps with the assortment of large-format stores because these are company stores belonging to a company that has its brands (or its producers) and supplies both specialist and large-format stores. This information is reflected in the market because, in the study on the availability of non-alcoholic wines carried out as part of this study, it was found that the assortment of specialist stores and large-format stores overlaps by approximately 50%, i.e., approximately half of the non-alcoholic wines available in specialist stores are also available in large-format stores. Moreover, all interviewees stated that they consider the latest market trends when creating their assortment.

(...) Nowadays, you have to follow trends. Otherwise, you would be left behind [R2].

Regular market research is a crucial part of my role. I stay updated on market movements, monitor the offerings of my peers in other importing companies and specialist stores. This helps me stay ahead of the curve and make informed decisions [R5].

During the conversations, some interviewees pointed to the trends currently observed in the alcohol market, including the growing 0% trend, the fashion for non-alcoholic products, the development of the natural wine trend, and wine collecting. Moreover, some interviewees emphasized the role of quality as an essential factor in shaping the assortment of their store.

(...) I wanted to create a store with premium alcohol. Moreover, people buy less from me but of better quality, and therefore, these alcohols are more expensive [R1].

Quality is our top priority. We believe that non-alcoholic wine is a product that can either be excellent or disappointingly poor in quality. We always scrutinize the ingredients to ensure we offer the best to our customers [R5].

This approach proves that stores use a product strategy to maintain the competitiveness of the offer, which requires that the products offered by the company be as good or even better than those offered by the competition. This, according to the assumptions of Walas-Trębacz (2002) and Mruk and Rutkowski (1994), means that the store must focus on all product features, especially on the quality and aspects of newness and modernity of the product. This attitude is also in line with the premiumization trend observed in recent years, which involves the increase in the popularity of more expensive and considered higher-quality alcoholic beverages (Fal, 2020). Moreover, the premiumization trend has significantly gained importance during the pandemic, especially in the alcohol category. This is partly because consumers are increasingly trying to recreate high-quality gastronomic experiences in the comfort of their own homes (Plata et al., 2022).

Some interviewees also mentioned their thoughts and experiences, the level of inflation, and the need to ensure product diversity in their offer, which are other factors influencing the development of the assortment.

When assessing their offer of non-alcoholic equivalents of alcoholic beverages, some respondents described their assortment as sufficient, possibly planning to introduce one new product or replace the existing one with a better one.

What I have is enough, I think; maybe I will add one wine because recently we also got one sparkling white wine, which is very good. Maybe some non-alcoholic red wine. However, I think it is enough [R1].

Our perspective is that a diverse product range is crucial. As a company, we strive to stand out by offering superior products or by providing items of similar price but higher quality. We understand that if a product is not meeting consumer expectations, it's best to replace it with a more appealing option [R4].

In terms of non-alcoholic wines, the market is well-stocked. We identified a total of 64 different products in specialist stores and a whopping 141 in all types of stores in the Tricity area. This wide availability across the wine category spectrum suggests that potential consumers won't face any purchase barriers. However, the situation is different for substitutes for spirits, with only 7 products found in specialist stores and 9 in all types of stores.

Some interlocutors indicated that they plan to expand the range of non-alcoholic equivalents by introducing new products, but sometimes, this is determined by the producers who supply the goods to the wholesalers. Introducing new products determines the competitiveness of the assortment offered, and optimizing this process is one of the instruments of product category management (Kłosiewicz-Górecka, 2018). This approach fits into the strategy of expanding products (offer) or the strategy of a new product, which involves the need to introduce new

products to the offer to ensure high profit in a short period or the future (Walas-Trębacz, 2002; Mruk, Rutkowski, 1994).

When asked about the observed purchase barriers on the part of customers, most interviewees indicated that consumers of this type of product are determined to purchase and are aware of this choice. Therefore, they do not observe any barriers on their part, such as price or stereotypes. Some respondents mainly observed this attitude among young consumers.

People consciously come for non-alcoholic wine [R1].

I mean, it seems that when it comes to price, once a person has already decided to buy a given non-alcoholic product, it probably does not make much difference for him (...) I think that even now, young people, I think that up to the age of 30, are not influenced by whether something is non-alcoholic or alcoholic. They are not influenced by the opinions of others who drink alcohol. Because it used to be so ingrained that if someone did not drink alcohol, they were some recluse or something, today, the youth is more developed, and there are no stereotypes such that one drinks non-alcoholic and the other alcoholic; I think they sit at the table together [R2].

Some of the interlocutors, however, pointed to the observed barriers on the part of consumers, mentioning, among others, objections to products intended to be a substitute for vodka or the high price of these products. Some people also drew attention to the fact that these types of products are purchased only as a replacement for alcohol products and are forced by the need, e.g., pregnancy, driving, or taking medications permanently.

All respondents stated that there were no difficulties with the availability of these products in wholesalers. Moreover, some of the interlocutors also indicated that they had no difficulties because the company supplies its wholesalers itself and they have their brands.

They are widely available, practically in every wholesaler. Accessibility is truly powerful. Virtually every product, rums, gins, and wine. There is a lot of it on the market [R1].

Availability is rather, from what I observe, they are constantly available [R5].

We do not have these difficulties because we supply our wholesalers [R4].

Moreover, some claim that these products are widely available in wholesalers and that new products always appear.

Most interviewees indicated individual customers as the target market for their stores. Sometimes, this was because some stores did not have a license for the HoReCa segment, and some were company stores dedicated to individual customers.

Only individuals in this store, because we do not have a license for HoReCa [R3].

We are a company store, so we are a branch strictly dedicated to retail customers [R4].

Some respondents, however, indicated that due to the scale of orders, e.g., in the summer or holiday season, orders from representatives from the HoReCa sector predominate.

5. Summary and Conclusions

Product category management is primarily about understanding and identifying consumer needs. The research shows that when shaping the assortment, representatives of selected stores take into account customers' expectations and needs to a large extent. Some of 14 the store owners indicated that they planned to expand the assortment and introduce new products that are substitutes for alcoholic beverages, which may increase the assortment's competitiveness. Optimization of this process is one of the instruments used in product category management.

Hence, the article refers to the availability and shaping of the assortment of non alcoholic equivalents of alcoholic beverages in selected distribution channels in managing this product category. The research shows that the highest availability of substitutes for alcoholic beverages occurs in large-format stores, while the lowest is in small-format stores. In the case of wines without alcohol, it was found that all types of stores surveyed offer these goods in significant quantities. A different situation occurs in the case of substitutes for spirits. Limited availability may encourage consumers to look for other alternative products and completely discourage them from choosing a given product. Moreover, this state of affairs may constitute a primary barrier to developing this market segment and a primary barrier to managing this category in the product sector.

From the conducted research, it can be concluded that when shaping the assortment of non-alcoholic equivalents of alcoholic beverages, representatives of selected stores apply specific strategies towards this group of products, including competitiveness of the offer or size of the assortment. This is important because, as part of product management, the company should develop effective strategies to maintain the offer's competitiveness, the optimal size of the assortment, and the inflow of new products, ensuring profit. Many companies owe their success and high market position to a well-prepared and implemented strategy for individual products.

The topics presented in the article are current and significantly evolving. According to the authors, this article may contribute to further discussion and research in managing the category of non-alcoholic equivalents of alcoholic beverages, mainly due to the dynamic development of this segment in recent years. Directions for further research include exploring the issue of the availability of non-alcoholic equivalents of alcoholic beverages from the consumers' point of view - whether the assortment offered by stores is sufficient in the opinion of consumers and whether customers are open to new products. The increasing willingness of consumers to purchase non-alcoholic equivalents of alcoholic beverages, observed in recent years, is, according to the President of the Management Board of the Polish Public Health Association, the desired direction of market development from the point of view of remodeling alcohol consumption in Poland, i.e., improving the structure of alcohol consumption, resulting in building more responsible consumer attitudes towards alcohol (Fal, 2020). All the more so

because, as recent data show, alcohol consumption in society has increased as a result of the COVID-19 pandemic (Ramalho, 2020).

Due to the conditions of development of the segment of non-alcoholic equivalents of alcoholic beverages in Poland, in the competitive fight, products that are substitutes for alcoholic beverages, as a separate category, should be positioned in modern distribution channels as an innovative, attractive category of products with significant development potential and attractive market attributes for people, who, for various reasons, do not want or cannot consume alcohol, at the same time contributing to positive changes in social trends in alcohol consumption.

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EMPLOYEES' EXPECTATIONS REGARDING MANAGEMENT METHODS IN AN AGILE ORGANIZATION IN THE LIGHT OF OWN RESEARCH

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Purpose: The purpose of this article is to identify and understand employee expectations regarding the management methods used by management in agile organizations. The research aims to determine which aspects of work and professional development are most important to employees and how they evaluate various elements related to management in such environments.
Design/methodology/approach: The research used a survey method, conducted in the period January-March 2024 on a sample of 1018 respondents. The analysis of the results was based on the identification of dominant answers and the study of correlations between various employee expectations and management methods.
Findings: The research showed that employees attach the greatest importance to opportunities for professional development, work flexibility and access to training. Recognition and rewards for achievements also play a key role in employee motivation. Support for personal development, on the other hand, was less important to respondents.
Research limitations/implications: Research limitations include the use of a standardized survey, which may have limited the depth of responses obtained. The sample size of 1018 individuals, while large, may not fully reflect the diversity of all employees in agile organizations, which limits the generalizability of the results.
Practical implications: The results can be used by organizations that want to better adapt their management methods to the needs of employees, which can lead to higher levels of engagement and job satisfaction. Identified key aspects, such as professional development and flexibility, can become a priority in the management strategy.
Social implications: A better understanding of employee expectations towards management methods can help build more friendly and supportive workplaces. This can improve the quality of professional life and improve the work-life balance of employees.

Originality/value: The research provides a novel perspective on agile organizations from the perspective of employee expectations, which allows for the identification of important management elements. The focus on the human aspects of management in the context of agile methodologies is an added value and fills a gap in the existing literature on agile management.
Keywords: agile organization, employees, management, governance, Kanban.
Category of the paper: research paper.

1. Introduction

Modern organizations operate in a dynamically changing environment that requires them to adapt quickly and be able to respond to new challenges. In such conditions, agile management methods are gaining importance, becoming an indispensable element of the strategy of many companies (Cappelli, Tavis, 2018). Agility, as an approach that enables flexible management and quick adaptation to changing market conditions, allows organizations to better use the potential of employees and quickly introduce innovations (Harraf et al., 2015). However, for agile management to be effective, it is crucial to understand the expectations of employees towards the management methods used by management in such organizations. Despite the growing popularity of agile methods, there is still a lack of research that would comprehensively analyze this relationship, taking into account the diversity of employee expectations and the specificity of their needs (Brown, Jones, 2018).

Taking up this topic is important for several reasons. First of all, employee expectations are one of the key factors influencing the success of implementing agile management methods. Modern organizations cannot function effectively without taking into account the perspective of their employees, who increasingly value the opportunity for professional development, work-life balance, and flexible working conditions. In the face of increasing competition on the labor market, the ability of organizations to attract and retain talented employees is crucial, which makes the analysis of their expectations towards management methods an extremely current topic.

The novelty of the conducted research lies in looking at agile organizations from the perspective of employee expectations, which allows for the identification of key management elements that affect their satisfaction and engagement. Instead of focusing only on technological or process aspects of agile methods, this research focuses on human factors, such as the need for recognition, the possibility of continuous improvement of skills or work-life balance. This type of approach allows for a more holistic picture of the functioning of agile organizations, taking into account both business needs and employee expectations.

The aim of the research is to identify and analyze employee expectations regarding management methods used by management in agile organizations and to assess which management elements are most important to them. The research conducted aims to understand

which aspects of work and professional development are key for employees and how their needs can be better taken into account in management strategies. This knowledge can help organizations adapt their practices to the real expectations of employees, which will increase efficiency and long-term employee satisfaction, as well as strengthen the company's position on the market.

1.1. The essence and characteristics of an agile organization

The essence of an agile organization is based on flexibility, the ability to quickly adapt to change, and openness to innovation. An agile organization, also known as agile, operates in a way that allows for dynamic response to changing market conditions, customer needs, and internal challenges (Abdmouleh, Alammari, Gastli, 2015). The key assumption of this approach is to create a structure and processes that allow for efficient change management, eliminating the long decision cycles and hierarchical barriers characteristic of more traditional management models. In an agile organization, the emphasis is on rapid iteration and continuous improvement, which means that actions are taken in shorter time cycles, allowing for rapid testing, learning, and corrections (Doz, Kosonen, 2008).

An agile organization is focused on the customer and their needs, which is the central point of all activities and decisions. In such an environment, it is important to collect and analyze customer feedback to introduce improvements to products and services in real time. Close cooperation with customers and constant monitoring of their requirements allow for quick adjustment of the offer, which increases competitiveness on the market. The customer becomes an integral part of the product development process, and their feedback is the basis for continuous improvement of the offer (Alshehhi, Nobanee, Khare, 2018).

Agile organizations are characterized by a flat organizational structure, where hierarchy is minimized in favor of cooperation and team autonomy. This approach promotes faster decision-making, as teams can independently carry out their tasks without having to wait for top-down decisions to be accepted. Employees have more freedom to take initiatives and implement projects, which promotes innovation and motivation. Autonomy in action makes team members feel responsible for the results of their work, which in turn translates into greater commitment to achieving the organization's goals (Felipe et al., 2020).

Communication in an agile organization is a key element that plays a significant role in coordinating activities. Communication is usually direct and frequent, thanks to which teams can quickly respond to emerging problems and share information. Team meetings, such as daily stand-ups or retrospectives, allow for ongoing monitoring of progress and setting priorities. This way of exchanging information makes the organization more transparent, and all employees are aware of common goals and directions of action (Lambri, Sironi, Teti, 2024).

Agile organizations also place great emphasis on an iterative work process. Work is done in short, iterative cycles, which allows for rapid delivery of customer value and verification of progress (Liu, 2024). These iterations, often called sprints, allow for testing new solutions in a short period of time, which gives the ability to quickly adapt to changing conditions and make necessary modifications. This approach minimizes the risk of long-term investments that could turn out to be unsuccessful, because each iteration provides feedback and allows for course corrections (Kurnia, Chien, 2020).

An agile organization also focuses on continuous improvement, both at the level of teams and the entire organizational structure. Continuous improvement involves constantly searching for ways to improve processes, improve efficiency and eliminate unnecessary activities. As a result, the organization becomes more adaptive and open to change. Employee development and taking care of their competences are an integral part of this process, which is why agile organizations often invest in the development of their teams through training, workshops and personal development programs (Luthra et al., 2015).

An important aspect of agile organizations is also a high tolerance for experimentation and risk-taking (McNamee et al., 2012). These organizations accept that making mistakes is part of the learning and innovation process, which allows them to introduce new solutions without fear of failure. Such a work climate promotes creativity and a tendency to make bold decisions, which in turn allows for finding effective solutions to emerging problems faster. Thanks to this, agile organizations are able to maintain a competitive advantage by constantly adapting their products and services to changing market conditions (Prieto, Talukder, 2023).

In summary, an agile organization is a management approach that focuses on flexibility, rapid adaptation to change, collaboration, and innovation. Its structure is based on team autonomy, direct communication, and an iterative work process, which allows for effective project implementation and rapid delivery of value to the customer. Agile organizations are able to dynamically respond to challenges and seize emerging opportunities, which makes them particularly effective in a rapidly changing business environment.

1.2. Management methods used in an agile organization

The management methods used in an agile organization focus on providing a structure and processes that support flexibility, rapid response to change, and effective collaboration within teams (Fiddler, 2017). Agile organizations most often implement approaches based on Agile methodologies such as Scrum, Kanban, Lean, or Extreme Programming (XP). Each of these methodologies offers specific frameworks and tools that help teams work in short cycles, deliver value iteratively, and systematically improve processes (Jones, Adam, 2023).

Scrum is one of the most commonly used management methodologies in agile organizations. It is based on work in sprints, i.e. short, usually two-week cycles, in which the team completes set tasks (Deloitte, 2024). After each sprint, a retrospective meeting takes place, during which the team analyzes what has been achieved and what improvements can be made

in the future. This process allows for quick testing of solutions, making corrections and adapting to changing project requirements. In Scrum, an important role is played by the Product Owner, who defines priorities and ensures that the tasks carried out are in line with the customer's expectations, and the Scrum Master, whose task is to remove obstacles that may inhibit the team's progress (Munodawafa, Johl, 2019).

Kanban is another methodology that is widely used in agile organizations. It focuses on visualizing work, so team members can more easily monitor project progress and identify potential issues, such as process bottlenecks. Kanban is based on boards that show the flow of tasks through various stages, from initiation to execution to completion. This method allows you to control the flow of work and avoid overloading teams, so you can make the most of available resources. Kanban also fosters a culture of continuous improvement, where teams regularly analyze the effectiveness of processes and make changes to increase efficiency (Rut, Meyer, Andrzejczyk, 2022).

Lean Management, which is the foundation of many agile methodologies, focuses on eliminating waste and maximizing the value delivered to the customer (Bukowska, 2023). In agile organizations, the Lean approach is used to streamline processes, reduce unnecessary steps in production or project implementation, and introduce improvements that contribute to lower costs and shorter product delivery times. Thanks to Lean, teams are able to better manage resources and focus on delivering key results that are important from the customer's perspective. Lean Management also emphasizes the importance of engaging all employees in the process of streamlining activities, which leads to building an organizational culture based on continuous learning and innovation (Masoud, Basahel, 2023).

Extreme Programming (XP) is a method that is used mainly in agile organizations operating in the technology industry, especially in software development teams. XP focuses on programming best practices such as pair programming, test-driven development (TDD), and frequent code deployment and integration. The use of this method allows for quick response to changes in project requirements and maintaining high quality of the produced software. XP supports close cooperation with the customer, who is involved in the entire product development process, thanks to which it is possible to better understand the needs of end users (He, Harris, 2021).

Management in an agile organization often also includes the introduction of a servant leadership approach, which emphasizes the leader's role as a person supporting the team, and not just as a person directing actions (Erdil, 2014). In agile organizations, leaders are primarily tasked with removing barriers that may hinder the work of teams, and motivating employees to develop their competences and creativity. In the servant leadership model, the leader is a mentor who helps teams achieve better results, supporting them in achieving goals and ensuring appropriate working conditions (Capgemini, 2024).

Agile organizations also pay special attention to change and risk management. Agile methodologies assume that change is inevitable, so it is important for teams to be able to adapt to it quickly. Practices such as rapid iterations, regular reviews, and retrospectives allow teams to monitor risks on an ongoing basis and implement appropriate corrective actions. This ensures that risks are identified and managed on an ongoing basis, minimizing the likelihood of larger problems in the future (Luo et al., 2020).

Agile organizations also use digital tools and technologies that support communication, collaboration, and project management. Tools such as Jira, Trello, and Slack allow teams to manage tasks, exchange information, and track work progress in real time. This allows teams to work effectively even in dispersed locations, which is particularly important in the context of the growing popularity of remote work. These technologies also support the transparency of activities, which allows for better monitoring of task implementation and identification of possible delays (Mycka, 2023).

based management methods, where constant exchange of opinions and feedback is crucial to maintaining high quality of work and rapid implementation of improvements. Practices such as daily team meetings (daily stand-ups) or retrospectives allow for ongoing discussion of progress and problems and joint development of solutions (Yang, Liu, 2012). Thanks to this, teams can better respond to changing needs and expectations, both internal and external. Management in an agile organization also assumes a focus on results and values delivered to the customer, and not only on the implementation of the assumed plan. A key element here is measuring progress using specific indicators that allow for assessing whether the team delivers the expected results in the assumed time. Instead of strictly sticking to the original project assumptions, agile organizations adapt their goals and actions depending on the obtained results and the current market situation (Rahimi, Mansouri, 2019).

These management methods support an organizational culture in which the team is the center of attention, and processes are designed to facilitate maximum adaptation to changes and promote quick decision-making. Agile management is not only about adopting specific tools and techniques, but also about transforming the way we think about the role of the leader, team, and organization in the process of delivering value. This approach allows companies to achieve greater competitiveness and maintain an advantage on the market thanks to the ability to quickly respond to the challenges of the modern business world.

1.3. Employee Expectations and Leadership Management Methods in an Agile Organization

The relationship between employee expectations and management methods in agile organizations is a key element influencing efficiency and satisfaction in the workplace. Agile management methods such as Scrum or Kanban are characterized by high flexibility, decentralization of decisions, and focus on meeting customer needs. However, these elements may interact differently with individual employee expectations, which include aspects of

professional development, work comfort, and recognition for achievements (Sedej, Justinek, 2021).

Agile organizations, based on iterative work processes and rapid response to changes, create an environment conducive to acquiring new skills and developing competencies. Employees in such organizations often expect the possibility of continuous improvement and access to knowledge resources, which allows them to keep up with changes and develop their competencies. For this reason, it is crucial to introduce management methods that provide employees with the appropriate amount of training, workshops and educational resources. Employees want not only to acquire new qualifications, but also to see the possibility of practical application of the acquired knowledge, which increases their sense of meaning in the work they do (Joiner, 2019).

One of the most important expectations of employees towards management in agile organizations is ensuring a balance between work and private life. Agile management methods, which assume great flexibility in planning work time, can support this aspect, allowing employees to better manage their time (Adan, Fuerst, 2016). Flexibility in planning tasks and the possibility of remote work affect the sense of comfort and freedom, which in turn translates into greater job satisfaction. Employees expect that the management of agile organizations will create conditions that not only allow for professional development, but also take into account their needs in the context of their personal lives (Seifollahi, Shirazian, 2021).

Another important element that is important in the context of agile management is recognition and rewards for achievements. Although agile organizations often promote a culture of cooperation and collective effort, employees expect that their individual contributions and successes will be recognized and appreciated. Introducing reward and recognition systems that are aligned with both individual and team achievements can positively affect motivation and engagement. Employees need to see that their efforts and commitment bring concrete results, which can be crucial to maintaining a high level of motivation in agile teams (Skyrius, Valentukevič, 2020).

Relationships and networking play a special role in agile organizations, as they promote collaboration and knowledge exchange. However, not all employees see them as a key element of their professional work. In agile organizations, where teams must often collaborate and exchange knowledge, networking can be a foundation for effective project implementation. However, for some employees, the opportunity to build professional relationships may not be a priority, which indicates the need for a differentiated approach to team management. Teams must be led in a way that respects individual employee preferences for collaboration and social interactions to ensure a balance between collaboration and autonomy (Sherehiy, Karwowski, 2017).

In agile organizations, great attention is also paid to providing a friendly and motivating work environment (Borowski, 2021). Employees expect that the atmosphere in the workplace will support their creativity and allow for the open expression of ideas and opinions. In agile

teams, where autonomy and responsibility are divided, it is extremely important to create an organizational culture that promotes cooperation and encourages active participation in decision-making processes. However, for the work environment to truly motivate employees, management must be focused on building an atmosphere of trust and mutual support, which is especially important in the context of dynamic changes and high demands placed on teams (Attar et al., 2022).

Management in agile organizations must also take into account employees' expectations regarding support for personal development. Although many agile methods focus on professional development and acquiring new competencies, for some employees it is equally important to provide space for personal development that goes beyond direct professional benefits (Akkaya, 2021). However, these expectations are diverse, which means that management in agile organizations should be flexible enough to offer various forms of support, both for those who are looking for development opportunities in the context of their career and for those who value support in more personal aspects (Bray et al., 2019).

Analysis of these employee expectations remains crucial for the effective implementation of agile management methods. Management should be adapted not only to the specifics of projects and market requirements, but also to the individual needs and preferences of employees. Only then will an agile approach be able to maximize employee engagement, use their potential and achieve a competitive advantage in a dynamically changing market. Integration of employee expectations with management practices allows for the creation of an environment that promotes not only efficiency and innovation, but also long-term employee satisfaction and loyalty to the organization.

1.4. Research Methodology

The aim of the research was to identify and understand employee expectations regarding management methods in agile organizations. The research aimed to analyze which aspects of work and professional development are most important to employees and how they assess various elements related to management in the work environment. The research hypothesis assumed that employees in agile organizations attach the greatest importance to opportunities for professional development, work flexibility and access to training and knowledge resources, and factors related to personal ambitions and family expectations are less important to them. As part of the research, research questions were asked about which specific elements of management are perceived by employees as key to their job satisfaction and which aspects influence their decisions to stay in the organization. We also asked which factors employees consider to be the least important in the context of management in an agile organization. The research method was a survey conducted in January-March 2024 on a sample of 1018 respondents. The survey allowed for collecting data on employee opinions on various aspects of management and their expectations regarding work in agile organizations.

The study obtained sociodemographic data on the study participants, including their gender, age, place of residence and professional activity. The respondents included both men and women, of different age groups and with different professional status and place of residence. The group of respondents included men and women. The men represented different age groups, from those under 20, through those aged 21-25, to those over 35. The age of the female respondents was similarly diverse, including women under 20 and those aged 21-25.

The respondents lived in different types of locations. The men included residents of both villages and cities of various sizes – from cities with up to 20 thousand inhabitants, through cities with 51 to 200 thousand inhabitants, to cities with over 200 thousand inhabitants. The women also came from different locations, including cities with over 200 thousand inhabitants and villages. The respondents were involved in various forms of professional activity. Among the men, some worked full -time, regardless of their place of residence and age. Others worked on the basis of a contract for services or a contract for specific work, and in some cases they combined full-time work with running their own business or ran a farm. In the case of women, there was also a diversity of professional activity. Some of them worked on the basis of contracts for services or contracts for specific work, others remained professionally inactive, and some were employed full-time.

The study covered various professional groups, from people employed permanently, through those running a business activity, to those working on the basis of flexible forms of employment, such as civil law contracts. This way, a diverse picture of respondents was obtained, which allows for a thorough understanding of their expectations and preferences regarding management methods in agile organizations.

1.5. Presentation of Research Findings

The research aimed to identify and analyze employees' expectations regarding the management methods of the management in an agile organization. The results presented in Table 1 show the diversity of respondents' approaches to various aspects related to their development and job satisfaction.

Table 1.
Employee expectations in relation to management methods in agile organization

Employee expectations	Definitely not	Rather not	I don't have an opinion	Rather yes	Definitely yes
Recognition and Achievement Awards	3	9	48	216	742
Work Balance	14	32	70	321	581
Development of competences and qualifications	0	16	25	278	699
Access to training and knowledge resources	0	22	91	341	564
Practical application of the acquired knowledge	2	25	44	295	652
Continuous improvement of skills	1	15	31	305	666
Career opportunities	3	22	48	266	679

Cont. table 1.

Networking and relationship building	31	74	146	365	402
Work flexibility and mobility	11	37	170	371	429
Working in a friendly and motivating environment	91	121	206	288	312
Expectations for support for personal development	402	192	169	146	109

Source: Own study based on research.

In relation to recognition and rewards for achievement, the vast majority of respondents expressed strong support, with 742 strongly agreeing with the need for this element, and a further 216 expressing moderate support. Just 3 strongly disagreed and 9 tended to disagree. A small number of 48 had no opinion. Similarly high support was recorded for the balance between work and personal development, with 581 strongly agreeing and 321 tending to agree. A smaller number of 70 had no opinion and 14 strongly disagreed with the approach, while 32 tended to disagree.

The development of skills and qualifications was also highly valued. 699 respondents strongly agreed with the need to invest in skills development, while 278 tended to agree. Only 16 people disagreed and 25 were undecided. Access to training and knowledge resources was met with a positive response from 564 people who strongly agreed with the idea, while another 341 were moderately supportive. However, 91 respondents were undecided and 22 tended to disagree, while none expressed strong disagreement.

Practical application of acquired knowledge was important for 652 people who strongly supported the concept, while 295 people agreed to a lesser extent. 44 respondents were undecided, 25 rather disagreed with the solution, and 2 people strongly disagreed. Continuous improvement of skills, like other aspects, was received positively. 666 respondents expressed strong support, while 305 rather agreed. The number of undecided people was 31, only 15 people rather disagreed with the idea, and only 1 person strongly disagreed.

Professional development opportunities were highly valued, with 679 people strongly supporting this aspect and 266 tending to agree. 48 respondents were undecided, 22 tending to disagree, and only 3 people strongly disagreed. Networking and relationship building, on the other hand, received slightly less but still significant support, with 402 people strongly supporting this aspect and 365 tending to agree. A significant number, 146 respondents, were undecided, while 74 tended to disagree and 31 strongly disagreed.

Flexibility and mobility were appreciated by 429 people who strongly supported this idea, while 371 people agreed moderately. 170 people were undecided and 37 expressed negative opinions. Only 11 people strongly disagreed with this solution. The issue of working in a friendly and motivating environment was met with mixed reactions. 312 respondents strongly supported this idea, while 288 rather agreed. However, a large number, 206 people, were undecided, 121 rather disagreed with this aspect, and 91 people expressed strong opposition.

Expectations regarding support for personal development were met with the most negative responses. As many as 402 people strongly disagreed with this, and 192 had rather negative opinions. 169 people had no opinion, while 146 rather agreed with the idea, and only 109 expressed strong support.

Table 2 presents correlations between individual employee expectations regarding management methods in an agile organization, which were discussed in Table 1. The values in this table reflect the strength of the relationship between different factors. Values close to 1 indicate a very strong positive correlation, which means that if one factor increases, the other also tends to increase. In turn, values close to -1 suggest a strong negative correlation, i.e. an increase in one factor is associated with a decrease in the other.

Table 2.
Correlation Table

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1	1										
2	0.96	1									
3	0.99	0.98	1								
4	0.95	0.99	0.97	1							
5	0.98	0.99	0.99	0.98	1						
6	0.98	0.99	0.99	0.98	0.99	1					
7	0.99	0.98	0.99	0.97	0.99	0.99	1				
8	0.83	0.94	0.88	0.96	0.90	0.90	0.88	1			
9	0.83	0.93	0.87	0.96	0.90	0.90	0.88	0.99	1		
10	0.79	0.89	0.83	0.92	0.85	0.85	0.83	0.97	0.99	1	
11	-0.58	-0.65	-0.60	-0.68	-0.62	-0.61	-0.61	-0.75	-0.75	-0.816	1

Source: Own study based on research.

It can be seen that the closest values to 1 are between most of the variables, suggesting that employees who positively evaluate one aspect of management tend to have similarly positive opinions about others. For example, a correlation of 0.99 between the development of competencies and qualifications and opportunities for professional development shows that these two aspects are closely related. Similarly, the correlation between the balance between work and personal development and access to training and knowledge resources is 0.99, suggesting that employees expect these elements to interact with each other.

Also interesting are the relatively lower correlations, such as .83 between recognition and rewards for achievement and work flexibility and mobility. This indicates that although these factors are related, employees may perceive them as more independent of each other. Even lower correlations are found between building relationships and other aspects, indicating that networking does not always align with other employee expectations.

In turn, the value of -0.816 for expectations regarding support for personal development suggests that this aspect is negatively correlated with many other factors, especially with work flexibility and mobility, networking, and continuous improvement of skills. This may mean that support for personal development is perceived as less important or even incompatible with other expectations regarding more professional aspects of work.

In summary, the correlation table indicates that many employee expectations are strongly related, suggesting that positive satisfaction of one of them can lead to satisfaction in other areas. However, support for personal development seems to be an exception, showing a negative correlation with other factors.

2. Discussion

The conclusions from the conducted research indicate the complexity of employees' expectations towards management methods in agile organizations and the diversity of their priorities. Employees show particularly high expectations regarding the opportunities for professional development, which includes the development of competences and qualifications, access to training and the possibility of practical application of acquired knowledge. These aspects are highly rated, which suggests that employees are looking for an environment that allows them to continuously develop and acquire new skills. High correlation values between these variables confirm their mutual connections. This means that agile organizations that invest in the development of employee competences can count on their positive perception of other management-related activities.

At the same time, it was noted that employees value the balance between work and personal development and flexibility in the context of work and mobility. These elements also found strong support, which indicates that an important factor for employees is the ability to adapt work to their needs and lifestyle. The balance between development and work life is closely correlated with access to training, which suggests that employees prefer management systems that not only support development, but also take into account their time and resources, allowing them to achieve personal goals. Another important aspect is recognition and rewards for achievements. A significant proportion of respondents see rewarding for effort and results as a key motivator. High support rates indicate that employees expect agile organizations to recognize their contribution and achievements, which can be seen as an element building satisfaction and loyalty to the employer.

However, not all aspects received the same high support. Relationship building and networking, although considered important, were not rated as highly as other aspects. The low level of correlation between networking and other expectations suggests that employees may perceive relationship building as less directly related to professional development or as an aspect independent of other key organizational activities. This may be due to networking being viewed more as a personal initiative than as part of the systematic activities of the organization.

It is also worth noting the relatively low level of support for expectations regarding support for personal development. The vast majority of respondents expressed negative opinions on this aspect, which may suggest that employees perceive support for personal development as less important or not in line with the nature of an agile organization. This also results from the negative correlation between this element and other aspects, such as work flexibility or professional development opportunities, which may indicate discrepancies between expectations for professional development and support in more personal areas.

The research highlights the importance of aligning management methods with employee expectations, while recognizing that some elements, such as personal support, may not be equally important to all groups. Understanding these differences can help organizations better align their management strategies, potentially leading to greater employee satisfaction and engagement in agile environments.

Based on these conclusions, practical recommendations for companies can be made. They indicate the need to focus on creating conditions that enable professional development of employees. It is worth investing in systematic training, workshops and competence development programs that allow not only acquiring new skills, but also their practical application in everyday work. Such activities can increase employees' self-esteem and their commitment to achieving the goals of the organization.

Another important area that agile organizations should pay attention to is ensuring work-life balance and flexibility in the context of working time planning. Introducing the possibility of remote work, flexible working hours or reduced working hours can significantly increase employee satisfaction and allow them to better adapt their professional duties to their personal needs. Such an approach also helps maintain long-term motivation and prevents burnout.

It is also worth developing recognition and reward systems that take into account both individual and team achievements. Recognition for effort and visible work results contributes to building loyalty and a sense that the employee's contribution is noticed and valued. Practices such as financial rewards, additional days off or public recognition can increase employee motivation and engagement, which in turn will have a positive impact on their productivity.

Although building professional relationships and networking are not a priority for all employees, it is still worth investing in initiatives that support cooperation and knowledge exchange. Organizing industry meetings, integration workshops or experience-sharing sessions can support the creation of stronger bonds between employees, which in turn translates into better cooperation in teams. However, it is important that these activities are tailored to individual preferences and do not impose a mandatory form of participation.

While support for personal development is not a priority for most employees, it is worth offering it as an optional benefit, available to those who see value in it. This could include the opportunity to participate in mentoring programs, personal development courses or coaching sessions. Such initiatives can be a valuable addition to an employer's offer that enriches the work environment without imposing a uniform approach on all employees.

Understanding the diverse expectations of employees and skillfully adapting management strategies can contribute to building a more friendly and motivating work environment. Companies that can flexibly respond to the needs of their employees and integrate these needs with business goals can gain greater loyalty and increase the effectiveness of their teams. Such an approach not only allows for better matching of activities to the expectations of employees, but also strengthens the position of the organization as an attractive employer in a competitive labor market.

Figure 1 shows the management methods used by the management in an agile organization, which enable achieving high flexibility and the ability to adapt in dynamic market conditions. The methods shown indicate the importance of an iterative approach to task implementation, where a quick response to changes and ongoing adjustment of activities to customer needs and market conditions play a key role. The figure emphasizes that thanks to the use of these methodologies, teams can work more autonomously, which promotes faster decision-making and better work organization.

One of the conclusions resulting from the analysis of the drawing is that these methods, despite different approaches and specific tools, have a common goal - improving efficiency by shortening project implementation cycles and maximum involvement of teams in the process of creating value. It is clearly visible that the emphasis is on cooperation and exchange of information, which allows for faster identification of problems and their solution. These methods also support the building of an organizational culture based on continuous learning and improvement, which in turn promotes the development of employee competences and their motivation to act.

The figure also highlights that this approach to management can lead to better resource utilization and waste reduction, which is especially important in the context of Lean Management. When combined with visualization tools such as Kanban, organizations can better manage workflow and avoid downtime, leading to smoother task execution. In turn, Scrum and Extreme Programming emphasize the importance of close cooperation with the customer and frequent deliveries, which minimizes the risk of the product not meeting their expectations.

The analysis of the figure suggests that the use of agile management methods not only improves operational efficiency, but also strengthens the commitment of employees who, thanks to greater autonomy and management support, feel more responsible for the projects they are implementing. In this way, organizations can better use the potential of their teams, which in the long term translates into their competitiveness and ability to introduce innovations.

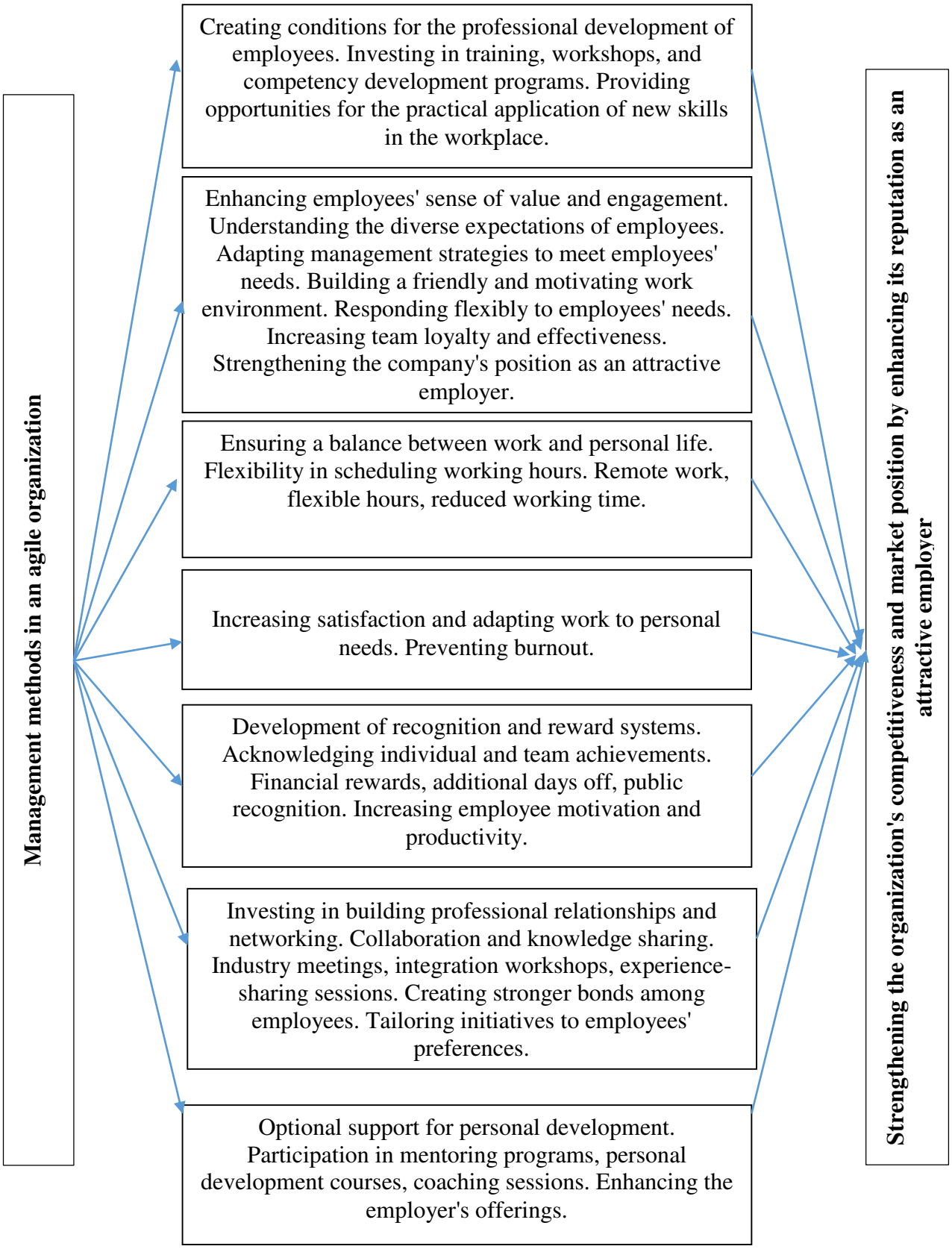

Figure 1. Management methods of the management in an agile organization.

Source: Own study based on research.

3. Conclusions

The research results obtained in this article are worth comparing with the research of other researchers. The research results indicate the complexity of employee expectations in agile organizations, especially in the context of professional development, work flexibility and recognition for achievements. Employees value opportunities to develop their competences, which is consistent with other studies that emphasize the importance of continuous improvement of skills and the availability of training in agile organizations. For example, research described by McKinsey (2023) shows that the success of agile organizations depends largely on the ability to support employee development and create an environment conducive to learning and experimentation. Agile teams are characterized by high dynamics and the ability to quickly respond to changes, which is supported by professional development and coaching (McKinsey & Company, 2023).

Similar results are confirmed by research on the approach to professional development in organizations during the pandemic. As noted in research published by Emerald Insight (2021), employees increasingly expect access to tools that enable their independent development, which is particularly important in the context of remote and hybrid work. Organizations must adapt their strategies to meet these expectations, which includes a greater emphasis on flexibility and personalization of development paths (Emerald Insight, 2021). Armstrong and Taylor (2020) also point out that professional development is key in the context of human resources management, and employers should provide opportunities for competence development in line with the needs of the organization and employees.

At the same time, research indicates the importance of work-life balance, which is particularly valued by employees of agile organizations. Examples of such activities include supporting a balanced work style and the ability to adjust the work schedule to individual needs, which positively affects engagement and job satisfaction (McKinsey & Company, 2023).

It is worth noting that despite the general trend towards flexibility and professional development, some aspects, such as networking or support for personal development, do not enjoy the same high level of support. McKinsey research indicates that agile organizations often focus on the autonomy and independence of teams, which may explain the lesser importance of building relationships in formal structures (McKinsey & Company, 2023).

In conclusion, both the results of the described studies and other analyses indicate that agile organizations that invest in professional development and work flexibility can count on higher employee engagement and satisfaction. However, it is crucial to understand the diverse priorities of employees and adapt management strategies to them.

Future research directions could focus on in-depth analysis of individual aspects of management in agile organizations and their impact on different groups of employees. An important research area could be a more detailed understanding of how investing in

professional development, as well as access to training and practical knowledge, affects long - term employee engagement and retention in the organization. Research could also include analysis related to the effectiveness of development programs in the context of different industries and taking into account the specifics of the labor market.

Another research direction could be to analyze the role of work flexibility in shaping job satisfaction and work-life balance, especially in the context of different age and professional groups. This could include research on the impact of remote work on productivity and a sense of belonging to an organization, especially in dynamically changing work environments. It would also be worth considering the changing expectations of younger generations entering the labor market to better understand their needs and preferences for agile management methods.

Future research could also explore the topic of motivation and recognition, examining which forms of reward are most effective in building employee engagement. It could be important to examine how different reward and recognition systems affect motivation and how these practices translate into team performance. It could also examine whether there are differences in the perception of financial and non-financial rewards among employees from different sectors and levels of professional experience.

In addition, in the context of building professional relationships, an interesting direction could be research on the role of networking in agile organizations. This could include analysis of how initiatives supporting cooperation and knowledge exchange between employees affect the innovation and adaptability of the organization. Research could also include ways in which agile organizations can effectively integrate different generations of employees and promote cooperation between them, which is especially important in the context of a rapidly changing labor market.

Given the relatively low level of support for personal development support, future research could explore how this aspect could be better integrated into human resource management. This could include investigating whether and how personal development support can affect long -term employee satisfaction and loyalty, and what forms of support are most desired by different professional groups. Research could also examine whether employees' preferences in this regard change depending on the phase of their careers.

In summary, future research directions should focus on better understanding the diverse needs of employees and on finding ways in which agile organizations can adapt to these needs. Enriching research with more diverse perspectives and comparative analyses can allow for the development of more effective management strategies and contribute to increased competitiveness of organizations in the market.

The research conducted to identify employee expectations towards management methods in agile organizations had some limitations that are worth considering when interpreting the results. The first limitation was the method of data collection, based on a survey, which, although it allows for collecting a large amount of information, may also limit the depth of the

answers. The survey does not provide an opportunity for an in-depth understanding of the motivations and emotions of respondents, which could be better captured in individual or group interviews. The results may only reflect declared opinions, which may differ from the actual attitudes and behaviors of employees in practice.

The second limitation was the focus on a sample of 1018 respondents, which, while a large group, may not fully reflect the diversity of experiences and expectations of all employees working in agile organizations. The sample may have been limited geographically or by industry, which affects the ability to generalize the findings to other sectors or regions. The lack of full representativeness may affect how the research findings can be applied in practice by different organizations.

Another limitation was the specific time of conducting the research, which took place in the period January-March 2024. This time could have affected the results due to specific market circumstances, such as the economic situation, changes in the labor market or even seasonality in the demand for labor. The results could have been different if the research had been conducted at a different time, especially in the context of a dynamically changing labor market. Another significant limitation was the form of the survey response, which may not have taken into account all possible answer variants, which could have influenced the way respondents answered. This may lead to the phenomenon of incomplete generalized analysis, where some important aspects or subtle differences in expectations may have been omitted. This limitation results from the nature of standardized research tools, which, on the one hand, allow for easy data analysis, but on the other hand limit a deeper understanding of the phenomena being studied.

In addition, the analysis did not take into account dominant preferences, such as calculating the mode for each variable, which could have provided a more precise picture of which answers were chosen most often. Although the correlation analysis provided important information about the relationships between individual factors, the lack of mode analysis may limit the understanding of detailed trends and the most frequently chosen options by respondents.

Finally, the interpretation of the results may also have been partly subjective, due to the need to translate complex survey data into specific conclusions and recommendations. Researcher influence on interpretation may affect the way conclusions are formulated and what aspects are emphasized, which may introduce a degree of interpretive bias. Future research could expand on these limitations by including more diverse research methods and a broader representation of respondent groups to obtain a more complete picture of employee expectations in agile organizations.

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ORGANIZATIONAL RESILIENCE AND ITS CONTEXTS – A SYSTEMATIC REVIEW OF THE LITERATURE

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Purpose: The purpose of this paper is to identify and highlight key contexts of organizational resilience discussed in publications from 2010 to 2022.
Design/methodology/approach: This article is based on a systematic literature review conducted using the Web of Science and Scopus databases for the period from 2010 to 2022, with additional studies from before 2010 and from 2023 included to capture significant developments in the field.
Findings: The findings of this study indicate a need for further research on building organizational resilience across various contexts, including external threats such as economic and financial crises, natural disasters, the COVID-19 pandemic, cybersecurity issues, and military conflicts.
Research limitations/implications: The main limitations of our article stem from the selection criteria applied to publications in the Web of Science and Scopus databases. The core phrase chosen was 'organi?atio* resilience' AND context, within the categories of Management, Business, Economics, Business Finance, Management and Accounting, and Econometrics and Finance.
Practical implications: The discussion and findings presented here will provide a foundation for developing a questionnaire on building organizational resilience from a sustainable development perspective.
Social implications: The presented content has helped in capturing the most important contexts of organizational resilience discussed in publications during the period under investigation. These contexts will be incorporated into the questions for a survey on building organizational resilience from a sustainable development perspective.
Originality/value: The article has helped identify the most important contexts of organizational resilience. These contexts will be incorporated into the questions for a survey on building organizational resilience from a sustainable development perspective.
Keywords: organizational resilience, context, systematic review of the literature.
Category of the paper: Literature review.

Introduction

"Make your organization more resilient" seems to be the buzz phrase in management practice recently (Hillmann, Guenther, 2021). Initially introduced by Holling (1973), the term reflects two main aspects: an organization's capacity to return to a state of equilibrium (engineering resilience) and the extent of disruption a system can endure before reaching collapse (ecological resilience). Over the years, numerous definitions have emerged, encompassing:

- an organization's ability to endure, adapt, and grow amid change (Fiksel, 2006);
- its capacity to recover post-disruption (Burnard, Bhamra, 2011);
- the preparedness to anticipate and respond to disruptions, ensuring survival and continued success (British Standards Institution, 2014; Torabi et al., 2015);
- a dynamic capacity for adaptation, evolving and growing over time (Hamsal et al., 2022; Barton, Sutcliffe, 2023);
- an overarching concept enabling not only continuity but also growth, learning, and progress, regardless of surroundings' challenges (Bhamra, 2015).

Additionally, Rahi (2019) expanded on this by defining "project resilience" as the capacity of the project system to be aware of its surroundings and vulnerabilities, and to adapt in order to recover from disruptive events and achieve its objectives.

Based on a broad literature review, Hillmann and Guenther (2021) proposed an integrative model of organizational resilience, emphasizing the importance of resource mobilization and resilient behavior. According to this model, organizational resilience is the ability of an organization to maintain functions and recover fast from adversity by mobilizing and accessing the resources needed. An organization's resilient behaviour, resilience resources and resilience capabilities enable and determine organizational resilience. The result of an organization's response to adversity is growth and learning.

The definitions of organizational resilience across researchers highlight the necessity for a comprehensive review of the most recent literature. The systematic literature review conducted in this study aims to consolidate various perspectives and provide an understanding of resilience in today's volatile environment.

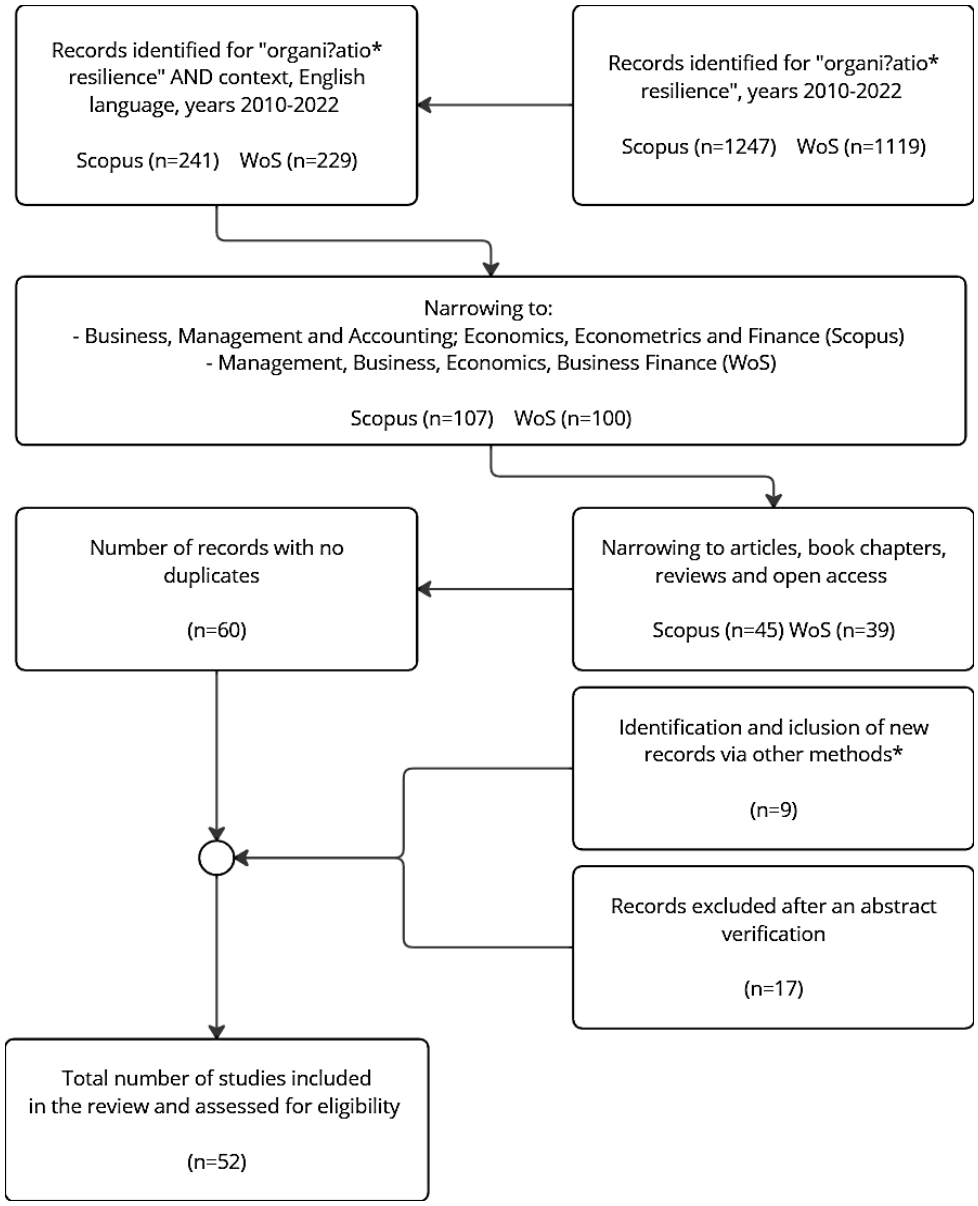
For this review, publications from Web of Science and Scopus were analyzed, with notable studies published prior to 2010 also referenced. Given the growing relevance of resilience in addressing global challenges, this review lays the foundation for future research, representing the initial phase of a broader project at the Department of Business Management of the University of Economics in Katowice, titled 'Organizational Resilience in the Perspective of Sustainable Development".

Methodology

To conduct the study and to identify the main contexts of organizational resilience we have employed a systematic literature review aimed at identifying various conceptual dimensions of organizational resilience. We believe that literature reviews play an important role in academic research. However, systematic reviews face challenges such as lack of authoritative protocols (Paul et al., 2021) which influences also the planning phase (Xiao, Watson, 2019). To avoid most of them our systematic literature review was inspired by the PRISMA model (Lenart-Gansiniec, 2021; Page et al., 2021), which emphasizes transparency and rigor in the research process. The work done involved several stages. Starts with the identification of relevant studies through predefined search criteria, followed by the screening and application of inclusion and exclusion criteria to manage volume of literature. Eligibility of records were based on authors assessment of their relevance and quality, ensuring that only robust research contribute to the final synthesis of findings (Goertel, 2023). This structured approach aimed at enhancing the credibility and reliability of our review, particularly in light of the dynamic and increasingly complex nature of organizational resilience (Bhamra et al., 2011).

The first step involved selection of relevant keywords to facilitate the search and contextual analysis. The primary term, "organizational resilience," was selected on basis of its relevance to the study's objectives. It aligns with our research focus, referring to the ability of entity to sustain its operations in the face of surprising, uncertain, unstable conditions. This search was conducted with the use of the Web of Science (WoS) and Scopus databases. The scope was further refined to include only specific categories: for WoS, these are Management, Business, Economics, and Business Finance, while for Scopus database, Business, Management and Accounting, along with Economics, Econometrics, and Finance were selected. The decision to limit the review to these categories was made to ensure a targeted approach within the most relevant academic fields for our study. Additionally, the identification of new records was carried out by incorporating important studies published before 2010 and those from 2023, as of the date of article selection conducted in June 2023.

This timeframe includes all the most recent available works up to the end of May 2023. Following the initial search, a thorough screening process was applied. Studies that did not directly engage with the topic or align with the research objectives were excluded from the final analysis. This refinement process ensured that only the most relevant articles remained. Finally, a total of 52 studies were included in the review, forming the basis for the comprehensive literature analysis. The following stages of the process of selection, along with the number of results obtained, are illustrated on diagram on Figure 1.



* New records include studies published before 2010 and those from 2023, that were identified as significant by the authors, which were added based on the article selection conducted in May 2023.

Figure 1. The diagram of the stages of a literature review and the number of results.

Source: own work on a basis of Scopus and Web of Science search engines.

Results

Upon reviewing the selected publications, it is evident that organizational resilience lacks a singular, definitive context. Existing research of organizational resilience primarily focuses on the factors that enhance or detract from an organization's viability in the face of threat. While this organization level focus makes important contributions to theory, organizational resilience is also intrinsically dependent upon the resilience of broader social-ecological

systems in which the firm is embedded. Moreover, long-term organizational resilience cannot be well managed without an understanding of the feedback effects across nested systems. In opinion Williams, Whiteman and Kennedy (2021) in the wake of increasing ecosystem volatility induced by climate change, interest in organizational resilience is growing with managers keen to become more adaptive and protect their organizational assets and revenue streams. Yet, we currently have little knowledge of how efforts to enhance organizational resilience may interfere with the natural adaptive cycle of ecosystems, detract from social-ecological resilience and feed back to the organization over time and across spatial scales. They believe that the natural sciences offer organizational scholars the conceptual basis to move toward a more holistic and long-term understanding of cross-scale resilience and the crucial role of organizations.

Korber and McNaughton's (2018) analysis broadens the conversation by linking resilience to entrepreneurship, identifying six research streams. The purpose of their paper was to review existing literature at the intersection of resilience and entrepreneurship. Their paper identifies six research streams at the intersection of entrepreneurship and resilience: resilience as traits or characteristics of entrepreneurial firms or individuals, resilience as a trigger for entrepreneurial intentions, entrepreneurial behavior as enhancing organizational resilience, entrepreneurial firms fostering macro-level (regions, communities, economies) resilience, resilience in the context of entrepreneurial failure, and resilience as a process of recovery and transformation. The review revealed publications imprecisely define constructs and use a limited amount of the extant scholarship on both entrepreneurship and resilience. In their opinion more research should take a more holistic approach to explore entrepreneurship and resilience from a multi-level and longitudinal perspective, especially in the context of socio-ecological sustainability.

Disasters, crises and conflicts frequently serve as contexts for organizational resilience discussions. The 2008 financial crisis prompted questions about the role of CEOs and corporate governance (CG) in banks' resilience to shocks, such as the Lehman Brothers collapse of September 2008 (September 15, 2008 – the date of Lehman Brothers bankruptcy). Buyl, Boone and Wade (2017) found that CEO narcissism was associated with higher risk-taking— reflected in the riskiness of banks' policies. Moreover, they found that this effect was even stronger when narcissistic CEOs were explicitly incentivized towards risk-taking (through stock options), but weaker when these CEOs were more effectively monitored (through the presence of knowledgeable outsider directors). Hence, their findings suggest that it is the combination of CEO narcissism and specific CG practices that leads towards (excessive) risk-taking.

Similarly, Sajko et al. (2021) examined (i) how CEO greed affects corporate social responsibility (CSR) and (ii) how these affect firms' resilience to systemic shocks. They suggest that greedy CEOs are less likely to invest in CSR, especially these strongly motivated by bonuses, threatening the resilience of their firms. They advocate for condemning such behavior to protect organizational integrity.

In war-torn environments, Noor and Walsh (2020) explored the (un)ethical dilemmas faced by managers. War-induced violence disrupts rational management practices, replacing them with improvised, often unethical behaviors and relationships that resemble the "tribal" ones. These new norms complicate standard business operations, dividing wartime management into three main areas: practical aspects of managing in situations of adversity, coping mechanisms, and ethical challenges.

Walker et al. (2020) explored the resilience of diverse organizations, providing essential services to the public, following earthquake disruptions. Their research highlights four critical areas that substantially influence resilience at the organizational level. These include:

- the nature of leadership and situational awareness at senior and middle levels,
- the degree to which organizations are employee-oriented,
- internal and external cooperation,
- the scope of both informal and formal learning among individual employees as well as the organization as a whole.

These key areas, according to the authors, should be viewed as the adaptive capacity of the organization.

The study of Martinelli, Tagliazucchi and Marchi (2018) contributes to the scientific debate on organizational resilience in disaster management, studying it through the lens of dynamic capabilities (DCs) and social capital, and analysing the role of different types of DCs in developing entrepreneurs' resilience during the various periods of a natural disaster. They prove that DCs and social capital are instrumental to enhancing organizational resilience; moreover the contribution of each category of DCs (reconfiguration, leveraging, sensing and interpreting, learning and knowledge integration) and social capital to entrepreneurs' resilience changes according to the temporal phase of the natural disaster under analysis.

The pandemic crisis is another phenomenon that has prompted many researchers to reflect on organizational resilience in various types of enterprises. The lockdown has caused many activities to move to virtual reality. It is therefore reasonable to ask how digitalization has affected the resilience of enterprises. In this context, Bürgel, Hiebl and Pielsticker (2023) ask two questions:

- Whether higher levels of digitalization increase entrepreneurial firms' resilience to pandemic-related crises?
- How context factors (e.g., level of globalization, family firm status, firm size, industry, strategy, prior performance, transformational leadership style, and regional embedding) impact the digitalization–crisis resilience relationship?

Research indicates that globalized and non-family businesses demonstrated greater resilience to the crisis, if they had pre-existing digital capabilities, such as a digitized business model. Enhanced digitalization can be viewed as facilitating cross-cultural interactions, which provide such benefits as technology transfer and knowledge exchange as well as international

trade continuity to globalized and non-family businesses. While digitalization doesn't fully protect these businesses against pandemic impacts, it significantly aids communication despite reduced face-to-face interactions. The pandemic has proven that digital technologies have a profound effect on how organizations systematize and manage their work, and how they create and deliver value to customers. The recent devastating events in Ukraine support this perspective—many Ukrainian companies "quickly switched back" to online-only ways of working. In informal conversations, Ukrainian managers told us that their employees moved across different regions within Ukraine and to different countries in Europe and that the experience with digital technologies that they had gained during the pandemic eased that transition (Minbaeva, Navrbjerg, 2023).

In their efforts to adopt new technologies and their applications, organizations must consider managing the risks associated with the digital environment. Therefore, digital business resilience and cybersecurity are increasingly becoming the context for building organizational resilience. Garcia-Perez et al. (2023) suggest a positive correlation between organizations' effort put in cybersecurity training for employees and subsequent cybersecurity spending increases. Training staff in cybersecurity enhances intellectual capital, building a knowledge foundation across operational and management levels. Trim and Lee (2022) further highlight that cybersecurity, as a strategic management priority, is essential for resilience. They argue that managers should gain insights into the applications, operations, and strategic potential of artificial intelligence to strengthen organizational resilience.

The COVID-19 pandemic is also a context to study the drivers and performance outcomes of organizational resilience in young technology firms. Anwar, Coviello and Rouziou (2023) showed that the individual resilience of top management team members and the level of inter-functional coordination among key areas are positively linked to organizational resilience. In turn, organizational resilience strengthens performance in the face of an adverse environmental shock.

The COVID-19 pandemic triggered significant changes worldwide, and the negative impact was severe in the business environment, requiring immediate decisions to counteract the emerged disruptions. Such difficult phenomena enhance the need of business continuity and resilience, as well as crisis management capabilities for enterprises. Stötzer and colleagues (2022) indicate the methods by which nonprofit organisations are managing the disruptive and extreme risks of a pandemic. The results of their study demonstrate that resilience mechanisms founded on behavioural, resource, and capability variables have become instrumental in surmounting the challenges posed by the pandemic. Argatu and Puie (2021) presented an instrument mapping the ability to overcome the pandemic threats by social economy entities. This instrument is based on three pillars: (1) self-awareness (transformative power and valuing internal resources; (2) collaboration pursuits, (the development of a cooperative network among social actors in the community); (3) resilience insightfulness, based on risk assessment activities, business continuity, proactivity towards innovation and increased knowledge.

An issue of development of organizational resilience in social enterprises operating in developing countries was addressed by Littlewood and Holt (2018). They identified the strategic challenges faced by these organizations, along with the essential resources and capabilities required to navigate complex and unpredictable environments.

In response to pandemic threats and related stressors, Bostock and Breese (2023) examine resilience within sports organizations, addressing a gap in the sports management literature by focusing on resilience at the organizational level. Their article addresses a gap in the sport management literature on resilience in being focused at the organisational level. It builds on key themes in the individual/team sport resilience literature in taking a temporal, dynamic approach and linking resilience to performance management. They introduce the Framework for Organizational Resilience Management (FfORM) within the context of sports management, though the model can be applied across various types of organizations.

A key aspect of building organizational resilience lies in securing a competitive market position. Pratono (2022) explores the impact of organizational resilience and marketing communication on competitive advantage, proposing that product development is the primary driver of this position. Findings indicate that product development is less effective at sustaining competitive advantage during periods of high information technology turbulence than in periods of low turbulence. The research identified four general strategic scenarios based on two criteria—information technology turbulence and competitive advantage:

1. Nurturing Innovators (low information technological turbulence, high competitive advantage), based on: promoting product development to maintain competitive advantage, strengthening marketing communication to enhance product development, enhancing resilience to support product development.
2. Anticipatory Innovators (high information technological turbulence, high competitive advantage) based on: allocating additional resources for both marketing communication and organisational resilience to maintain competitive advantage, especially when product development alone is insufficient.
3. Proactive Innovators (low information technological turbulence, low competitive advantage) based on: allocating resources for product development under conditions of low information technological turbulence to foster competitive advantage, accompanied by enhanced marketing communication and organizational resilience.
4. Reactive Innovators (high information technological turbulence turbulence, low competitive advantage) based on: directing additional resources toward marketing communication, as it has a greater impact on competitive advantage than has an organizational resilience.

You and Williams (2023) explore the role of stakeholder relationships in building organizational resilience, focusing on organizations that collaborate with various stakeholders – such as government bodies, suppliers, and customers – to access various resources that strengthen resilience. These relationships, however, create complex and unpredictable

interdependencies with both positive and negative outcomes. Their study shows that certain relational mechanisms (relational competence, innovative assimilation, and integrative trustworthiness) help to build and reinforce a collectively held orientation when responding to disruptions, whereas other relational mechanisms (identity constraints and asymmetry) serve to undermine resilience. The findings in their paper show that "identity constraints" concerning "who we are" in relation to others can create cognitive and emotional barriers for organizations when adapting to a changing environment - identity constraints act to undermine resilience. Managers are encouraged to be critically reflective on these constraints and be prepared to challenge beliefs, assumptions, and behaviors that may obstruct effective learning. Their findings suggest also that interorganizational relationships based on "asymmetry" can be vulnerable to disruptions. This relates to the demarcation of boundaries between an organization and its stakeholders in terms of power and information. The study supports the view that resilience in practice depends on cooperation within the system as a whole (Andersson et al., 2019), and high levels of asymmetry in relationships can lead to uncooperative behavior. Filimonau and De Coteau (2020), on the other hand, highlight that insufficient cooperation both between the company and its stakeholders and among the stakeholders themselves hinders effective planning and disaster recovery. To address these challenges, they propose developing a framework for action to overcome such problems.

Waehning et al. (2023) also draw attention to relationships and network connections. Their paper offers important theoretical insights into how the resilience of breweries, and other small and medium enterprises (SMEs), is shaped by complex interdependencies and networks and how their adaptive responses might strengthen future business models. Authors reveal a range of factors influencing growth in the UK craft beer sector before the pandemic crisis, such as levels of investment and local network ties, and identify a range of strategies implemented by brewers in response to the crisis, including new packaging and supply channels, more intensive marketing and greater online engagement with customers. Analysis of the intersection between aspects of individual and organisational resilience also revealed that dynamic responses to an external crisis depend on individual resilience characteristics before organisational strategies can be developed. Interesting considerations on building resilience in SMEs were presented by Campagnolo et al. (2022). Their paper empirically uses planning for adversity as an anticipation stage of organizational resilience and tests it in the context of immigrant and native-led SMEs. Results support that regularly scanning for threats and seeking information beyond the local community equips immigrant-led SMEs with a broader structural network which translates into new organizational capabilities. Furthermore, results contribute to the proces-based view of resilience demonstrating that regularly planning for adversity builds a firm's resilience potential, though the effect is contingent on the nationality of the leaders.

In reviewing the selected publications for this systematic analysis, it is important to note that many of them focus on building organizational resilience in small and medium-sized enterprises (SMEs) at different levels. Saad, Hagelaar, Velde, and Omta (2021) describe a multidimensional approach to fostering resilience in SMEs operating in developing countries, where environmental disruptions are frequent and complex. They categorize resilience-supporting factors from the literature into three groups: entrepreneurial factors, firm-specific factors, and environmental and interaction factors.

Borms and colleagues (2023) highlighted the need for resilience in SMEs following the pandemic crisis. They explore how circular strategies can help businesses maintain stability, finding that companies with higher circularity scores tend to be more resilient during crises (such as COVID-19) compared to those with lower circularity. Their findings demonstrate that the best results in maintaining organizational stability arise from combining multiple circularity strategies, and they highlight that company size does not impact the adaptability and flexibility of businesses responding to crisis-driven changes.

Eriksson, Heikkilä, and Nummela (2022) present a detailed analysis of the link between SMEs' resilience and a business model focused on internationalization. They identify several critical factors for building resilience in an international context:

- Digitalization of Services: by offering novel digital services, SMEs can deliver higher and more comprehensive value to their customers, strengthening their market position both locally and internationally.
- Strategic Collaboration: choosing the right approach to strategic cooperation – either with a single or multiple partners in host markets – affects resilience. While partnering with one player is simpler, collaborating with multiple partners requires more resources and commitment but enhances resilience by reducing dependence on a single partner.
- Customer Intimacy: continuously developing close relationships with customers in host markets is essential for resilience, as it improves customer service processes and fosters customer loyalty.
- Agile Use of Resources and Expertise: resilience depends on a comprehensive resource base, including both internal resources and those gained through partnerships.
- Improved Revenue Model: implementing an adjusted payment model, such as monthly fees and constant invoicing, provides a steady cash flow and strengthens robustness of the business.

When faced with challenging conditions, rapid access to various forms of resource can be a key determinant of organisational resilience. The concept of social capital offers the potential to provide insights into this process and thereby gain a better understanding of organisational resourcefulness in a time of major disruption. McGuinnessa and Johnson (2014) showed how small and medium sized businesses (SMEs) in a UK case study were able to exploit their social capital for the necessary resources to help them survive the impacts of a severe flood event. Further, the nature of the resourcefulness may display a level of path-dependence related to the

type of business. These preliminary findings show that firms which managed to recover quickly tended to demonstrate high levels of resourcefulness and problem solving capability. They find that flexibility, organisational culture and certain mindsets associated with particular professions e.g. engineering, appear to have a positive effect. Leveraging social capital, that is, the ability to utilise relationships and networks outside of the firm also emerges strongly as a critical factor which allowed some firms to respond and recover more quickly than others.

Intellectual capital plays a vital role in enhancing the resilience of SMEs, as highlighted by Agostini and Nosella (2022). The researchers explore how intellectual capital (IC) components – namely human capital, organizational capital, and relational capital – can bolster SMEs' resilience in face of disruptive changes, such as pandemics. They find that this combination of IC components aids SMEs in adapting to shifting conditions and taking advantage of emerging opportunities. Agostini and Nosella's study marks one of the earliest attempts to explain the relationship between intellectual capital and SME resilience, revealing a strong connection between the two constructs that calls for further investigation.

Another insightful study by Unguren and Kacmaz (2022) examines the relationship between organizational resilience, employer support for employees, and employee engagement. In their opinion employers' investment in their employees within the scope of organisational resilience would positively impact employees' perceived organisational support. Simultaneously, this study found that perceived organisational support positively impacts work engagement. Sources provided to employees, especially social support, play important roles in improving employees' work engagement. They underline, that social exchange theory (Caesens, Stinglhamber, 2014) predicts that employees with higher levels of perceived organisational support may be more devoted to their jobs and more included with the organisation, helping it achieve its goals. In this context, opportunities organisations provide to their employees may improve work engagement and produce maximum benefit and productivity in cases of crises. An important finding obtained in the study was that perceived organisational support fully mediated the effect of organisational resilience on work engagement. Meanwhile, He, Oláh and Morshadul (2022) highlight the important role of social support in building organizational resilience. Their results show that employee psychological ownership and the social supports have a positive effect on organizational resilience, which implies that the key to improving organizational resilience lies in the psychological recognition of employees. They discussed the mechanism of organizational identity, which helps to understand interactions between employee psychological ownership, the social supports, and organizational resilience. Based on emotional cognition, their study found that employees' identification with the organization and acting are key factors in improving organizational resilience.

Hadjielias, Christofi, and Tarba (2022) explore the role of social capital, particularly in managerial responsibilities, in building organizational resilience in response to the COVID-19 crisis. Their study suggests that leadership resilience encompasses three major components:

personalized communication, alertness, and stewardship. In their findings, personalized communication emerges as a key competency that enables owner-managers to psycho-emotionally converse with and support each individual in the workplace in light of the pandemic events. Alertness is a second leadership competency linked to an increased alertness to and monitoring of any potential psychological problems arising within the workplace. A second facet of this alertness is linked to any entrepreneurial opportunities for business change or expansion suited to take advantage of the new conditions or to alleviate any functional issues. Stewardship pertains to the enhanced acknowledgement, made by the owner-managers of small family firms, that they act as actual stewards of their firms and that the latter's survival is merely down to their own actions.

Țiclău, Hințea and Trofin (2021) examine resilience as the ability of a system to adapt to new environmental conditions brought about by the COVID-19 pandemic. They emphasize the importance of resilient leadership as a means of navigating adversity and socio-economic crises. Their findings suggest that government regulations and financial pressures were the primary challenges facing the surveyed companies, irrespective of their sector. Conversely, Župerkienė and colleagues (2021) focus on resilient leadership within SMEs, which, in the context of the pandemic, involves adapting and responding to the crisis, recovering and strengthening the organization, and maintaining continuous, sustainable operations.

Environmental considerations and Environmental Performance (EP) are also becoming essential factors for fostering organizational resilience, especially within SMEs. EP refers to the use of resources to produce goods and services with minimal environmental impact. Marsat and colleagues (2022) demonstrate that high EP significantly boosts resilience in the face of Environmental Controversies (EC). Their research shows that companies with strong EP are more flexible and recover more quickly from controversies, such as EC.

Similarly, Ferrón-Vílchez and Leyva-de la Hiz (2023) highlight that companies, particularly SMEs, which employ social and environmental practices (SEPs) are better positioned to build organizational resilience during crises. Those implementing Corporate Social Responsibility (CSR) prior to the COVID-19 pandemic achieved higher financial performance compared to those that did not. This proactive approach has become a necessary pre-requisite for building resilience and growth. Environmental issues in resilience-building are also linked to Green Supply Chain Management (GSCM) practices. Ullah and colleagues (2022) explain that GSCM implementation by the companies is founded on environmental skills and competitive advantage. Their findings reveal that firms implementing GSCM practices effectively reduce material, energy, and water consumption, resulting in time and financial savings. Through energy-efficient production systems, companies also reduce costs associated with bringing products to market. Overall, the authors conclude that firms adopting GSCM practices are better equipped to withstand economic and financial crises.

Azadegan and colleagues (2019) also examine supply chain disruption management as a component of building organizational resilience. They notice that when supply chain disruptions occur, firms tend to focus on procedural response strategies instead of on flexible approaches, which can actually undermine resilience. Their study also underscores the significant role of institutional pressures from regulators and industry associations in shaping these responses.

Notably, many SMEs are family-owned businesses. Ingram and Bratnicka-Myśliwiec (2019) define organizational resilience of a family business as a dynamic, ambidextrous capability to recover from and positively adjust to an unexpected, adverse situation. They conceptualized organizational resilience along two dimensions: community robustness and creative agility identified as a key duality of organizational resilience in the context of family businesses. Results demonstrate that ambidextrous organizational resilience is positively correlated with the competitive advantage of a family business. They discussed the contribution of the theory of ambidexterity and dynamic capabilities to the understanding of organizational resilience, as well as the implications of the latter for the creation of competitive advantage by a family. Other autors explore the concept of resilience set within a family business context and the influences familiness and the nature of noneconomic factors such as interpersonal relations and relationship dynamics influence organisational performance. Their paper reveals family business as a complex interrelationship between complimentary social-ecological systems. It highlights the nature of threats to family business and potential organisational responses but also adds to this the challenges of relational nature of familiness and how this presents additional layers of complexity in the decision-making process and in implementation (Beech et al., 2020).

Research suggests that a key factor influencing organizational resilience is the decentralization of management. Traditional managerial hierarchies often prove to be ineffective under dynamic environmental conditions (Lee, Edmondson, 2017), in the sense that they inhibit employees and other staff members from responding to these conditions on the spot. Some organizations therefore complement their hierarchical structure with more distributive forms of power. One successful example involves a Dutch firm in which top management, in the face of a severe collapse of its sales and profits, did not lay off employees but listened to an alternative solution offered by an employee, to subsequently turn the situation around and avoid any layoffs (Romme, Georges, 2015). This case as well as other examples illustrates a form of structural empowerment in which employees obtain a substantial amount of influence, including regular opportunities to provide input on tactical and strategic issues (Maynard et al., 2012). In organizational settings, structural empowerment goes beyond the conventional notion of psychological empowerment, which refers to the individual employee's sense of self-efficacy and autonomy. Instead, structural empowerment enables employees to represent their interests in a responsible and self-determined way (Lee, Edmondson, 2017), implying they can directly or indirectly affect decision-making at various levels (i.e. their

formal power) as well as develop connections and interactions with other organizational members (i.e. informal power) (Laschinger et al., 2004). This suggests structural empowerment may have positive consequences for organizational resilience, by enabling the organization to effectively respond to its fast-changing environment (Van den Berg et al., 2022).

Recent publications have explored connections between organizational resilience and feminist themes. Casprini et al. (2023) examined the relationship between goal setting and proactive resilience (measured through two dimensions, i.e. the willingness of the firm to survive in the long run and the attitude of the firm to preserve the environment and be environmentally sustainable). In addition, they took into account attitudes towards proactive organizational resilience represented by women and men who manage companies. In turn, Witmer (2019) offers a contrasting approach, using a feminist lens to critique conventional notions of organizational resilience, which often focus on management processes aligned with traditional masculine structures. Her work aims to reveal and dismantle power dynamics within gendered organizations by challenging dominant practices and discourses that suppress diverse voices, limiting both inclusive resilience practices and inclusive theoretical development in organizational resilience. Typically, in times of high stress, organizations lean on normative masculine approaches – such as rationality and logic – to tackle "tough" problems (Kantur, Iseri-Say, 2015). Organizational resilience is enacted during times of high stress when organizations typically turn to normative masculine practices of rationality and reason to address "tough" problems (Kantur, Iseri-Say, 2015), thereby marginalizing normative feminine practices of collaboration, learning, and creating a safe emotional environment which are equally crucial to organizational resilience (Van Breda, 2016). Resilience thrives best in contexts of shared power, decentralized decision-making, and with team based or network structures (Lengnick-Hall et al., 2011). In contrast, patriarchal structures with hegemonic masculine management practices support an unequal gendered order, which define and limit who has access to resources and to the broader space where innovative decisions are made that could lead to resilience (Billing, 2011). The result of Witmer's (2019) considerations is the presentation of the degendered organizational resilience model. The model analyzes the following three different aspects of organizations: (1) power structure, to identify which resilient practices receive status based on established gendered organizational hierarchies and roles, (2) actions, to identify how resilience is enacted through practices and practicing of gender, and (3) language, to identify how and what people speak reinforces collective practices of gendering that become embedded in the organization's story and culture.

Discussion and conclusions

The contexts discussed for building organizational resilience are not exhaustive. The main limitation of our article is related to the selection criteria used for publications included in the Web of Science and Scopus databases. We focused on sources containing the core phrase "organizational resilience" AND "context" within the categories of Management, Business, Economics, Business Finance, Management and Accounting, and Econometrics and Finance. Our literature review primarily spans 2010-2022, though key publications from earlier years and 2023 were also included for their valuable contributions to the topic.

Our review of contexts that drive the need to build organizational resilience suggests that these contexts are continuously expanding, with new ones emerging over time. Generally, the focus is on assessing an organization's capacity to handle environmental disruptions and establish a new path forward – referred to as building resilience in the organizational dimension. Additionally, resilience can be viewed through a territorial dimension, where it pertains to the collective capacity of actors within a specific geographic area to manage external disruptions (Gilly, Kechidi, Talbot, 2014).

The studies examined most often address issues related to external threats to organizations, such as economic and financial crises, natural disasters, the COVID-19 pandemic, cybersecurity, and armed conflicts. Building resilience in today's business reality also involves leveraging network connections with various stakeholders. It is impossible to separate organizational resilience from the broadly understood organization's resources, their availability, and their ability to be utilized in times of threat. It is worth noting that people are frequently cited as a key resource, along with their individual skills and the ability to work as a team. The competencies of both operational employees and managers are essential.

Many of the publications studied are not only analytical case studies of companies facing the need to build or strengthen resilience against various environmental challenges. They also offer proposals for implementing specific solutions, such as:

- The Laminated Interactional Model (LIM), which addresses a critical gap in the literature on organizational resilience in marketing management in response to the crisis triggered by the COVID-19 pandemic (Vanharanta, Wong, 2022).
- Strategic Management of Organizational Resilience (SMOR), which aids organizations of various complexities in understanding their strengths and weaknesses, assessing internal and external processes, gaining a more detailed understanding of risk management, and fostering a culture of resilience (Moura, Tomei, 2021).
- Control mechanisms, both formal and informal, related to managerial control (Frare et al., 2023).

Building resilience is a universal issue affecting any entity that aims to survive and thrive in the future. However, numerous publications indicate that it is a particularly significant challenge for small and medium-sized enterprises.

As a conclusion, it is worth adding that the literature review on building organizational resilience in various contexts will be used to prepare survey questions (the survey will be conducted in selected companies listed on the Warsaw Stock Exchange), and the results will be analyzed in the second phase of the research project titled *Organizational Resilience in the Perspective of Sustainable Development*.

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THE IMPACT OF THE ECONOMIC GROWTH ON THE FINANCIAL SECURITY OF THE HEALTH CARE AND SOCIAL ASSISTANCE SECTOR IN POLAND

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Purpose: The study's primary aim is to assess the impact of economic growth on the financial security of the healthcare and social assistance sector from 2008 to 2022.
Design/methodology/approach: The paper consists of a theoretical background and a research part. We created a synthetic indicator of financial security and examined the correlation between it and GDP per capita. Additionally, we developed a statistical model estimated using the Ordinary Least Square method.
Findings: We verify that the financial security indicator of section Q fluctuates in the examined period, although it has a slight positive trend, and that GDP per capita from the two periods before has an impact on its level ($p < 0.05$).
Research limitations/implications: The study limitations are related to the selection of data, the method of calculating correlation coefficients and the OLS estimation method. Additionally, it should be noted that we analyzed the impact of only the level of GDP, which is an important research limitation.
Practical implications: The empirical implications are related to introducing a model allowing for the assessment of the impact of GDP on the financial security of the health sector. Additionally, we have developed a synthetic indicator for assessing the sector's financial security.
Social implications: The financial situation of health care depends on macroeconomic conditions and demand for medical services.
Originality/value: The paper's novelty is developing a synthetic indicator of financial security in section Q and examining the relationship between this indicator and GDP per capita in Poland.
Keywords: economic growth, financial security, the health care and social assistance sector.
Category of the paper: research paper.

1. Introduction

The health care and social assistance sector (section Q) is important for the stable socio-economic development of the country. Providing medical care for the population is one of the basic tasks of the state, and the right to medical care is one of the tasks included in the constitution. Section Q consists of companies that provide broadly understood medical services. The development of enterprises here depends on macro-social factors and those related to the internal situation of enterprises. However, whether endogenous or exogenous factors influence the financial and property situation cannot be clearly stated.

The paper's primary goal is to assess the impact of economic growth, measured by GDP per capita, on the financial security of Poland's health care and social assistance section from 2008 to 2023. Financial security is a financial situation that enables current functioning and future development. Therefore, assessing financial liquidity, profitability, debt level and operational effectiveness is crucial here.

The main research hypothesis is as follows: "The increase of GDP per capita has a statistically significant ($p < 0.05$) positive impact on the financial security of the health care and social assistance section".

The paper's novelty is developing a synthetic indicator of financial security in section Q and examining the relationship between this indicator and GDP per capita in Poland.

We verify the main hypothesis based on the designated synthetic indicators of financial security, linear correlation analysis, Pearson's r, Spearman-s Rho, Gamma and Kendall rank correlation coefficients, Ordinary Least Square (OLS). We check our model's linearity, normality of distribution, homoscedasticity and autocorrelation. The study used data from the Central Statistical Office and Eurostat databases.

The study includes an introduction, theoretical background, research methodology, research results, discussion and conclusion.

2. Theoretical background

Financial security (FS) is a complex, multi-faceted, and variously defined economic category. It is next to important terms such as economic and national security. These categories are close and connected (Szafraniec-Siluta et al., 2024). Maintenance and improvement of financial security is one of the essential parts of the functioning and development of enterprises (Allen et al., 2014; Dovhan, Rippa, 2022; Zaleska, 2024).

FS can be defined as the ability of enterprises to maintain the ability to repay current liabilities and a high level of efficiency in undertaken activities (Franc-Dąbrowska, 2006). Financial security constantly reduces and eliminates targeted monetary risk to secure capital adequacy (Raczkowski, 2014). It may define a state that gives a sense of certainty of existence and a guarantee of its preservation as well as development opportunities; its name can also determine the financial guarantee of the existence and development of the enterprise, which is created as a result of the company's daily, long-term efforts to ensure good financial condition" (Karbownik, 2012, p. 66). By financial security can be understood as "protection of the financial interests of enterprises at all levels of financial relations" (Zahorodniy, Voznyuk, 2007).

Financial security is one of the stages in the company's goal of financial independence. In the first stage, managers strive to obtain financial protection, i.e. a financial situation in terms of liquidity, profitability and debt level that covers current liabilities. The second stage is financial security or a situation that guarantees the existence and development of the enterprise. The third stage that companies should strive for is financial freedom, which, in addition to financial security, also includes financial opportunities to implement even in unforeseen circumstances investment (Karbownik 2012, p. 67).

Financial security can be analyzed at two levels (Karbownik, 2014, p. 18).

- operational means all the financial conditions for the effective and efficient continuation of business activity by an economic entity; good financial standing plays a pivotal role here,
- strategic, emphasizing factors and indicators that influence the long-term development of enterprises.

Accrual and cash ratios are used to assess financial security (Tang et al., 2022). Therefore, data to assess its level comes from all financial statements, including the balance sheet, profit and loss account, and cash flow statement.

Due to the lack of data availability, analyzing cash indicators at the sector level is impossible. Hence, it is necessary to use accrual ratios. Therefore, financial liquidity determines how much an enterprise can cover its current liabilities with liquid assets, i.e., current and increased financial liquidity indicators are determined (Bernardin, Tifani, 2019; Nowicki et al., 2024).

Analysis of profitability ratios, one of the basic indicators for assessing financial security, determines how quickly we will achieve a return on the capital employed in the enterprise. Analysis of the ratio of the result to individual balance sheet items provides answers about the current situation of the business and enables the design of development activities in particular areas. Most often, the higher the profitability ratios, the more favourable the entity's financial situation (Dirman, 2021; Taddeo et al., 2024).

An important debt indicator is the overall financial situation, which is the ratio of external capital (liabilities) to assets. The overall debt ratio is the most general picture of the financing structure of a company's assets. The higher the value of this indicator, the higher the risk the

lender bears. Hence, it is often assumed that a value above 0.67 indicates excessive credit risk. A low level of the indicator proves the financial independence of the company (Özyeşil et al., 2024).

Financial security depends on the following factors (Misztal, 2019; Misztal, Kowalska, 2020):

- external, including legal conditions, level of economic growth, research and development expenditure, and situation on the labour market,
- internal, financial conditions, structure of enterprise assets, management strategies and models, management skills of entrepreneurs.

One of the factors important for financial security is economic growth (Song et al., 2021; Chen et al., 2023). However, the literature on the subject needs to include publications devoted to the statistical assessment of this phenomenon. Although the authors often indicate that this relationship is positive, the strength of the relationship in section Q still needs to be explored.

3. Research methodology

The research was conducted on Poland's health care and social assistance sector (section Q) from 2008 to 2023. The data for the study were taken from the Central Statistical Office and Eurostat databases; they are annual. We want to analyze how financial security was shaped over the period studied and whether events such as the economic downturn from 2008 to 2012 and the COVID-19 pandemic impacted the FS level in section Q.

However, the main goal of the study is to assess the relationship between economic growth and financial security in section Q. Therefore, we have put forward the following research hypothesis "The increase of GDP per capita has a statistically significant ($p < 0.05$) positive impact on the financial security of the health care and social assistance section".

The study was conducted in the following stages:

- synthetic indicator of financial security was determined,
- the relationship between GDP per capita and financial security was examined using Pearson's r, Spearman-s Rho, Gamma and Kendall rank correlation coefficients,
- a single-equation model was created; which was estimated using the ordinaryleast squares method.

We create financial security indicator (FS) based on:

- stimulants: classic current liquidity ratio (liquidity of the third degree), classic quick liquidity ratio (liquidity of the second degree), net return on sales (ROS), return on total assets (ROA), return on equity (ROE), total assets turnover ratio, equity share in asset financing (self-financing), liabilities coverage ratio with tangible fixed assets,

- destimulants: inventory turnover ratio in days (inventory cycle), receivables turnover ratio in days (receivables cycle), liabilities turnover ratio in days (liabilities cycle), operating cost level ratio, total debt ratio, equity debt ratio - financial leverage, long-term debt ratio.

We use the following formulas:

$$FS_{ij} = \frac{\sum_{i=1}^{n} \frac{S_{ij}}{max\, S_{ij}} + \sum_{i=1}^{n} \frac{min\, DS_{ij}}{DS_{ij}}}{n};\ FS_{ij} \in [0;1] \tag{1}$$

where:

FS_{ij} – the normalized value of the j-th variable in the i-th year,

S_{ij}/DS_{ij} is the value of the j-th variable in the i-th year,

n is the number of metrics.

To assess the relationship between the FS and GDP per capita, we used:

- the Spearmans rang, which we determined based on the following formula:

$$r_s = \frac{\frac{1}{6}(n^3 - n) - (\sum_{i=1}^{n} d_i^2) - T_x - T_y}{\sqrt{\left(\frac{1}{6}(n^3 - n) - 2T_x\right)\left(\frac{1}{6}(n^3 - n) - 2T_y\right)}},$$
$$d_i = Rx_i - Ry_i,\ T_x = \frac{1}{12}\sum_j (t_j^3 - t_j)\ ;\ T_y = \frac{1}{12}\sum_k (u_k^3 - u_k) \tag{2}$$

where:

t_j is the number of observations in the sample having the same j-th rank value of the variable x,

u_j is the number of observations in the sample having the same k-th rank value of the variable y,

$R_x$is the ranks of x in the sample,

$R_y$is the ranks of y in the sample.

- the Pearson's R given by the formula:

$$r_{Pearson} = \frac{\sum_{i=1}^{n}\left(FS_i - \overline{FS}\right)\left(\text{GDP}_i - \overline{GDP}\right)}{\sqrt{\sum_{i=1}^{n}\left(FS_i - \overline{FS}\right)^2}\sqrt{\sum_{i=1}^{n}\left(DGP_i - \overline{GDP}\right)^2}}, r_{Pearson} \in [-1;1] \tag{3}$$

- The Kendall rank:

$$r_{Kendall} = \frac{(\text{number of concordant pairs}) - (\text{number of disordant pairs})}{(\text{numer of pairs})} = 1 - \frac{2(\text{number of concordant pairs})}{\frac{n(n-1)}{2}} \tag{4}$$

- The Gamma corellation coefficient:

$$r_{Gamma} = \frac{N_S - N_D}{N_S + N_D} \tag{5}$$

where:

N_S - the number of pairs of cases ranked in the same order on both variables,

N_D - the number of pairs of cases ranked in reversed order on both variables.

We also create an equation based on formula:

$$FS = \propto_0 + \propto_1 \cdot GDP + \propto_2 \cdot GDP_{(t-1)} + \propto_3 \cdot GDP_{(t-2)} + \varepsilon_i \quad (6)$$

the residual for each observation is as follows:

$$e_i = FSi - \hat{\propto}_0 - \hat{\propto}_1 GDP_i - \hat{\propto}_2 GDP_{(i-1)} - \hat{\propto}_3 GDP_{(i-2)} - \varepsilon_i \quad (7)$$

We use the OLS regression to estimate model:

$$s(\hat{\propto}_0, \ldots, \hat{\propto}_3) = \sum_{i=1}^{n} (FSi - \hat{\propto}_0 - \hat{\propto}_1 GDP_i - \hat{\propto}_2 GDP_{(i-1)} - \hat{\propto}_3 GDP_{(i-2)} - \varepsilon_i)^2 \rightarrow \min \quad (8)$$

4. Research results

Table 1 presents the number of entities from section Q operating in Poland in 2008-2022. In the period under review, a trend is growing. Entities increase yearly (except for 2018, 2020 and 2021).

Table 1.
Number of entities from section Q operating in Poland in 2008-2022

Poland – section Q	
Year	**Number of entities**
2008	281
2009	313
2010	341
2011	359
2012	396
2013	440
2014	466
2015	470
2016	475
2017	487
2018	476
2019	488
2020	474
2021	470
2022	485

Source: own study on the basis of Eurostat, https://ec.europ a.eu/Eurostat, 25.10.2024.

Table 2 shows the indicator of real GDP per capita (EUR) of section Q entities in Poland in 2008-2022. The average value of this indicator in the period under review is 11 750 EUR (standard deviation 1,894,895 EUR; median 11,390 EUR), while the maximum value is 15,190 EUR (2022), and the minimum is 9180 EUR (2008). The real GDP per capita (EUR) indicator of section Q entities in Poland in 2008-2022 characterises a positive trend.

Table 2.
Indicator of real GDP per capita (EUR) of section Q entities in Poland in 2008-2022

Poland – section Q						
		Descriptive statistics				
Year	Real GDP per capita (EURO)	Mean	Standard deviation	Median	Min	Max
2008	9180					
2009	9330					
2010	9740					
2011	10250					
2012	10400					
2013	10480					
2014	10900					
2015	11390	11750	1894,895	11390	9180	15190
2016	11740					
2017	12340					
2018	13120					
2019	13720					
2020	13720					
2021	14750					
2022	15190					

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, 25.10.2024.

Table 3 presents the values of analytical indicators used to create the financial security indicator of section Q entities in Poland in 2008-2022. Taking into account liquidity indicators, they are at optimal levels. Except the current liquidity indicator in 2010-2012 and 2014, where its level is slightly too low. Profitability indicators should increase year by year; unfortunately, in section Q entities in Poland in the years 2008-2022, the values of these indicators sometimes decrease and sometimes increase (negative situation).

Table 3.
Analytical indicators of the financial security indicator of section Q entities in Poland in 2008-2022

Financial security – analytical indicators, Poland – section Q					
Year	Financial liquidity		Profitability		
	Classic current ratio	Classic quick ratio	Return on sales	Return on assets	Return on equity
2008	1,36	1,25	0,23%	7,69%	16,32%
2009	1,31	1,20	4,89%	6,54%	15,19%
2010	1,19	1,09	3,62%	4,66%	11,39%
2011	1,13	1,02	1,29%	1,58%	3,80%
2012	1,18	1,07	2,88%	3,48%	8,05%
2013	1,3	1,18	3,17%	3,20%	7,15%
2014	1,14	1,03	2,56%	2,46%	5,54%
2015	1,38	1,26	2,77%	2,63%	5,97%
2016	1,36	1,24	1,61%	1,61%	3,73%
2017	1,29	1,17	1,89%	1,90%	4,29%

Cont. table 3.

2018	1,24	1,12	1,47%	1,52%	3,10%
2019	1,3	1,18	2,07%	2,16%	4,63%
2020	1,36	1,22	3,70%	3,78%	8,36%
2021	1,42	1,28	6,16%	7,19%	15,75%
2022	1,35	1,22	3,52%	4,28%	9,29%

Source: own study on the basis of https://wskaznikibranzowe.pl/, 25.10.2024.

Table 4 shows the continuation of the values of analytical indicators used to create the financial security indicator of section Q entities in Poland in 2008-2022. The values of the efficiency of operation indicators - inventory turnover ratio in days, receivables turnover ratio in days, payables turnover ratio in days and financial cost level ratio, should decrease from year to year, which means improvement in the efficiency of inventory, liabilities, and payables management. Decreasing the financial cost level ratio means taking profitable actions that reduce operating costs. In entities of section Q in Poland in the years 2008-2022, the values of these indicators do not always decrease (negative situation). The total asset turnover ratio should increase, but this is also not true in the examined entities (negative situation). The indicator of debt - total debt, equity debt and long-term debt should decrease from year to year (improving the entity's creditworthiness and credibility), which is not always the case in the entities examined. The remaining indicators belonging to this group should increase year by year.

Table 4.

Analytical indicators of the financial security indicator of section Q entities in Poland in 2008-2022

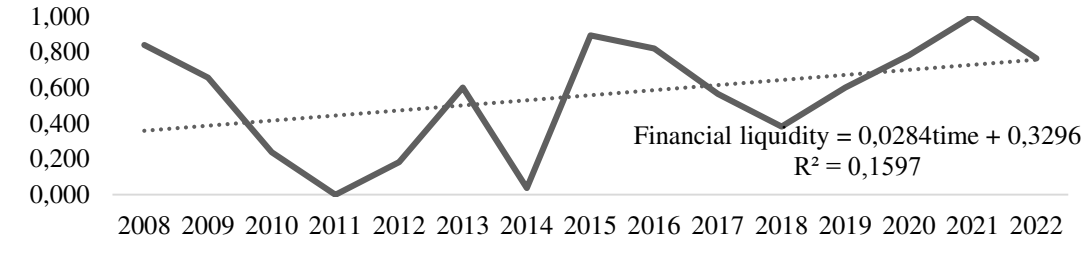
Financial security – analytical indicators, Poland – section Q										
Year	Efficiency of operation					Debt				
	Inventory turnover ratio in days	Receivables turnover ratio in days	Payables turnover ratio in days	Total asset turnover ratio	Financial cost level ratio	Rate of share of equity in asset financing	Total debt ratio	Debt equity ratio	Long-term debt ratio	Liability coverage ratio with tangible fixed assets and total debt ratio
2008	3	41	56	1,47	0,92	47,12%	52,88%	56,92%	59,10%	58,37%
2009	4	42	62	1,34	0,93	43,08%	112,24%	132,14%	144,52%	140,22%
2010	4	46	70	1,29	0,95	40,90%	50,06%	66,09%	69,52%	65,91%
2011	4	44	73	1,23	0,96	41,63%	234,04%	180,59%	185,49%	198,96%
2012	4	45	72	1,21	0,96	43,29%	56,71%	131,02%	58,17%	218,65%
2013	5	46	70	1,01	0,96	44,70%	55,30%	123,71%	59,06%	200,03%
2014	5	48	77	0,96	0,97	44,34%	55,66%	125,54%	55,18%	221,64%
2015	5	50	68	0,95	0,96	43,98%	56,02%	127,36%	60,24%	198,09%
2016	5	47	66	1	0,97	43,21%	56,79%	131,44%	62,18%	195,82%
2017	5	44	70	1,01	0,97	44,17%	55,83%	126,38%	56,73%	209,44%
2018	5	43	67	1,04	0,99	49,04%	50,96%	103,93%	39,73%	274,99%
2019	5	45	66	1,05	0,98	46,74%	53,26%	113,95%	44,95%	246,57%
2020	7	46	73	1,02	0,98	45,21%	54,79%	121,17%	42,51%	262,42%
2021	7	43	64	1,17	0,95	45,63%	54,37%	119,16%	39,46%	273,49%
2022	6	43	65	1,22	0,97	46,05%	53,95%	117,17%	34,12%	315,29%

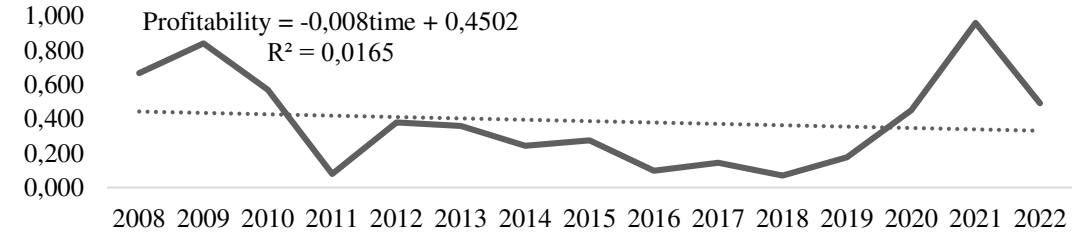
Source: own study on the basis of https://wskaznikibranzowe.pl/, 25.10.2024.

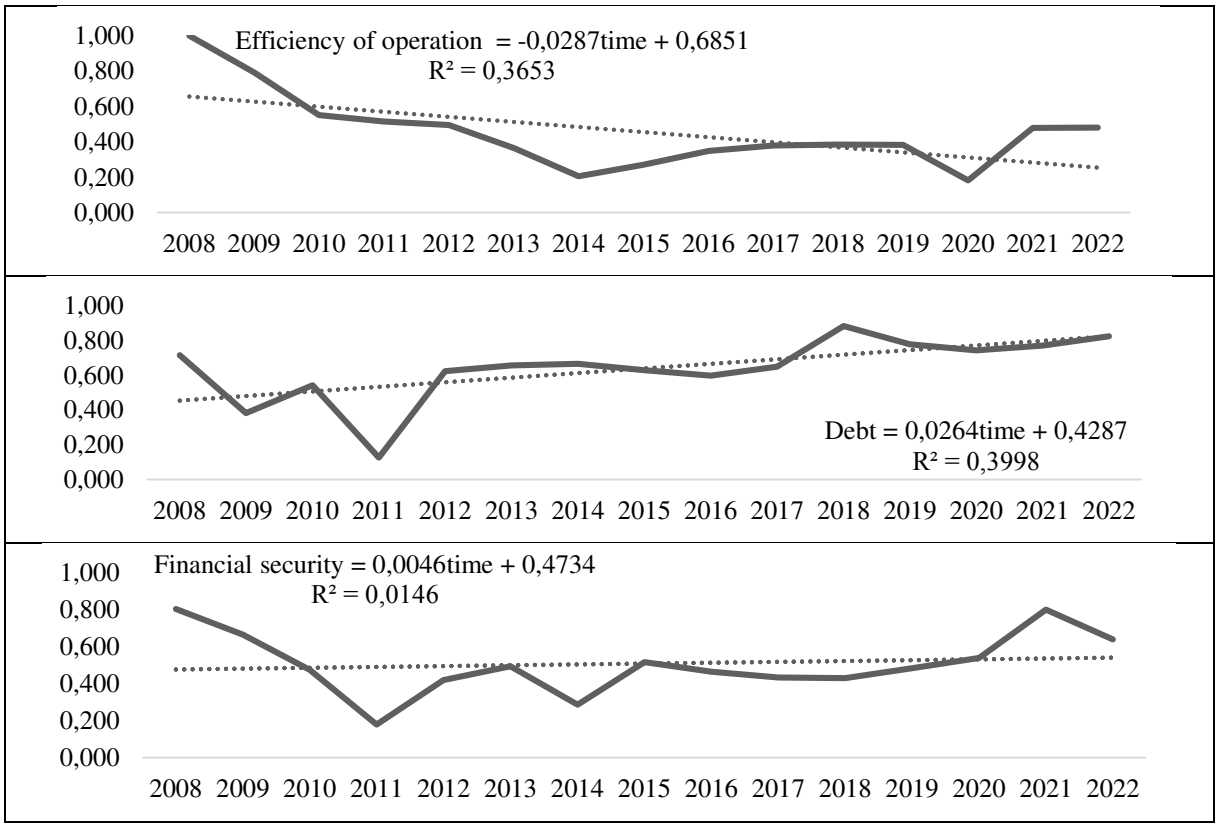
Table 5 presents the synthetic indicator of financial security of entities of section Q in Poland in 2008-2022 (with components). The average value of this indicator in the period under review is 0,510 (standard deviation 0,163; median 0,485), while the maximum value is 0,806 (2008), and the minimum is 0,181 (2011). The synthetic indicator of financial security of entities of section Q in Poland in 2008-2022 characterizes a positive trend.

Table 5.
Synthetic indicator of financial security of entities of section Q in Poland in 2008-2022 (with components)

Poland – section Q						
Year		**Financial liquidity**	**Profitability**	**Efficiency of operation**	**Debt**	**Financial security**
2008		0,839	0,667	1,000	0,717	0,806
2009		0,656	0,838	0,792	0,382	0,667
2010		0,238	0,569	0,551	0,544	0,476
2011		0,000	0,080	0,515	0,127	0,181
2012		0,182	0,380	0,494	0,625	0,420
2013		0,601	0,358	0,364	0,657	0,495
2014		0,036	0,243	0,205	0,667	0,288
2015		0,893	0,275	0,271	0,630	0,517
2016		0,820	0,098	0,348	0,599	0,466
2017		0,564	0,144	0,380	0,649	0,434
2018		0,382	0,070	0,385	0,884	0,430
2019		0,601	0,177	0,383	0,780	0,485
2020		0,781	0,450	0,182	0,745	0,540
2021		1,000	0,959	0,478	0,771	0,802
2022		0,764	0,490	0,481	0,825	0,640
Descriptive statistics	Mean	0,557	0,387	0,455	0,640	0,510
	Standard deviation	0,307	0,267	0,205	0,181	0,163
	Median	0,601	0,358	0,385	0,657	0,485
	Min	0,000	0,070	0,182	0,127	0,181
	Max	1,000	0,959	1,000	0,884	0,806







Source: own study on the basis of https://wskaznikibranzowe.pl/, 25.10.2024.

Table 6 shows the Pearson's R, Spearman-s Rho, Gamma and Kendall rank correlation coefficients between indicator of financial security and GDP, $GDP_{(t-1)}$, $GDP_{(t-2)}$ of entities of section Q in Poland in 2008-2022. The correlation coefficients are statistically significant between financial security and $GDP_{(t-2)}$ of entities of section Q in Poland in 2008-2022. There is a positive relationship between these variables and different levels of correlation coefficients regarding the strength of impact (a moderate correlation ($p < 0,05$, bolded in Table 6)).

Table 6.

Pearson's R, Spearman-s Rho, Gamma and Kendall rank correlation coefficients in the period from 2008 to 2022, $p < 0,05$ ($n = 15$)

Indicators	Correlation			
	Pearson's R	**Spearman's Rho**	**Gamma**	**Kendall rank**
GDP/Financial security	0,201	0,109	0,115	0,115
$GDP_{(t-1)}$/Financial security	0,463	0,365	0,289	0,287
$GDP_{(t-2)}$/Financial security	**0,688**	**0,641**	**0,481**	**0,477**

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, https://wskaznikibranzowe.pl/, 25.10.2024.

Table 7 presents the results of the OLS regression between the indicator of financial security and GDP, GDP(t-1), GDP(t-2) of entities of section Q in Poland in 2008-2022. The results meet the OLS estimation conditions, including no collinearity, homoscedasticity, normal distribution of variables, and no autocorrelation.

Table 7.
Results of the OLS regressions in the period from 2008 to 2022 ($p < 0,05$):
$FS = \propto_0 + \propto_1 \cdot GDP + \propto_2 \cdot GDP_{(t-1)} + \propto_3 \cdot GDP_{(t-2)} + \varepsilon_i$

Dependent variable	Independent variable	Coefficient	Std. error	P-value	R-squared
FS	Const	−0,308	0,221	0,191	0,537
	$GDP_{(t-2)}$	6,96E-05	1,95E-05	0,004	

Source: own study on the basis of Eurostat https://ec.europ a.eu/Eurostat, https://wskaznikibranzowe.pl/, 25.10.2024.

The OLS estimation results indicate that in entities of section Q in Poland in 2008-2022, GDP(t-2) has a statistically significant impact on financial security. The relationship between the examined variables is positive.

5. Discussion

The development of Poland's health care and social assistance (section Q) sector is visible in the increasing number of enterprises that constitute it. This sector needs help with many problems, including financial ones. However, it should be remembered that due to the population's health condition, it is extremely important for stable social development, including improving citizens' quality of life and health (Kieszkowska-Grudny, 2018; Trzeszczoń, 2024).

The results of financial analysis indicators show that the healthcare and social assistance sector needs help with problems in terms of liquidity, profitability, operational efficiency and debt (Kosycarz, 2016; Misztal, 2019). For most of the period, financial liquidity indicators are lower than the assumed level, and what is more, the profitability of the sector, both in terms of profitability of assets, equity and sales, is low (Bożek, 2022).

The research results indicate that the financial security of the sector had a slightly positive trend from 2008 to 2022, with a decrease in the indicator level visible during the financial crisis. Interestingly, the COVID-19 pandemic has positively impacted the financial and property situation of enterprises in the sector, which may be related to greater demand for medical services. We have seen both a slight improvement in liquidity and profitability. The increase in the sector's debt is significant.

The main research hypothesis is true, although it should be noted that only delaying GDP by two periods impacted the financial security of the sector, which may be because macroeconomic conditions are not crucial for the financial security of the health sector.

The empirical implications of the conducted study are related to the introduction of a model allowing for the assessment of the impact of GDP on the financial security of the health sector. Additionally, we have developed a synthetic indicator for assessing the sector's financial security.

Theoretical implications indicate the conduct of a theoretical review of financial security and research methodology.

The study has limitations related to the selection of data, the method of calculating correlation coefficients and the choice of the OLS estimation method. Additionally, it should be noted that we analyzed the impact of only the level of GDP, which is an important research limitation.

6. Conclusion

The financial security of the health care and social assistance sector in the years 2008 to 2022 has a slight positive trend, although it should be emphasized that the financial situation of the sector deteriorated during the financial crisis and improved during the Covid-19 pandemic. It should be emphasized, however, that the liquidity ratio and profitability are still low, and a phenomenon that should also be assessed negatively is the increase in the sector's debt.

Financial security depends on several factors, including the level of GDP. Our research has shown that delaying the economic growth rate by two periods has a statistically significant impact on the sector's financial security level.

We will devote further research to identifying exogenic and endogenous factors important for the financial and property situation of the health sector in Poland and selected European Union countries.

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CONSUMER BEHAVIOUR FROM THE PERSPECTIVE OF BEHAVIOURAL ECONOMICS PRINCIPLES

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Purpose: The paper aims to determine how consumer behaviour and attitudes are shaped in the framework of behavioural economics principles. It analyses input from a survey about purchase decisions, pointing out the critical role of emotional factors in impulse purchases. The survey is preceded with a background of behavioural economics as an interdisciplinary field at the interface of economics and social sciences, including psychology.
Design/methodology/approach: The survey was conducted in 2024 on a sample of 120 respondents. The research tool was a survey questionnaire. The study employed the CAWI technique (Computer Assisted Web Interviewing), whereby respondents fill in an online questionnaire on a computer or mobile device. The respondents could access the questionnaire through social media. The sample consisted of adult consumers of the general product and service market.
Findings: The results show that most respondents are aware of the role of emotions in purchase decisions. The same concerns applying social influence techniques in marketing; half of the respondents are aware they succumb to it. Note that emotions can be effective marketing tools, such as manipulation, when their influence is covert. Individuals with high awareness become more immune.
Research limitations/implications: Behavioural economics is a developing academic field. As a relatively new economics sub-discipline, it facilitates interesting, interdisciplinary research. Today, its area of interest reaches far beyond standard marketing to neuromarketing methods or the application of behavioural tools in the public sector.
Practical implications: The practical application of behavioural economics focuses on guiding purchase decisions through marketing efforts. Moreover, considering the growing interest in and awareness of the effectiveness of behavioural tools, they can be universally deployed in various fields of public policy.
Social implications: Behavioural economics is increasingly widespread in modern decision-making in such domains as economics (financial decisions), marketing (purchase decisions), education, and health care. In general, behavioural economics focuses on all those practical instances where the human factor plays a greater role than was previously expected.
Originality/value: The paper should be of interest to all researchers curious about behavioural economics, i.e. a merger of economics and social sciences. It presents the results of research on emotions and their impact on consumer purchase decisions and consumer self-awareness of susceptibility to social influence.

Keywords: behavioural economics, irrational behaviour, consumer behaviour, emotions, social influence.
Category of the paper: research paper**.**

1. Introduction

Behavioural economics and its impact

Behavioural economics is a rapidly growing subdivision of modern economics. Its characteristic features are interdisciplinarity and association with empirical and experimental research. At its core, it questions the assumption of consumer rationality, which would have the buyer making choices based on an ordered set of preferences. Homo economicus is at the centre of economics theories, classical and neoclassical both (Zalega, 2015; Wilson, 2020).

Behavioural economics focuses on the potential of irrational factors in an individual's decision-making. It investigates the drivers of economic decisions and their consequences (Miller et al., 2016). Therefore, behavioural economics means 'going beyond any limits imposed by the concept of homo economicus' (Zalega, 2015, p. 7).

The interest in behavioural economics has been on the rise since the 1960s (Cartwright, 2011; Mączyńska, 2018; Trogler, 2021). But its origins date much further back. Its roots are believed to lie in psychological behaviourism, connected, in a way, with classical associationism of British empiricism represented by John Locke and David Hume (Graham, 2000; Niemcewicz, 2018). However, in actual fact, the true beginning of behavioural economics was A. Smith's *The Theory of Moral Sentiments*, where he explains that people are not driven solely by their own interests but feel a natural 'sympathy' towards others. This complementary combination of economics and psychology has been obvious for decades (Cartwright, 2011; Geiger, 2014). Then, in the early twentieth century, they both started to function independently, and neoclassical economics abandoned the behavioural context. This perspective was initiated by Vilfredo Pareto, who wrote, 'Pure political economy has therefore a great interest in relying as little as possible on the domain of psychology' (Cartwright, 2011, p. 5), arguing for economists to focus solely on facts instead of motives for behaviour.

Behavioural economics gained much attention recently after Richard H. Thaler was awarded the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 'in 2017 for his contributions to behavioural economics' (The Nobel Prize, 2017). The starting point for Thaler, but also for behavioural economists in general, was their sceptical view of theories of neoclassical economics, which had been the mainstream economics programme since the nineteenth century. The problem economic researchers had with the 'Nobel Prize' for Thaler was that he had disproven many established theories of mainstream economics with

research on individual human behaviour. The main concern was with considering the homo economicus model as the only proper theory for describing the economic decisions of individuals. Thaler demonstrated that cognitive aspects are very important as they affect the economy and market by guiding decisions. Thaler's research was considered ‘a path towards bringing economics theories closer to real life’ (Mączyńska, 2018, p. 247; Thaler, 2016). Note that in its extended grounds for the award, The Royal Swedish Academy of Sciences stated that ‘in total, Richard Thaler's contributions have built a bridge between the economic and psychological analyses of individual decision-making. His empirical findings and theoretical insights have been instrumental in creating the new and rapidly expanding field of behavioural economics, which has had a profound impact on many areas of economic research and policy’ (The Nobel Prize, 2017).

Behavioural economics should not be considered a coherent theory. Instead, it is a mixture of interweaving schools and programmes; a ‘wide, heterodox research project comprising hypotheses, tools, and techniques’. Its primary characteristic is that it opposes the paradigm of classical economics (Polowczyk, 2009, p. 4). Put simply, as a discipline, it focuses mainly on verifying ‘the assumptions of neoclassical and classical economics through results of psychological and sociological research’ (Niemcewicz, 2018, p. 10). According to R. Thaler (2016, p. 1580), ‘behavioural economics (BE) is the science that studies actual behaviour of economic agents and corresponding psychological factors that influence economic behaviour’.

Cartwright (2011, p. 3) defined it thusly: ‘behavioural economics is about understanding economic behaviour and its consequences (…) It's also about understanding whether people make good or bad choices, and could be helped to make better choices’, or from a slightly different perspective: ‘behavioural economics is about applying insights from laboratory experiments, psychology, and other social sciences in economics’ (Cartwright, 2011, p. 4).

Max Witynski pointed out the differences between behavioural and neoclassical economics (Barry, 2022, p. 6). ‘Behavioural economics combines elements of economics and psychology to understand how and why people behave the way they do in the real world. It differs from neoclassical economics, which assumes that most people have well-defined preferences and make well-informed, self-interested decisions based on those preferences. Behavioural economics examines the differences between what people “should” do and what they actually do and the consequences of those actions’ (Barry, 2022, p. 6).

The essence of behavioural economics lies in drawing on the achievements of social sciences, such as psychology and sociology, as well as biological sciences, such as neurobiology, to account for irrational behaviour (Stewart, 2005). Its primary research objective is to analyse human behaviour and driving forces involved in decision-making. Importantly, behavioural economics stands on the shoulders of classical economics and social sciences to more precisely describe economic phenomena. The utmost goal of including psychology in purely economic investigations is to find new approaches and solutions for more effective and precise resolution of problems an individual faces when making decisions. Some of these

choices affect the person's personal and professional future (Miller et al., 2016). With the help of psychological and sociological sciences, behavioural economics endeavours to analyse individuals' behaviour as they make a choice. It strives to demonstrate that when making a decision, the individual is under the constant influence of various limitations, emotional states, and surrounding stimuli. Therefore, the main and primary assumption of behavioural economics is to eliminate any premises of rational decision-making.

Behavioural economics considers a diversity of factors affecting human decision-making. Some notions crucial for the operationalisation of behavioural economics include (Zygan, 2013, p. 13):

a) heuristics is a method of discovery, a problem-solving procedure, and a technique for creative expression of thoughts. Heuristics is a simplified method for assessing and solving problems. A person who employs heuristics in information processing skips some data and 'cuts corners';
b) framing means emphasising a specific perspective, for example, regarding benefits and losses;
c) mental accounting involves assigning costs to 'mental accounts' and considering each separately as a function of potential gains and losses.

Studies in this sub-discipline of economics based mainly on experiments and observations are aimed primarily at analysing and describing behaviour. The primary focus is any behaviour different than 'what economics calls rational' and is considered a 'cognitive bias' (Polowczyk, 2010, p. 1; Kaleta, 2019).

Although neoclassical economists do permit certain cognitive limitations that make individuals 'make bad choices', they do not believe these obstacles affect macroeconomics and tend to disregard them. Behavioural economists, on the other hand, are not convinced. They believe that 'in aggregate, errors do not cancel each other out but rather reinforce each other to be more pronounced and contribute to the fallibility of the economy even more' (Kotlarek, 2014, p. 112).

Congdon et al. (2011) believe that deviations from the principle of rationality helped shape outlooks on decision-making mechanisms. In neoclassical economics, which is the traditional economic theory, individuals are rational in making decisions and strive for maximum profits. However, individuals do not always behave rationally when making decisions (Tversky et al., 2000; Alm et al., 2013; Sijabat, 2018). This is where the space for behavioural economics opens up.

As suggested by R. Sijabat (2018, p. 80), in behavioural economics, an individual's behaviour and actions are considered as resulting from an interaction between two factors:

- 'normative preferences, referring to individual goals and activities believed to promote optimal welfare,
- revealed preferences, the decisions that may not always promote optimal welfare'.

Unfortunately, optimal welfare is not always achievable because an individual's choices and decisions are affected by certain unconscious predispositions or susceptibilities. The first type is emotions, which can belie the reality. Other types include problems due to different perceptions of reality, which in itself can be distorted, fear of new, unfamiliar, undefined situations, and the influence of people around the individual (Kaleta, 2019; Ogaki, 2017). Therefore, one must not disregard the susceptibility of individuals to errors when making decisions, which may lead to decisions not always being in their best interest (Pereira, 2016).

Neuroeconomics is an interesting part of behavioural economics. It employs an interdisciplinary approach whereby brain function imaging is used to improve economic insights. Neuroeconomics is defined as 'a field that investigates the physiological and neural basis of decision-making processes, integrating concepts from behavioural economics with observations of the central and peripheral nervous system to understand the reasons for irrational behaviours and improve human decision-making' (Grewal et al., 2016, p. 143). Neuroeconomics takes it upon itself to explain the decision-making process. According to C.F. Camerer et al. (2005) insights offered by neuroeconomics may affect how researchers investigate two traditional problems of economics: 1) intertemporal choice and self-control and 2) decision-making in circumstances characterised by risk and uncertainty (Miłaszewicz, 2017, p. 259).

R. Yu and X. Zhou (2007) identified research areas that might interest neuroeconomics but also 'significantly contribute to economics theories' (Miłaszewicz, 2017, p. 259). They are:

1) calculation of utility in decision-making: neuroeconomic research confirms previous economics principles of calculating utility.
2) the role of emotions in economic decisions: the traditional economics approach is to ignore the effect of emotions in decision-making. It is mostly because emotions are hard to quantify.
3) economic decisions in the social context because decision-making always takes place in social circumstances. People make decisions based on expectations regarding the potential actions of others and their effects. Neuroeconomic research found evidence to support this view.

By facilitating the combination of economics and psychology, neuroeconomics builds new research methods (Camerer et al., 2005; Greco, 2018). For instance, the results of neuroeconomics paved the way for an economic map of the brain, which offers evidence that certain brain activity is the strongest when the person is making economic decisions (Miłaszewicz, 2017, p. 259). Brain imaging can be considered the most popular neuroscience tool today.

Nevertheless, orthodox economists voice several objections to the core assumptions of behavioural economics. Their criticism focuses on the experimental method employed in the sub-discipline. According to the opponents of the behavioural approach, experiments prevent the generalisation of an individual's market behaviour to entire populations. Especially when

behavioural experiments are set mainly to ‘identify patterns in how individuals or small experimental samples respond to stimuli’ (Zalega, 2015, p. 18; Ogaki, 2017). Other complaints regarding behavioural experiments in economics concern the application of analytical criteria that are difficult to measure, such as influencing an individual's decisions or the impact of the social environment (Niemcewicz, 2018).

Another controversial topic is the investigation of decision-making processes by neuroeconomics, a sub-discipline of behavioural economics. Although critics of neuroeconomics do not question the existence of correlations between brain activities in different areas, they challenge the possibility of identifying unambiguous causal relationships for behaviour. G.W. Harrison (2008) enumerated the main controversies surrounding the use of neurobiology techniques in economics. They focus on two main problems: how neurobiological data are acquired, and how they benefit the economics. These doubts actually concern the ‘idea of insights into the human brain as a way for improving the state of knowledge about economic behaviour’ (Zalega, 2015, p.18).

Consumer behaviour

Consumer behaviour is investigated mainly by sciences interested in ‘various aspects of the purchase process and consumption of goods and services’ (Sobczyk, 2018, p. 171). Economics and management are among them, as are social sciences such as sociology, psychology, and anthropology. The very term ‘consumer behaviour’ was used for the first time in the early twentieth century by an American economist, W.H. Reynolds (Sobczyk, 2018; Schoultz et al., 2022).

Consumer behaviour can be defined as ‘a multidisciplinary subdiscipline of marketing characterised by the study of people operating in a consumer role involving acquisition, consumption, and disposition of marketplace products, services, and experiences’ (MacInnis et al., 2009, p. 900; Malter et al., 2021). Consumer behaviour can also be considered a process involving the ‘acquisition, consumption, and disposition of goods, services, time, and ideas by decision-making units’ (Lee, 2022).

Others define it as ‘the totality of consumers' decisions concerning the acquisition, consumption, and disposition of goods, services, time, and ideas by human decision-making units’ (Hoyer et al., 2008, p. 3). G. Antonides and W.F. van Raaij (2003, p. 24) proposed a much broader view of consumer behaviour. For them, it is ‘mental and physical activities combined with their motives and causes performed by people and groups in a consumption cycle to pursue their goals and values, leading to satisfaction and welfare, taking into consideration individual and societal consequences of these actions’ (Sobczyk, 2018, p. 172).

Research on consumer behaviour covers observation and also analysis of purchase decisions. Economics views these decisions in two ways, as mentioned above. In the traditional perception of classical economics, the consumer is a rational individual for whom marketing factors are critical: the price, product specifications, or place of sale. In this case, the consumer's

financial resources seem to be a critical factor. Whereas behavioural economists see purchase decisions differently. For them, the consumer can be irrational in their choices and subject to certain subconscious processes (Porowska, 2016, p. 72). As noted by Niemcewicz (2018, p. 13), 'observations offered by behavioural economics tore down two pillars of homo economicus: self-interest and rationality of choice' (Kesternich et al., 2017).

The literature offers a variety of models representing the consumer decision-making process. R. East, M. Wright, and M. Vanhuele (2014, p. 20) proposed three main consumer decision models:

- 'The cognitive model assumes consumer decisions are based on rational analysis. The consumer reviews all potential gains and losses connected with each product or service.
- The reinforcement model, where consumer decisions result from the environment, especially rewards or losses brought by the decisions. Such reinforcements can be positive or negative.
- The habit model, where consumption behaviour stems from learnt behaviour, which is moulded by the setting and society. This model is very general and assumes a properly functioning market of goods and services' (Żak, 2017, pp. 29-30).

An analysis of the problem of purchase decision-making requires considering two important aspects: cognitive and motivational. The cognitive aspect is related mainly to the individual's subject-matter knowledge, 'which allows them to formulate possible variants of actions and participate in the consequences of the actions' (Szcześniak, 2020, p. 379). The other motivational aspect enables the consumer to verify the market offering by evaluating the attractiveness of the variants they choose from.

Consumer behaviour is affected by numerous factors. Internal factors include personality and demographic determinants, such as sex, age, education, income, or lifestyle. Other internal drivers are psychological determinants, including personality, motives and habits, perceptions of attitudes, learning, risk tolerance, and lifestyle. Some external factors that affect an individual's economic decisions are such economic factors as price, income, place of sale, and advertising. Social and cultural determinants of consumer behaviour are mainly social groups, reference groups, or trendsetters (Zwierzyński, 2017; Tatlilioglu, 2014).

The literature divides the factors into cultural and marketing forces, considering the diversified attitudes to the problem. Moreover, as noted by Korneta and Lotko (2021), the broad range of classifications stems from differences in the characteristics of purchase decision conditions in different industries and for different customer segments.

Recently, marketing efforts have been more focused on psychological aspects. This approach is consistent with the concept advocated by representatives of behavioural economics (Porowska, 2016). People are usually oblivious to the processes in their minds and cannot judge how much their behaviour is affected. Nevertheless, this shortcoming does not prevent the consumer from offering seemingly logical arguments justifying the behaviour.

Notably, the consumer perceives their behaviour as completely under their control, while the truth may be quite the opposite. This information is pivotal for market research (Graves, 2010).

According to A.J. Kimmel (2013), there are five psychological aspects affecting consumer behaviour: personality and lifestyle, motivation, perception, decision-making, and social behaviour. Purchase decisions are formed by combining these aspects with consecutive stages the consumer passes through. The stages were defined by M.R. Solomon (2019). They are: 'problem recognition, information search, evaluation of alternatives, product choice, and post-purchase evaluation' (Schoultz, 2022, p. 1). The decision is realised during these stages the consumer has to go through.

According to H. Mruk (2017, p. 85), new research methods are the key to a 'higher-level' understanding of consumer behaviour. It concerns mainly investigations into the brain's response to stimuli facilitated by new technologies. H. Mruk (2017) gives an example of EEG (measurement of electrical activity in the brain), which can visualise the activation of individual parts of the brain. Other instances include fMRI (functional magnetic resonance imaging), which tests brain activity (controversial because of its invasiveness) and eye-tracking devices. The latter can be used to learn which shelf and which specific spot the consumer watches and for how long.

Consumer behaviour investigation methods are thriving, and many more are used than just those listed above (Mruk, 2017; Chrysochou, 2017). Some institutions today use proprietary, patented tools in addition to generic research methods. Their research capabilities include testing brain responses to advertising videos, useful for business.

Still, such tests come with no fewer than two problems. First of all, the fact that one can identify the response of a specific brain area to a stimulus, such as structures linked with emotions, does not mean that the stimulus will cause a specific consumer behaviour. It is because decisions are usually driven by several stimuli (Mruk, 2017, p. 85).

The other problem with neuromarketing research is ethical. Its opponents argue that it may reinforce marketing manipulation and choice creation (Niemcewicz, 2018; Harrison, 2008). Therefore, it is necessary to obtain an ethics committee opinion when designing an experiment or brain research method. The committees grant recommendations regarding the research before it is commenced. It is a new and specific situation compared to classical marketing research, which employs mainly quantitative methods or primary data analysis, such as statistics (Mruk, 2017, p. 87).

2. Research methods and results

The primary objective is to determine how consumer behaviour and attitudes are shaped in the framework of behavioural economics. It analyses input from original research on purchase

decisions, pointing out the important role of emotional factors in impulse purchases. The point of reference for the survey is the background of behavioural economics as an interdisciplinary field at the interface of economics and psychology presented above. Moreover, the survey results for active consumers identify sales process manipulations and consumer self-awareness of their susceptibility to social influence.

The survey was conducted in 2024 on a sample of 120 respondents. The research tool was a survey questionnaire. The study employed the CAWI technique (Computer Assisted Web Interviewing), whereby respondents fill in an online questionnaire on a computer or mobile device. The respondents could access the Google Form questionnaire through social media.

The CAWI method was used because it is very often employed in market and opinion research. It offers quick and easy data acquisition from a large number of respondents, which ensures a complete insight into opinions or a market. The sample was diversified in terms of age, sex, residence, and education.

It consisted of adult consumers of a wide product and service market. Most of the respondents were women (nearly 54%). Another dominant subgroup were younger people; participants under 44 constituted over 69% of the sample. The least numerous were seniors aged 65 and more. The small share of the oldest participants is not surprising because of the survey method (an online questionnaire).

The largest group were respondents with secondary education (about 34%), and over one-fourth of all the participants had occupational educational background. The smallest group in terms of education were people with primary education (only 8%). A university degree was declared by 18% of the sample. Most of the respondents were married (nearly 53%) (Table 1).

Table 1.
Respondent profile by sex, age, marital status, and education [%]

Specification		**Respondents**
Sex	F	53.8
	M	46.2
Age	18-14	22.1
	25-34	23.3
	35-44	24.0
	45-54	12.7
	55-64	11.7
	65 and over	6.2
Marital status	married	52.6
	single, divorced, widow/er	47.4
Education	primary	8.2
	basic vocational	25.4
	secondary	34.2
	post-secondary	14.2
	higher	18.0

Source: original work.

An investigation into the purchase decisions of the respondents should start with their declarations of where they shop most often (including online stores). Another worthwhile driver is the answers specifying factors significantly affecting their purchase decisions. Both questions were multiple-choice questions.

Responses to the first one indicated that the respondents most often shopped in supermarkets (about 67% of the answers). Slightly less popular, but still important, was shopping in shopping centres and online (both about 50%). The respondents were much less eager to choose corner shops (about 21%) and local open-air markets (nearly 13%).

The next question investigated what guided the respondents the most during shopping. The most common option was price. It was critical for over 86% of the sample. Slightly less popular drivers were special offers (71%) and quality (61%). A third-party opinion from friends, family, or a public figure seemed to be rather important for about one-fifth of the respondents. The least weighty factor for purchase decisions was comparison with another brand. This option was selected by a few respondents (Figure 1).

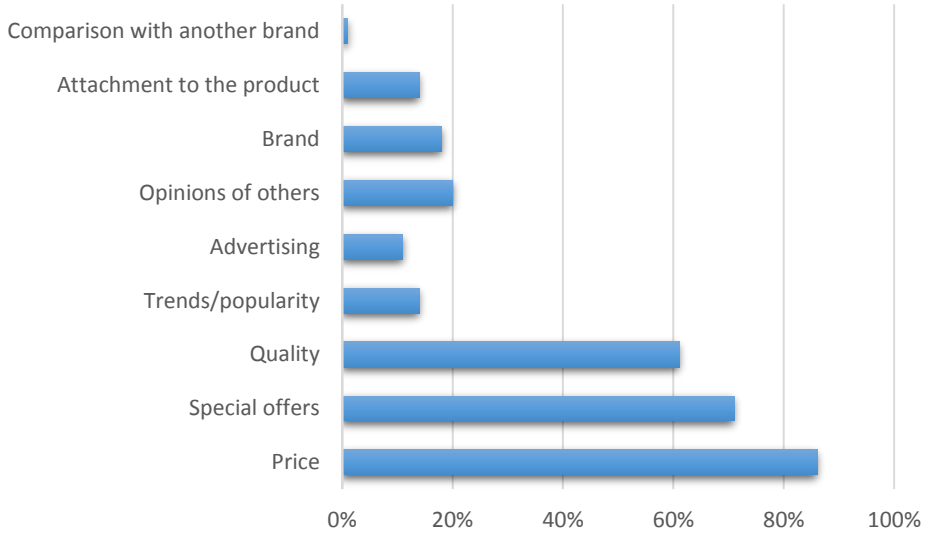

Figure 1. Sample structure for question 'What is your primary guiding factor when shopping?'
Source: original work.

Behavioural economic research on consumer behaviour also considers emotional circumstances, such as purchase decisions, price analysis, or the impact of senses (Mruk, 2017, p. 82). But are consumers aware that their choices are affected by emotions? The present results indicate that the declared respondent awareness is outstanding. Nearly 89% of them claimed they were aware that intense emotions may affect consumer behaviour and decisions when shopping. The option linked with the opposite view and the percentage of respondents declaring they never heard about this association were similarly scarce (6% and 5%, respectively) (Figure 2).

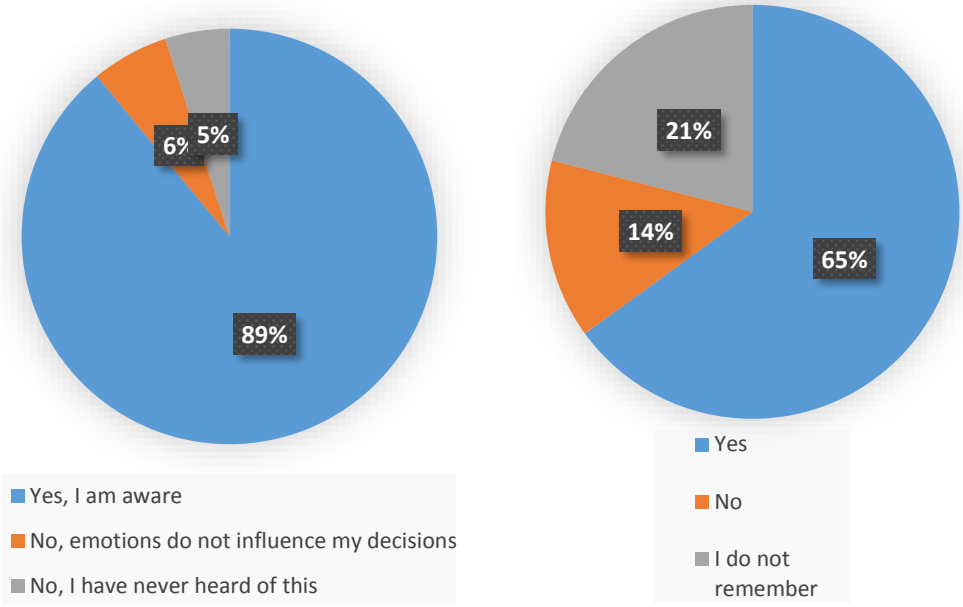

Figure 2. Sample structure for questions 'Are you aware that strong emotions may affect consumer behaviour and purchase decisions?' and 'Have you ever made a purchase when in an intensive emotional state?'

Source: original work.

The issue of the role of emotions in purchase decision-making was expanded with the question of whether the respondents had ever made a purchase when in a state of intensive emotions. Apparently, it was a rather common situation. About 65% of the respondents chose the affirmative option, while only 14% opted for the opposite one. Over one-fifth of the respondents could not recall such an event (Figure 1).

A purchase in an intense emotional state may not only be unnecessary but also a regrettable commitment. The respondents were asked about such consequences. As many as 94% of the respondents confirmed that they sometimes bought products or services they did not need. The frequencies of such purchases varied: 24% chose 'very often', 23% 'often', and 47% 'occasionally'. Only 6% of the respondents declared they had never bought an unnecessary product or service.

Spur-of-the-moment purchases are also linked with overspending compared to the planned amount. Only 3% of the respondents never experienced it, and half of the sample went through excessive spending very often. It was a common problem for 23% and a sporadic issue for 24%.

Consumer purchase decisions are critical for understanding the market. Therefore, consumer behaviour analysis gives a better insight into consumer needs and preferences. This way, the product and service portfolio can be better adapted to consumer needs. Nevertheless, understanding this behaviour and identification of factors, such as psychosocial ones, that affect it paves the way for consumer manipulation (Forum PPP, 2024;

Greco, 2018; Jovanovic et al., 2020). Therefore, were the survey participants aware that social influence is inherent in marketing and that they are also affected by it?

Interestingly, as shown in Figure 3, the respondents declared they were fully aware of sellers using manipulation. As many as 86% claimed they saw ubiquitous manipulation. Mere 3% made no such observations, and a few respondents could not answer the question (Figure 3). Interestingly, when asked whether they fell prey to social influence when shopping, only 14% clearly confirmed. Almost half of the sample agreed conditionally (‘generally yes’), and 7% chose the negative answer.

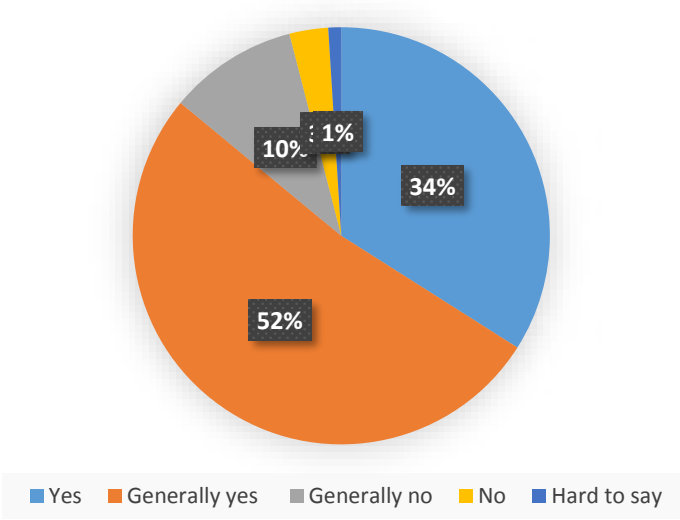

Figure 3. Sample structure for question ‘Are you aware of and see marketing/seller manipulation?’
Source: original work.

Moreover, nearly 60% of the respondents declared they could give examples of manipulation by marketers/sellers aimed at consumers. The respondents most commonly offered multipacks and retail product placement as examples. The respondents indicated that products are never placed randomly in stores, such as at the checkout counter or at eye level. Another example of social influence in marketing that the participants enumerated was free samples and arguments from authority or expert endorsement. Other marketing tools they indicated included lower prices before special seasons, higher product prices at the shop window (which makes other products in the store seem cheaper), eye-catching advertisements, leaflets, and banners, Black Friday or other seasonal sales, loyalty programme discounts, and aroma, for example of freshly baked bread.

3. Discussion

Principles of behavioural economics have been growing more popular recently. They mainly question the rationality of market choices and decisions made by customers. Researchers from the University of Łódź investigated the grounds for taking economic theories into account in business decision-making with a 2017 survey among managers, students, and academics. The objective was to verify thirteen selected fundamental economic theories of buyer behaviour and market decisions. The authors concluded, factoring in methodological limitations, that their results undermined traditional economic principles of buyer choices. The respondents can be considered to have questioned the relevance of classical economic theories of buyer behaviour (Kozielski, 2018).

A work by W. Świder (2020) offers a broad review of selected effects and heuristics studied with behavioural economics. It aimed at determining how the use of irrational behaviour can help improve the outcomes of business marketing efforts, for example. The sheer multitude and diversity of the examples proposed by the author suggest the potential of behavioural economics. Many heuristics and effects listed in the article are employed in practical marketing operations. Still, according to the author, it is hard to clearly indicate the strategies that are yet to be employed in business practice. It may be because many promotional strategies are confidential.

Authors of a study on 400 respondents from Podkarpackie and Małopolskie Voivodeships, Poland reached rather ambiguous conclusions regarding the impact of emotions on purchase decisions. They strove to identify associations between emotional and rational drivers of purchase decisions affected by product placement. The authors concluded that purchase decisions result mainly from rational causes, although 'the influence of emotional stimuli is apparent, and they may also be rationally justified in many cases' (Cyran et al., 2017, p. 44)

On the other hand, a survey of customers at Miniso demonstrated that emotions consumers experience directly impact their intent to buy a product again. The authors focused, in particular, on impulse purchases that are made based on emotional factors and may increase consumer willingness to repurchase (Azizah et al., 2024).

The important role of emotional factors in impulse purchases was confirmed in a CAPI survey on a representative sample of 1000 Poles aged 15–74 from various places in Poland.

The results show that over half of the participants (53%) admitted to impulse shopping from time to time. In a subgroup of those who experienced pangs of guilt when buying unnecessary things (42%), most were optimistic about their sustainable consumption competencies, while among those who felt happy (18%), most estimated their sustainable consumption competencies negatively (Dąbrowska, 2024).

The impact of emotional content on purchase decisions in the context of online product reviews was noted by authors of a study on 106 Internet users. Their results show that the reliability of reviews is important for purchase decisions, but only regarding negative online reviews by customers. The results indicate positive emotions related to online customer reviews and may be valuable to both sellers and customers (Guo et al., 2020).

A study analysing emotions and investigating their importance in the purchase process in the cosmetic industry also considers them a critical factor. The online and offline survey involved 125 respondents (consumers). Its results show that nearly all the respondents (91%) believed emotions to be highly relevant to their consumer behaviour. Interestingly, positive emotions were found to be more impactful in the industry, according to the responses (Jovanovic, 2020).

Slovak researchers also investigated the problem of building emotional relationships (Vrtana et al., 2023). This study focused on the impact of Dove advertising on the intensity of consumer emotions and their irrational purchase decisions. Its authors conducted an online survey with a psychodiagnostic tool (the subjective emotional, habitual well-being scale, SEHP) on a sample of 417 Slovak consumers. The results show that emotions brought by advertisements vary depending on age, for example. Moreover, emotional references in advertisements may build an emotional relationship with the brand. Furthermore, the authors concluded that the current advertising trends of using emotional references may promote impulsive and irrational purchase behaviour. Additionally, consumers may become part of the brand, which promotes emotional bonding between consumers and the brand.

Eventually, behavioural economics principles may be employed in much more than just marketing. Public administrations that eagerly employ the latest achievements have had behavioural economics tools in their portfolio for over a decade. The most pronounced of them are the World bank, OECD, and the European Commission. A Report by the Polish Economic Institute (2019) includes analyses and recommendations on how to apply behavioural economic knowledge in the public sector. According to the report, only 58% of participating officials declared ‘attempting to understand or change how citizens behave’. Organisational units, finance and budgeting divisions, and legal departments were among those that refrained from such attempts.

The behavioural perspective can account for what is ignored in standard economic and legal analyses but is still important to the public good.

The authors of the report pointed out that the behavioural approach may help the Polish public sector to better integrate its operations with other efforts that are part of a wider administrative reform, such as computerisation, service design, or big data–based decision-making.

Another example of how behavioural economics principles can be put into practice is research by the World Bank (Hernandez et al., 2017) for the Polish government. The investigation concerns the tax administration in Poland. The sample were all natural

taxpayers in Poland who were more than PLN 50 in arrears, which makes 149,925 people. The taxpayers were randomly assigned to groups. Some of them received standard tax demand letters (as used by Polish Revenue Offices), and others received one of nine letters drafted according to behavioural economics principles, such as a notice of oversight, a letter concerning public good (positive or negative tone), or a letter appealing to social norms. The results show that behavioural letters improved tax recoverability rates and reduced debt levels compared to traditional admonition letters. The conclusion was that interventions where behavioural tools are used may bring financial benefits.

4. Conclusions

Behavioural economics, an interdisciplinary field at the interface of economics and social sciences, helps analyse human behaviour and motives in decision-making processes. The goal of including psychology in purely economic investigations is to find new approaches and solutions for more effective and precise resolution of problems a person faces when making decisions. Sometimes, these decisions affect their personal and professional future in the long term. Other times they concern typical marketing, momentary choices consumers make virtually every day.

The study analyses input from a survey about purchase decisions, pointing out the important role of emotional factors in impulse purchases. The paper also points out manipulations in the sale process.

There are three main factors guiding the respondents' purchases. These are price, special offers, and product and service quality. Such factors as brand or advertising were selected by about every tenth respondent.

Nearly all the participants (89%) were very much aware of the strong influence of emotions on consumer behaviour and their purchase decisions. The other participants were of the opposite opinion (6%) or had no knowledge in this regard (they had never heard about it, 5%). Interestingly, over two-thirds of the respondents declared rather frequent purchases in strong emotions, and merely 14% chose the opposite option. Impulse shopping caused remorse in 94% of the respondents, and merely 6% declared they had never bought an unnecessary product or service. Only 3% of the sample never spent more than initially planned, and half of them considered this problem as occurring ‘very often’.

The participants declared being fully aware of seller manipulations: 86% of them noticed manipulations everywhere. Still, only 14% admitted manipulation susceptibility during shopping, while almost half of the sample agreed conditionally (‘generally yes’), and 7% chose the negative answer. On the other hand, nearly 60% of the respondents declared they could give

examples of manipulations by marketers/sellers aimed at consumers. The respondents most commonly offered multipacks and retail product placement as examples.

The results show that most respondents are aware of the role of emotions in purchase decisions. The same applies to the application of social influence in marketing; more than half of the respondents are aware they succumb to it. Note that emotions can be effective marketing tools, such as manipulation, when their influence is covert. Individuals with high awareness become more immune.

In summary, note that 'the behavioural perspective does not invalidate economic thought and its categories' (PIE Report, 2019, p. 42). The need to deviate from the model of the rational homo economicus is increasingly mentioned in public space in general, not only in economics or marketing. It is because of the weight of universal psychological mechanisms and their ultimate role in the decision-making of modern individuals in financial, educational, and health domains. These mechanisms can be independent of intelligence, education, or social background. This is especially true for practical areas of economic or social policy, where the human factor is more consequential than previously thought.

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LOGISTICS ASPECTS IN THE QUALITY OF LIFE OF STUDENTS AS STAKEHOLDERS IN URBAN LOGISTICS IN UNIVERSITY CITIES

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Purpose: Research on smart cities and quality of life is advanced. However, there are few publications analyzing the logistical aspects of quality of life. In addition, publications conceptualize residents without considering segments within this stakeholder group. The purpose of this article is to evaluate the logistical aspects of students' quality of life in college towns.
Design/methodology/approach: The article compares three academic cities. The logistics systems of the cities were characterized according to attributes indicating intelligent and sustainable development of passenger transportation. Key solutions for integrated urban transportation, micromobility and intelligent transportation systems are identified. The next step discusses the results of a survey of students living in the surveyed cities. A customer satisfaction index was developed.
Findings: Recommendations have been identified for academic city managers in improving the flow of people in the city. Each case study also identified good practices that are highly appreciated by students.
Originality/value: Applying customer satisfaction characteristic methodology to evaluate logistics aspects affecting students' quality of life.
Keywords: smart city, quality of life, passenger transport, sustainable transport.
Category of the paper: research paper.

1. Introduction

Today's cities face many problems, not only in terms of transport accessibility, but also in terms of the environment. The ever-increasing volume of traffic contributes to transport congestion as well as generating an increase in emissions of harmful substances into the atmosphere. In addition, urbanisation and urban sprawl result in the loss of green spaces, which has a negative impact on the quality of life of residents and urban ecosystems. Consequently, solutions aimed at both improving transport accessibility and protecting the environment are becoming crucial for the sustainable development of modern urban areas.

A sustainable city logistics system is one of the attributes of a smart city. This seems quite obvious, however, research in this area is still underdeveloped. Many researchers recognise that the organisation of the movement of people and cargo in a city influences the quality of life of its inhabitants (Witkowski, Kiba-Janiak, 2012; Kelli de Oliveira 2019; Stec et al., 2020). The quality of life of the inhabitants, on the other hand, is crucial in assessing the level of intelligence of a city (Kramarz et al., 2022).

In this paper, I focus attention on those logistics aspects that support smart city development by building a high quality of life in the city. An important factor for such urban development is to work with stakeholders in the movement of people and cargo in a city to design solutions that are a compromise for different stakeholders. In this paper, I have limited my research to the key stakeholder of urban residents. I have focused my attention on academic cities and therefore it was interesting in the research context to purposely narrow down the general population to students living in the cities under study. The aim of the paper is to assess the satisfaction of students a with the logistical aspects that affect their quality of life in a university city.

In the cities surveyed, various higher education institutions, both public and private, provide their educational offerings. Among the population surveyed, I have included both students who are natives and those who have settled in the city for the duration of their studies. This issue is interesting from two perspectives. Firstly, students in the cities studied make up a significant proportion of the population and are therefore a group that is an important stakeholder in the city. The high quality of life in the city leads them to decide to stay and work in the region. A second perspective is the relationship between the quality of life in a city and the absorptive capacity of the higher education market. Of course, the key element that attracts students to the centres in question is the educational offer and the quality of education. As Dumitrascu and Serban (2013) note, for most students the most important factor in choosing a university is the specialisation of studies. Also, the reputation of the university, the high quality of teaching methods and excellent career opportunities play an important role in this decision. However, as these authors' research shows, the comfort of living also influences the desire to study in a particular city. This is an additional criterion that is taken into account when comparing educational offers in different cities. In order to assess the logistical aspects in the perception of quality of life in the city, I adopted the gap identification methodology known from the evaluation of logistical customer service. I focused my attention on gap 4, i.e. customer satisfaction. This gap is a comparison between the expectations of the respondents and the logistics service actually delivered. The customer in the sense of my research is the stakeholder in the city's logistics system - the student.

In the theoretical background section, the relationship between a smart and sustainable city as well as resident satisfaction and urban quality of life will be explained. Residents' satisfaction with logistics solutions is discussed through the theory of logistical customer service gaps. The consequence of this approach is the adopted interpretation of the logistical service of city

logistics stakeholders. At this stage, the question arose: how to integrate the residents' (students') satisfaction with aspects of city logistics into an assessment of their quality of life in the city? This is the overarching question in the research conducted. In part of the empirical research, it was detailed to the problem of students' quality of life in university cities.

Answering this main question required the design of a research investigation, which is presented in the methodology section. Gap four of logistical customer service, understood as student satisfaction with logistics solutions in the city, was assessed through the Customer Satisfaction Index (CSI). The developed methodology was verified in a case study involving a review of smart city solutions: Warsaw, Cracow and Poznan. The results of the study are discussed in the results and discussion section.

2. Logistics service as a determinant of smart city development

2.1. The Smart City concept

Smart cities are often understood through the prism of digital cities. This is not a valid interpretation. Undeniably, modern technologies, including Cloud Computing, Internet of Things, Intelligence Artefact, and many others, are solutions applicable to smart cities, however, they cannot be the only criterion for valuing a city's level of intelligence. A smart city is a city that has the capacity to support the development of all its inhabitants. There are many interpretations of the term Smart City. One of them is given by A. Caragliu et al. (2011), stating that a smart city is one in which the development of human and civic capital, as well as transport and ICT infrastructure, require sustainable economic growth and a high quality of life. Such a city is characterised by sound management of natural resources through resource sharing (Caragliu el al., 2011). Hollands (2008), on the other hand, emphasises that the smart city concept aims to develop infrastructure based on modern information and communication technologies. These technologies are intended to support both social and urban development through the involvement of citizens, the introduction of economic solutions and the improvement of management efficiency (Dembińska et al., 2019). A smart city, is also a concept that aims to reduce energy waste and greenhouse gas emissions, thus a city focused on sustainability (Kramarz et al., 2022). There are many related terms that refer to modern urban infrastructure and they are:

- digital city (Yovanof et al., 2009),
- creative city (Hall, 2000; Florida, 2002),
- knowledge city (Carlillo, 2004),
- green city (Zygiaris, 2013).

The aforementioned concepts have common features, but focus differently on technological, social and environmental issues. The concept of smart cities, became widespread in 2007 thanks to an initiative by the European Union, which incorporated it into its policies. It is worth noting that it is a key element of a strategy aimed at effectively tackling social problems such as social inequality, poverty or unemployment. The smart city refers to the comprehensive management of cities, integrating communication technology and knowledge infrastructure. Importantly, this is done while making rational use of natural resources, which coincides with the concept of sustainability(Korenik, 2017; Dembińska et al., 2019). The Smart City concept identifies its six dimensions, including: smart economy; smart mobility; smart environment; smart people; smart governance; and smart living conditions (Kramarz et al., 2022). The first dimension, smart economy, refers to an efficient and technologically advanced economy that emphasises innovative products and the efficient exchange of goods, services and knowledge. Smart mobility refers to the implementation of integrated transport systems within a functioning city logistics system, which are based on the concept of sustainable urban transport. The dimension relating to the environment refers to activities that protect natural assets, which is done, among other things, through the use of renewable energy sources. Smart people refers to high-quality social capital and smart living conditions to a lifestyle lived in a safe city with access to technology. Smart governance refers to the actions of government that enable communities to be involved in changing their environment, as well as creating spaces with a high degree of accessibility to public services.

The transformation of cities to become smart cities is commonly understood through concrete and often measurable economic, environmental and social outcomes that include sustainability goals, as smart city development and sustainability practices overlap (Ang-Tan, Ang, 2022; Baibarac-Duigan, de Lange, 2021; Blasi et al., 2022). A smart city should therefore serve the economic well-being of its inhabitants and the competitive position of the organisation in the market (economic smart outcome), meet the welfare requirements of urban residents (social smart outcome), and must establish a balance in which economic and social needs do not come at the expense of environmental quality, but preferably contribute to it (environmental smart outcome). Furthermore, transforming ordinary cities into smart cities requires investment in social capital and human resources to upgrade traditional technologies (e.g. transport systems) and to develop new and modern technologies (e.g. information and communication infrastructure) (Sakuma et al., 2021).

The mobility of residents, the elimination of traffic exclusion, are the elements of urban logistics that are most often indicated in publications dealing with the Smart City.

In the implemented transport policy of modern cities, the foundation of this concept is the optimisation of the movement of people and cargo within the urban space (Rześny-Cieplińska, 2018, 2020).

2.2. Logistics service versus quality of life in the city

Urban logistics deals with transport (both of people and cargo), storage, organisation of transport networks, municipal management and waste disposal. All these activities are integral to the daily life cycle of the city as an economic, social and cultural space. The definition proposed by the Council of Logistics Management defines urban logistics as the process of planning, executing and supervising flows in a city and takes into account: flows that are recorded within the urban area, flows that are initiated externally and directed to the city, flows that are recorded within the city itself, interacting both externally and internally (Kalbarczyk, 2019). Aspects of city logistics relate to four main areas, which M. Szymczak (2008) classified: storage of goods that constitute urban resources, transport of goods, transport of people, waste and waste disposal.

Logistics solutions in smart cities therefore include not only the use of ICT, data analytics, intelligent transport systems, but also environmentally adapted urban warehouses (eco-hubs), the adaptation of infrastructure to logistics needs, and cooperation between different actors to improve the quality of life by improving logistics solutions in the city. These solutions affect the quality of life of residents and need to be integrated into other smart solutions in the city. Improvements in quality of life as a result of logistics measures include, but are not limited to: efficient management of deliveries, reduction of congestion, reduction of environmental pollution, optimisation of routes, minimisation of delivery times, better use of vehicles and efficient planning of deliveries taking into account residents' preferences. Quality of life is a much broader construct and encompasses many non-logistical aspects of a person's daily life, such as living situation, place of residence, infrastructure, space, sense of security, leisure time, state of the environment, work and income, education and educational institutions. Historically, the concept of quality of life has been linked to ideas of social well-being, environmental quality, poverty, social inequality, social exclusion, social vulnerability and sustainability. Wesz et al. (2023) identify 7 categories of quality of life criteria (Tab. 1).

Table 1.
Quality of life areas and criteria

QoL Dimensions	Urban QoL Indicators
Urban services	Solid waste collection, Water supply, Electricity supply, Internet services, Health-related services (hospitals, health centres, etc.), Education services (schools, nurseries, universities, etc.).
Economy	Employment opportunities, Cost of living (expenses on housing, food, etc.), Existence of professional courses (computers, crafts, hairdressing, etc.), Access to credit (facilitated payment terms in shops and commerce), Variety of commercial and service establishments (markets, shops, restaurants, banks, post office, etc.), Existence of tourist activities.
Culture and reaction	Number of green areas and parks, Quality and maintenance of green areas and parks, Existence of places to take part in outdoor sports, Existence of places for cultural activities (artistic events, museums, theatres, cinemas), Opportunities to take part in free cultural and artistic events, Conservation of historical, artistic, and cultural heritage (buildings, houses, and public spaces).

Cont. table 1.

Urban mobility	Quality of public transport (comfort), Availability of public transport (number of lines and itineraries), Ease of going from one's house to other parts of the city (workplace, study, friends' houses, etc.), Ease of displacement on foot (to carry out daily activities), Quality and location of cycle paths Existence of tourist activities.
Conviviality	Conviviality and interaction with neighbours, Conviviality and interaction with homeless people, Opportunities to participate in the decisions of your own building, Opportunities to participate in community activities (associations, artistic and religious groups, etc.), Respect for cultural, sexual, religious, and political differences, Identification with the neighbourhood and people's pride in living in it.
Security	Feeling of security in public places (sidewalk, street, etc.), Feeling of security when accessing one's building during the day, Feeling of security when accessing one's building at night, Safety for children and teenagers to experience the neighbourhood (walking, playing, etc.), Quality of policing, Quality of public lighting (sidewalks, streets, parks, etc.).
Environmental comfort	Noise pollution, Air pollution (feeling when breathing), Existence of trees on the pavements and in the parks (climate comfort), Cleanliness of public spaces (pavements, streets, parks, etc.), Drainage and sewage system (floods/odours), View from one's apartment window to the outside space (street/courtyard).

Source: Wesz, Miron, Delsante, Tzortzopoulos, 2023, p. 56.

One of the key areas affecting quality of life is the ability to move around the city. It is determined by a number of factors, such as, for example, land use, terrain, prevailing activities (tourist city, industrial city) and many others. It is also important to share the transport linear infrastructure for the movement of people and the movement of goods in a city.

The logistics service of a city according to the theoretical considerations cited will be understood as the range of logistics services that are provided to the city. In contrast, the logistical service of city logistics stakeholders will be understood as the ability of the city's logistics system to respond to the needs of stakeholders in terms of time, reliability, communication and convenience. Thus, in developing the concept of evaluating the logistical service of residents (as key stakeholders of city logistics), I have used the theory of logistical service gaps in this paper.

2.3. Satisfaction as gap of the logistical service to residents

A high quality of life, characterised by satisfaction and positive feelings, is experienced when an individual's resources in this area are not compromised and their needs can be met. In contrast, a person experiences a poor quality of life, as a result of dissatisfaction and negative emotions, when needs and resources are insufficient. The feeling of dissatisfaction that accompanies such a person is associated with incurring psychological costs when one's own needs are met.12 Thus, it is legitimate to use knowledge from customer satisfaction theory to assess residents' satisfaction with the logistical aspects that shape quality of life in a city.

Logistical customer service can be defined as service covering the activities necessary from the receipt of the order from the customer, but also during the manufacture and delivery of the ordered goods. An important aspect is also the carrying out of activities that will eliminate or

preclude errors arising in the execution stages of the order (Sułkowski, Morawski, 2014). In logistical customer service, key elements are identified that form the basis for the description of the logistical customer service process and the selection of metrics for its evaluation. The logistical elements of the customer service process are of particular importance to customers, while the importance ascribed to them by the customer may change, depending on the market segment, the type of products, the forms and types of distribution or the intensity of competition. Customer service is characterised by the following logistical elements (Kramarz, 2014): time, reliability of the implemented processes (punctuality, completeness, fault-free implementation), communication between the service provider and the customer, availability of the offer at the time the customer needs it, convenience, flexibility in terms of time, size and type of offer in relation to the expectations set by the customer.

Customer satisfaction is influenced by many factors related to communication. Among these are the provision of information about the status of the logistics service, including access to information about the order in real time (Sułkowski, Morawski, 2014). Modern IT systems greatly support communication with the customer, making it possible to create analyses, transmit order information or create a current situation on the entire order process (Walasek, 2014). Differentiated modes of transmission improve the quality of service by adapting the way the customer places an order to the customer's preferences and capabilities. All these aspects, analysed so far in the logistics systems of manufacturing, trade, service companies and entire supply chains and networks, have not yet been comprehensively reflected in research on city logistics systems. In such systems, the customer is the city stakeholder. When thinking of citizens as key stakeholders in city logistics, the overriding aim is to take care of their satisfaction. Thus, both the delivery time of the logistics service, its availability, flexibility (understood as alternative and integrated transport systems) as well as reliability, communication and convenience are extremely important factors in city logistics. In the pre-transaction phase of the city logistics stakeholder service, it is necessary to carry out a stakeholder analysis (segmentation - assigning roles), identify stakeholder needs, determine the city's current and planned logistics solutions - policies, investments. Segmentation, which is highlighted as extremely important in the analysis of logistical customer service, can be mapped in the city's stakeholder needs survey. The different stakeholder groups are segments that can be grouped into macro-segments in terms of their roles in the city's smart city development (Kramarz et al., 2022) on the one hand and separated into micro-segments in terms of their detailed behaviours and needs on the other. Students are such a micro-segment in the resident segment. The post-transition phase is geared towards policy implementation, the implementation of solutions, the realisation of investments and, above all, towards meeting the current logistical needs of stakeholders. The post-transaction phase should include maintaining the infrastructure, monitoring stakeholder feedback and encouraging the use of the designed solutions. Given this understanding of the phases of city logistics stakeholder service, a gap assessment can be attempted.

Many authors tend to identify 4 key gaps in customer service, which are shown in Figure 1 (Kramarz, 2014). In the context of logistics, service quality depends on the degree of congruence between customer expectations and the actual parameters of the services provided.

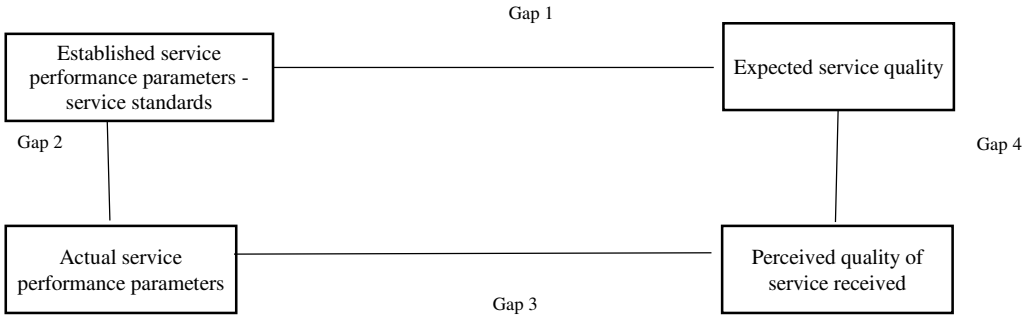

Figure 1. Gaps in customer service.

Source: Kramarz, 2014, pp. 48-50.

Gap 1 represents the difference between the customer's (stakeholder's) expected service quality and the specified service delivery parameters. In practice, this means that there is a gap between the customer's expectations of service quality and what has been planned for delivery. Gap 2 is the discrepancy that occurs at the service delivery stage. This gap is the result of deviations between the service standards set and the service actually delivered. In a city's logistics system, these include, for example, delays of buses, tram trains. The discrepancy between the customer's actual perception of the level of service and the company's perception of the level of service provided is represented by gap 3. Gap 4 describes the customer's satisfaction with the service performance process. The level of customer satisfaction is measured as the difference between the customer's expectations of service and the customer's actual perceived quality of the service provided.

In this paper, I have limited myself to interpreting and assessing the fourth gap due to the objective set.

3. Methodology

Conflicting goals in city logistics can be seen not only between different stakeholder groups, but even within one group, separate expectations can be seen. An example of this is the desire of cities to reduce external transport costs by reducing road transport in the city, with the aim of reducing pollution, noise, vibration and land occupancy. The benefits indicated are assessed by residents in the category of quality of life enhancing factors (clean air, safety) as beneficial and at the same time as negative, due to the reduction in mobility of residents. Due to these differences in the perception of logistical solutions, in this paper I adopted a methodology to adjust the rank of logistical criteria shaping quality of life by residents. The assessment of

logistical service gaps, according to the theory of logistical service gaps, requires the selection of an identification methodology for each gap separately. In the research presented in this paper, gap four was assessed.

In this paper, I analyse the impact of logistics solutions on the quality of life of residents (students). Logistics solutions have been assigned to three areas according to the assumptions in Table 2.

Table 2.
Factors examined in the characterisation of the city's logistics system

Area analysed	Factors in the area
1. Sustainable urban transport - ecology and tools to combat congestion	Characteristics of public transport: buses, trams, trains, cars Car sharing, Park&Ride solutions Micromobility: scooters, city bikes, mopeds Others - banning lorries from the city centre, paid parking, segregated zones, etc.
2. Infrastructure and safety improvements	Roads - technical condition Bus lanes Stops Freight routes Car parks
3. Communication, computerisation and automation of services	Information systems at bus stops Mobile applications e-tickets

Source: own work.

The areas indicated in Table 2 were analysed in three case studies. The case studies included:

- content and information analysis of intelligent transport systems operating in three selected cities,
- surveys targeting students living in the three selected cities. The survey questionnaire was the same in all cities. Respondents were asked to rate the elements indicated. First, they had to distribute a total of 100 points among all the elements, depending on their impact on the quality of life in the city. Respondents then rated each city on a five-degree Likert scale in terms of the established criteria.
- the calculation part involving the determination of the resident(student) satisfaction index for the logistical dimension of quality of life in the city. The calculation was based on a formula to determine the CSI% (3), which required the determination of the resident's satisfaction index CSI (1) and the maximum index CSImax (3). In accordance with the methodology for determining quality maps, which is a graphical deepening of the CSI, those elements were identified that significantly shape quality of life, but reach too low values in individual cities. The maps themselves are not included in the paper.

$$\text{CSI} = \sum_{i=1}^{n} W_i * C_i \quad (1) \quad \text{CSI} = = {}_{\max}\sum_{i=1}^{n} W_i * C_{max} \quad (2) \quad \text{CSI} = {}_{\%}\frac{CSI}{CSI_{max}} * 100 \quad (3)$$

where:

i – number of the element,

n – number of all elements,

w – weight of the element,

c – rating of the element.

The survey covered three cities: Warsaw, Cracow and Poznan. In Poland, there are 369 higher education institutions located in 97 cities. They have 1.3 million students, 235,500 of whom study in Warsaw alone. Analysts from the Polish Economic Institute developed an index of the academic nature of cities and on this basis indicated that, apart from the capital, the most academic cities in Poland are Cracow, Poznan and Wroclaw. The index is based on seven criteria: prestige, the situation of graduates on the labour market, innovation, scientific potential, scientific efficiency, study conditions and the internationalisation of universities. The model they built shows that academia influences the socio-economic development of cities by almost 80% (Raport: Po maturze). The analysts of the Polish Economic Institute also created a soft model examining the impact of the academisation of cities on socio-economic development, which was described using 17 indicators extracted from the Local Data Bank of the Central Statistical Office. These indicators referred both to the economic situation, demographics, living conditions or city resources. After a detailed analysis of all variables describing academic and socio-economic development, the model parameters were estimated, which showed that 78% of the socio-economic development of cities is determined by their academic performance. Among Polish cities, Warsaw tops the ranking, being at the same time the second city in Europe in terms of the number of students, with 235,000 people. It is ahead of Rome, Madrid and Barcelona, among others, and on a European scale, only Paris has more students. For this reason, I chose Warsaw for the study, as well as two cities from the leading Polish cities: Cracow and Poznan. The study involved 245 students from Warsaw universities, 238 students from Cracow universities and 233 students from Poznan universities. Thus, this is not a statistically significant sample, but it is a pilot study that indicates a certain trend that is worth analysing further in the future. The survey was conducted online.

4. Results and discussion

4.1. Characteristics of city logistics systems

In the three cities analysed, a number of activities are being implemented to improve the conditions of everyday life in the city. These initiatives are mainly investments in infrastructure development and the digital layer, which in effect translate into an increase in the quality of services provided by the city, including e-services. At the same time, this type of investment is accompanied by many activities aimed at building human and social capital, including involving citizens in co-governance.

Using innovative tools, these measures are improving the quality of life of the inhabitants, thus bringing the capital closer to a city that is developing intelligently. In 2024, the IMD ranked Warsaw 38th in the ranking (out of 142 cities included in the ranking), and it is worth noting that Warsaw is gradually gaining a higher position in the ranking. Varsovians rated their city highly in terms of access to timetables and online travel planning and the convenience of purchasing public transport tickets (as many as 71.1% of respondents rated this parameter positively). They were equally satisfied with public transport itself, with almost two-thirds of respondents giving this mark.

The public transport network in Warsaw is made up of buses, trams, underground and Rapid Urban Rail trains. In addition, it is possible to travel by Mazovia Railways and Warsaw Commuter Rail on the basis of WPT tickets, starting from daily tickets. Using Warsaw Public Transport (WPT), you can quickly and comfortably travel around the entire city and reach many of Warsaw's neighbouring towns and cities. The easiest way to plan your journey is by using the connection search engine. WPT vehicles can be used on the basis of tickets: time tickets (20-minute, single 75-minute, single 90-minute, group 75-minute), short-term tickets (daily, 3-day, weekend, weekend group) and long-term tickets (30- and 90-day). Temporary and short-term tickets come in the form of a cardboard box, while long-term tickets are encoded on the Warsaw City Card, among others. Micromobility is also developing intensively in Warsaw. Veturilo - is one of the largest urban bicycle systems in Europe. It constitutes an important element of Warsaw's transport ecosystem. Thanks to the development of bicycle paths, the network of which amounts to over 500 km in Warsaw, the system enables efficient access to various parts of the city, providing an alternative to means of public transport.

The complexity of the public transport structure in the metropolitan area poses challenges to the city administration. In order to minimise the likelihood of errors in the organisation of public transport, a separate entity called the Public Transport Authority (Zarząd Transportu Publicznego - ZTM) was established. It is a body superior to the city operators, whose task is to organise and supervise public transport in the Warsaw agglomeration area and neighbouring municipalities (ZTM, 2022). The Public Transport Authority (ZTM) sets the tasks for the modernisation change of the rolling stock owned by the transport operators and coordinates

them. Changes to the rolling stock occur quite slowly due to the course of tender competitions conducted in accordance with the Public Procurement Law (Journal of Laws 2019) and EU regulations. Urban buses are an example - only 9% are powered by environmentally friendly alternatives.

The Public Transport Authority of Cracow (ZTM) operates in Cracow. Passengers have the opportunity to purchase the Cracow City Card. Tickets can be purchased at PSPs (Passenger Service Point), in partner applications, mobile applications or ticket vending machines. From June 2022, Cracow residents can travel by hydrogen-powered bus. It is also worth mentioning Rapid Urban Transport and the "Feasibility study for fast, collision-free rail transport in Krakow". As a result of cooperation between ILF Consulting Engineers Poland and the Municipality of Cracow, a study was produced which recommends the Premetro project for Krakow. The Premetro, a type of public transport system that provides an intermediate solution between the traditional tram and underground. Construction of the tunnel is planned to start in 2029. In 2013, Cracow was the third most polluted city in Europe according to the European Environment Agency. However, since then the city has made ambitious efforts to improve air quality and reduce urban chaos. For the past two decades, Cracow has been working continuously to reduce pollution by modernising public transport and developing green spaces. In 2019, a ban on solid fuels was introduced as an important step in the fight against pollution. The city has become a leader in Europe with the introduction of the Clean Transport Zone and is part of the trend towards zero-emission public transport. Every space that has been reclaimed is now dedicated to pedestrians and cyclists, reflecting the vision of a city where air quality and public space are a priority. Cracow has 21,641 paid parking spaces.

The Public Transport Authority of Poznan (ZTM Poznan) plays a key role in the organisation and supervision of the city's public transport system. Public transport was used by 226.8 million passengers in 2022. The data shows that there is an upward trend in the aspect of the use of public transport by the inhabitants of this city. The city of Poznan is consistently developing its transport infrastructure with the aim of creating an efficient, comfortable and modern public transport system. It invests in new routes and the modernisation of existing ones, introducing innovative solutions such as quiet green tracks, bus lanes, two-way trams, hybrid buses and urban bicycle systems. The city has undertaken development activities based on the Smart City concept, creating the Smart City Poznan model. Smart City projects are subject to monitoring. To this end, a web-based platform with data is being developed, enabling the continuous presentation of indicators, dynamics and effectiveness of the innovations introduced. This will enable the city to track and evaluate the effectiveness of various solutions, which will allow it to continuously improve its infrastructure and services for residents. Poznan also sees a significant increase in the number of registered vehicles (by 9.3 thousand in 2022). Too many residents choose individual means of transport over public transport, which may be related to the need for greater mobility and convenience in travel. Therefore, there is a need to continuously improve and adapt the public transport offer in order to attract more passengers and encourage them to use this environmentally friendly mode of transport.

Table 3.
Characteristics of selected university cities in terms of smart urban logistics

Area analysed	Criterion characteristics	Warsaw	Cracow	Poznan
Students as stakeholders in city logistics	Number of universities (public and non-public) Number of students (including those living in dormitories, in private accommodation, living in the city, commuting to universities)	69 universities 235,500 students (academic year 2022/2023)	23 universities 129,360 students (academic year 2022/2023)	24 universities 112,000 (2024) students (academic year 2022/2023)
Sustainable urban transport - ecology and tools to combat congestion	Characteristics of public transport: buses, trams, trains, cars Car sharing, Park&Ride solutions Micromobility: scooters, city bikes, modpeds Others - paid car parks, segregated zones etc.	Integrated public transport - Public Transport Authority (ZTM) 58 electric buses, (25 are hydrogen fuel cell electric buses, Autosan Sancity 12 LFH tested, one of the greenest buses on the market), metro city bikes, electric bicycles, Park & Ride and Kiss & Ride systems	Integrated public transport - Public Transport Authority of Cracow Municipal Transport System Hydrogen-powered buses, Premetro rapid urban railway (plan 2029) Park & Ride system Clean Transport Zones long-term bike rental "LajkBajk", Park-e-Bike electric bike rental	Integrated public transport - Public Transport Authority (ZTM) Hybrid buses Hydrogen -powered buses (plan) Park & Ride system 337 Quiet, green tracks, city bikes, Hop&Go micromobility areas two-way trams, hybrid hire of electric bicycles (Bolt)
Infrastructure and safety improvements	Car parks Cycle paths Bus lanes	60,000 paid parking spaces 547.4 km of cycle paths 108.8 km of streets with contraflow (including 4.8 km of contraflow lanes) 78.6 km of footpaths and cycle paths 53.3 km of cycle lanes More than 68.5 km of dedicated lanes for public transport	The number of parking spaces has 21,641 paid parking spaces Cycle paths with separated cycling infrastructure of almost 250 km length More than 30 km of bus lanes	Number of parking spaces 14,201 spaces Number of parking meters 792 Cycle paths - nearly 400km 23 km of bus lanes

Cont. table 3.

Communication, computerisation and automation of services	Information systems at bus stops Mobile applications e-tickets	Personalised Warsaw City Card, Cycling map - Cycling Warsaw intelligent transport management systems, Passenger Information System SIP, mobile applications, intelligent street lighting, mobile application Warsaw 19115	Cracow City Card Intelligent Transport System (ITS), Cracow Municipal Transport Passenger Information System, DAROPLAN cycle map, Cracow Contact Centre application	PEKA (Poznan Electronic Agglomeration Card) Open data platform, Passenger Information Panel System (TIP) Intelligent Transport System (ITS) Interactive Cycling Map of Poznan, Smart Poznan Application

Source: own work.

All three cities are characterised by logistics solutions that fit into the Smart City concept. Warsaw has the most developed investments in this area. This applies to the availability of various means of urban transport, their integration, micromobility projects and the information sphere.

4.2. Identification of gap 4 – assessing differences in perception and evaluation of logistics elements in building student satisfaction with logistics service in the cities studied

Two assumptions were made in the research, taking into account the results of the literature. Assumption one, that the quality of life of residents is a key dimension of a smart city and assumption two, that logistical aspects significantly determine the quality of life. In line with these assumptions, a satisfaction survey was conducted on the logistical service elements of the residents (gap 4 of logistical service). The research was narrowed down to the problem of residents' mobility, which determine their mobility. In order to identify the gap 4 in logistical service for city residents, the same survey questionnaire was used in all case studies. As indicated in Table 3, all three cities have similar characteristics of the logistics system and are characterised by a metropolitan landscape. They are historic cities with a simultaneous role as an academic centre. It was therefore interesting in this context to compare the logistical elements shaping the quality of life of the inhabitants of these cities.

Table 4 shows the average results obtained in the survey conducted and the customer satisfaction index (CSI) determined from them.

Table 4.
Customer satisfaction index for logistics service elements in the Warsaw, Cracow, and Poznan

Elements	Warsaw			Cracow			Poznan		
	Average weight	Average rating	Weighted rating	Average weight	Average rating	Weighted rating	Average weight	Average rating	Weighted rating
Availability of alternative modes of transport	12,74	4,45	56,69	9,71	4,41	42,82	14,41	4,26	61,46
Travel safety	9,50	4,26	40,51	7,56	3,50	26,46	8,15	3,56	28,99
Travel time	12,47	3,74	**46,58**	11,68	3,35	**39,15**	13,85	3,79	**52,56**
Integration of transport systems	7,65	4,09	31,26	8,65	4,26	36,88	8,76	4,21	36,86
Pedestrian infrastructure	7,06	4,35	30,73	10,38	4,21	43,67	10,21	4,38	44,73
Communication, computerisation and automation of services	10,74	4,09	43,89	11,29	4,44	50,16	7,94	4,09	32,47
Cost of travel	6,74	3,32	22,38	10,56	4,18	44,10	7,68	4,29	32,96
Punctuality and regularity	13,09	3,53	**46,19**	13,38	3,03	**40,54**	12,62	2,94	**37,11**
Infrastructure for micro mobility	11,62	4,29	49,86	6,76	4,09	27,66	6,62	4,12	27,25
Environmental friendliness	8,41	4,29	27,96	7,74	3,74	28,89	6,82	4,29	29,30
CSI	396,053			380,318			383,695		
CSImax	500			500			500		
CSI%	79,21			76,06			76,74		

Source: own work.

The results obtained by the cities are good, however, they fall below 80%. In the table, bold italic text indicates results falling in the bottom right quadrant of the quality maps (the graphical version of which is not included in the paper), i.e. those which need to be improved in the cities in the first place due to their high importance for the respondents (average weighting above 10) and too low rating (below 4). Warsaw received the highest score and this is in line with Warsaw's position in both national and international rankings. Cracow and Poznan scored very similarly. When analysing the respondents' key preferences, it was assumed that for the number of elements analysed the indicated rank must be above average (a value above 10 was assumed). In Warsaw, these preferences included: Punctuality and regularity (13.09), Availability of alternative means of transport (12.74), Travel time (12.47). Infrastructure for micromobility (11.62), Communication, computerisation and automation of services (10.74), in Cracow: Punctuality and regularity (13.38), Travel time (11.68), Communication, computerisation and automation of services (11.29), Travel cost (10.56), Pedestrian infrastructure (10.38), while in Poznan: Availability of alternative means of transport (14.41), Travel time (13.85), Punctuality and regularity (12.62), Pedestrian infrastructure (10.21). Respondents in all three cities rated punctuality and regularity very low, in Warsaw (3.53), in Cracow 3.03), in Poznan only (2.94) and travel time: in Warsaw (3.74), in Cracow (.35) and in Poznan (3.79). These are results which, with the high importance of these two elements for the respondents, contribute to the low satisfaction rate with logistics services in the surveyed cities. In Warsaw, respondents rate the availability of alternative means of transport very high (4.45), which is also important to them, as well as the pedestrian

infrastructure (4.35), which, for students studying in Warsaw, was not shown to be an important factor in building their satisfaction (weighting only 7.05). The same respondents are clearly dissatisfied with the cost of travel (3.32) however, this factor is not a key factor for them either (weight of 6.74). In Cracow, respondents gave the highest rating (4.44) for communication, computerisation and automation, which is of high importance to them, and for the availability of alternative means of transport (4.41), which is of slightly lower importance. In addition to punctuality, respondents gave a low rating to Travel Safety (.5), which, however, is not a priority for them. In Poznan, respondents gave the highest rating (4.38) to pedestrian infrastructure, which is an important satisfaction factor for them. As in Cracow, Travel Safety was rated low (3.56) and is also not a priority for respondents.

The results obtained are interesting both on the level of recommendations for each city and in comparing similarities indicating general trends, expectations and direction for improving the logistics systems of other university cities.

Indicating recommendations for individual cities, according to the results marked in Table 3, all three cities should improve both travel times and punctuality and regularity. The second factor in particular is a major problem that discourages many people from using public transport. Due to the repetition of these two elements in the results obtained in all three case studies, it can be concluded that other academic cities should also improve these elements. From the point of view of the group of respondents selected for the study, the results in each city will depend on the degree of concentration of the city, the distance between the university(s) and the academies and other housing, the location of cultural, leisure and sports venues, the organisation of public space and the location of retail and service outlets. All three cities surveyed have dispersed development and large distances between the indicated points, meaning that public transport is more important than micromobility and pedestrian solutions. As the distance between these nodes decreases, the importance of the quality of pedestrian paths and micromobility solutions increases. All three cities surveyed are investing heavily in solutions to enhance sustainable mobility, as indicated in Table 2. The length of cycle paths is increasing every year. At the same time some cities, including Poznan (year 2021) are abandoning the urban bicycle system, which is being replaced by companies offering electric bicycle rentals. Such solutions are observed in all three cities. Micromobility and its development should also be looked at from a safety perspective. Studies carried out in 2022 show an increase in accidents involving cyclists in all three cities compared to 2021, however, analyses from 2018 onwards are not so clear (Table 5).

Table 5.
Number of accidents involving cyclists

	2018	2019	2020	2021	2022	Population	Number of accidents / 1,000 inhabitants
Warsaw	1019	961	917	887	917	1794166	0,51
Cracow	436	483	453	465	536	780796	0,69
Poznan	347	317	327	314	346	530464	0,65

Source: Study based on the Report Cities for Cyclists 2023: https://www.centrumrowerowe.pl/blog/miasta-dla-rowerzystow/?srsltid=AfmBOopBrxgzRF7hCO_iRIZaG25wEoa1PpNPkRfVWoXDf2BI8f9YgJen

Polish towns and cities undoubtedly aim at the creation of a cycling friendly and more widely for micromobility, which is indicated by an increase in funds devoted to development and maintenance of cycling infrastructure. The implemented projects underline not only the increase in cycling routes but also the improvement in safety in terms of broadly understood micromobility.

5. Conclusions

The sustainable development of urban flows translates into improved traffic flow, increased convenience for residents in terms of travel, and a higher standard of living in the urban area. It should be emphasised that it is also crucial to reduce emissions of air pollutants, reduce noise pollution, shorten travel times, increase road safety and limit the destruction of road infrastructure, which is an important part of the urban transport system. The development of urban logistics is inextricably linked to technological progress, which is influencing the evolution of the area. This understanding of sustainable urban flows fits in with the Smart City concept and is adopted in the paper as the leading one.

As pointed out in the research, a key stakeholder in city logistics is residents. In university cities, students play an important role in this stakeholder group. In order to assess the differences in students' perceptions of the elements of logistic customer service in the cities of Warsaw, Cracow and Poznan, a research procedure was applied in which respondents' opinions were collected using a survey questionnaire. The results obtained indicated two priority elements of logistic service, namely travel time and punctuality and regularity.

The research conducted is a pilot study. A limitation of the research conducted is the number of respondents. The results obtained point to directions for further research. It is certainly necessary to expand both the research sample and the cities included in the analysis. At the same time, the study of one group of stakeholders is also a limitation for inference. It is interesting to compare the logistical service needs of students with other resident segments and also the integral results obtained for the residents group with other stakeholder groups. Further studies will be dedicated to the other stakeholder groups. It is also a limitation that the

research focuses on gap four to the exclusion of the other gaps. Each of the gaps in the city's logistics service requires the shaping of a separate methodology. Further research will be directed towards developing a methodology to assess the remaining gaps.

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SEO AUDITING USING LARGE LANGUAGE MODELS AS A KEY UNIVERSITY MARKETING STRATEGY COMPONENT

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Purpose: Large Language Models (LLMs) are employed in a growing range of domains. They automatise processes and improve work efficiency. However, their application in website quality testing leaves a research gap. The paper aims to assess the capabilities and limitations of using selected LLM-based AI tools for SEO auditing as a critical component of a university's marketing strategy in a case study of a university website.
Design/methodology/approach: The paper reports a case study. The audited website belongs to a university where a new content management system (CMS) is deployed. At this stage, the audit minimises such adverse issues as deindexing and visibility loss. The SEO audit employed the following AI tools: ChatGPT, Microsoft Copilot, Gemini Google DeepMind, and Perplexity AI. Selected AI responses are quoted verbatim, while others have been synthesised. Some of them were subjected to semantic analysis.
Findings: LLM-based AI tools do not conduct an SEO audit in real time. LLMs can easily generate articles, abstracts, summaries, and other texts that may be used as input for meta tags or headings, such as H1. Therefore, LLMs can be useful for optimisation rather than quality assessment.
Originality/value: It is one of the first studies on the capabilities and limitations of Large Language Models regarding SEO audits presented with a case study of a university website.
Keywords: website quality, artificial intelligence, AI, LLM, GPT models, SEO audit, search engine optimisation.
Category of the paper: case study.

1. Introduction

Despite the dynamic expansion of AI, including Large Language Models (LLMs) and changes in how information is obtained (Strzelecki, 2024), search engine optimisation (SEO) remains critical for marketing strategies. This principle applies to various organisations, commercial and institutional both, including universities. SEO promotes continuous improvement of website and web application quality. The quality is evaluated through SEO audits, which may be done using AI tools (Chodak, 2024).

Traditional methods of assessing website quality are as effective as they are arduous (Król, Zdonek, 2020). AI tools could be useful in this regard thanks to their potential to streamline SEO audits and website optimisation. The paper offers an in-depth analysis of the application of selected AI tools for SEO audits. It focuses on the capabilities of Large Language Models regarding data analysis, process automation, and content optimisation. A better understanding of how AI can support SEO should help experts make sounder decisions and optimise websites more effectively, leading to higher search engine results page ranks and conversion rates.

Online platforms that make use of LLMs, such as ChatGPT, Microsoft Copilot, Gemini Google DeepMind, and Perplexity could automatise many SEO auditing processes, especially textual data analysis or content optimisation (Chodak, 2024). These tools process large datasets, which can provide more accurate and comprehensive analysis than traditional methods (Król, Zdonek, 2020). Moreover, machine learning algorithms allow AI models to learn from data available to them so they can identify patterns and regularities not accessible through basic analysis (Spitale, 2023). This raises the question of whether LLMs' characteristics show potential for revolutionising SEO and to what extent.

1.1. Aim and research gap

LLMs' possibilities are wide and growing. The technology is employed in a growing range of domains. It automatises processes and improves work efficiency. LLMs are becoming popular in marketing and advertising, e-commerce, education, medicine and health care, media and journalism, finance and banking, construction and architecture, entertainment and games, research, and the public sector and administration. Their application potential is still vigorously investigated. The literature review demonstrates that LLM research tends to focus on language model architecture and optimisation, security and ethics, and improvement of text generation and user interaction. The practical applications of LLMs and their potential social and economic impact are also investigated in depth (Cheng, 2023; Chodak, 2024; Lecler, 2023; Saka, 2023). In contrast, there are relatively few systematic analyses of LLM applications to improve SEO processes, such as website structural analysis, identification of technical errors, or content optimisation for search engines. This poses a certain research gap worth addressing.

The paper aims to assess the capabilities and limitations of using selected LLM-based AI tools for SEO auditing as a critical component of a university's marketing strategy in a case study of a university website. It addresses the following specific research questions: 1) To what extent are LLM-based AI tools useful for SEO auditing? and 2) How detailed are recommendations from an SEO audit generated by an LLM? The substantial deliverable of the paper is practical recommendations for using LLMs in SEO audits. The remainder of the paper is structured as follows. Section two contains potential capabilities and limitations of using Large Language Models in SEO audits and the research results to date. Section three presents the research methods, including a retrospective analysis of the study object, and outlines the research model and measurement tools. Section four offers the results discussed in the next section in the context of traditional SEO practices and the literature.

2. Background

2.1. Applicability of LLMs for SEO Auditing

Artificial intelligence (AI) is a generic term describing technologies and methods that allow machines to emulate intelligence and perform tasks requiring human abilities to understand, learn, and make decisions (Floridi, 2020). Large Language Models (LLMs) are sophisticated AI models for natural language processing (NLP) (Kalyan, 2023). LLMs are designed to understand and generate natural language (Spitale, 2023). In addition, such LLMs as GPT (Generative Pre-trained Transformer) are typical generative models. They are capable of creating new, original content, such as articles, dialogues, headings, titles, or programming or hypertext code from an input context called a prompt (Zhang, 2021). LLM advance is among the primary AI research and development areas. LLMs are constantly improved to create more precise and coherent content, but most of all, better understand human speech and text so that human-machine interactions can be elevated (Chodak, 2024). One example of such interactions is when a human (auditor) uses algorithms (‘machines’, in a sense) to assess the quality and position of ‘other algorithms’ (i.e. websites) in the global online ecosystem. The process is referred to as an SEO audit.

An SEO audit analyses and evaluates the quality of a website regarding its search engine optimisation. Its purpose is to flag problematic areas in need of optimisation. The end result is improved website visibility on the search engine results page (Edgar, 2023a). The literature analysis suggests that Large Language Models could be employed in SEO audits, particularly for content auditing, including textual element assessment (Cutler, 2023). Thanks to their ability to analyse text, generate content, and learn from large datasets, LLMs can potentially support search engine optimisation by generating content from input keywords, generating meta

description and meta title tags, and optimising existing content (Chodak, 2024). This means that LLMs can analyse existing text for search engine optimisation and suggest changes, such as new keywords and headings (H1-H3, for example) or inserting a call to action in the right place. Language models can also be useful for analysing reports and data from third-party test tools, such as the Google Search Console, Ahrefs, SEMrush, or Moz. They can synthesise and abridge large reports using simple language. All this shows that it is worth thoroughly analysing the capabilities and limitations of LLMs regarding SEO auditing.

2.2. Related work

In the digital era, university websites are critical for academic communication and reaching out to potential students. A well-optimised university website has a better potential to rank high on search engine results pages. In turn, good university visibility on search engine results pages supports its brand, recognition at home and abroad, and availability of research outcomes. It may also affect candidate application. As shown in the literature, search engine optimisation of university websites has become an indispensable part of marketing strategies.

The literature review indicates a growing role of search engines as a university enrolment tool. Research shows that search engine optimisation significantly improves university visibility on search engine results pages (Iddris, 2018). Shahzad et al. (2018) analysed various SEO techniques employed on university websites. They demonstrated that content optimisation, right keywords, and improved performance boost organic traffic, which is critical for university visibility on search engine results pages. Dolai (2023) investigated the impact of SEO on user engagement. He demonstrated that technical optimisation (Technical SEO), including optimisation of the URL and user experience (UX), affects search engine results page rank and conversion rate. Giannakoulopoulos et al. (2019) examined how SEO influences university website accessibility and search engine results page rank. They concluded that optimisation per W3C guidelines improves UX and SEO. Vállez and Ventura (2020) established that Local SEO boosts the number of university candidates from specific regions. Elsayed (2017) investigated search engine optimisation challenges relevant to university websites. He has shown that university portals are usually extensive, which calls for sophisticated SEO strategies, such as careful internal linking and meta tag optimisation. Cassar and Caruana (2023) demonstrated that multi-lingual content and optimisation of university websites for international search engines drive the number of international students up. Moreover, according to Al-Ananbeh et al. (2012), search engine-optimised websites with easily accessible content and user-friendly interfaces have a higher user retention rate. Shafaei and Taheri (2024) analysed selected SEO characteristics, such as optimising headings (H1, H2, etc.), removing duplicate content, and improving loading speed. The efforts were shown to affect indexing and search engine results page rank. Elbadrawy and Halim (2022) analysed search results and websites of selected universities. They discovered that those who had effectively used SEO techniques enjoyed increased organic traffic and higher search engine

results page rank. Their conclusions were corroborated by Supraba and Jati (2021). Therefore, the literature review shows that SEO is critical for university website optimisation. It affects their search engine results page rank, which determines the number of visitors, brand recognition, and enrolment effectiveness.

3. Materials and methods

3.1. Research object

The audited object is the website of the University of Agriculture in Kraków (UAK). The website was selected for the study because the deployment of a new content management system (CMS) coincided with the study. The process was commenced in 2024. The new CMS replaced a system used from 2010 to 2024, which is relatively long (Fig. 1). The system has become deprecated despite upgrades due to the emergence of new technologies. It was replaced with a new one, 'Platforma multiportalowa WEB360' (OPTeam).

Figure 1. Evolution of the graphic design of URK's website.

Source: original work based on the Internet Archive.

The University of Agriculture in Kraków's website has a long history. It has changed substantially between 2000 and 2024. Its first digital copies date back to 1998. They are available from the Internet Archive's Wayback Machine. However, they are incomplete due to missing graphics. The first complete copy is from April 2000. It is a website of the university under its previous name, Academy of Agriculture (HTML 4.0 Transitional). Content posting involved replacing files on the server via an FTP client (File Transfer Protocol). The first CMS (XHTML 1.0 Transitional) was implemented in 2010. It was used until 2024 with a few upgrades. A new multiportal CMS (HTML5) was deployed in 2024.

An SEO audit conducted when a new CMS is introduced helps avoid potential technical problems and fully utilise the new system. SEO audits are recommended at this stage because they can improve the quality of the new system regarding URL structure, performance, responsiveness (adaptation to mobile devices), UX usability, functionality, internal linking structure (no broken links), and content (Król, Zdonek, 2020). Any shortcomings detected during deployment can be handled before release for use and indexation. This minimises the potential adverse consequence of introducing a new CMS, deindexing, which could possibly lead to reduced search engine results page rank. Moreover, an SEO audit can help flag problems caused by content migration, which may also harm indexation.

3.2. Research design and measurement tools

The SEO audit followed the black-box model, where the auditor is a third party or at least not a member of the design/deployment team. They evaluate the website's quality, ignorant of its internal structure and source code (Bau, 2010). The auditor focuses on external interactions and verifies whether the system aligns with the assessment model. Black-box model testing involves inputting data and analysing the results to identify errors and problematic components in need of optimisation. This approach is particularly useful for assessing the website and web application quality from the user's perspective (Boukhris, 2017).

The URK website was audited using selected AI tools (Table 1). The first one is ChatGPT, an LLM-based AI by OpenAI. GPT (Generative Pre-trained Transformer) is a series of AI models trained on large datasets to understand, generate, and process natural language. Different versions of GPT models vary in terms of their text-processing capabilities (Cutler, 2023). It is important for the present study to note that ChatGPT has the SEO Audit Tool (DIAP Media) dedicated to SEO auditing.

Table 1.
AI applications used in the AI SEO audit

Item	Tool	URL*
1	ChatGPT OpenAI SEO Audit Tool (DIAP Media)	https://chatgpt.com
2	Microsoft Copilot	https://copilot.microsoft.com
3	Gemini Google DeepMind	https://gemini.google.com
4	Perplexity AI	https://www.perplexity.ai

*Accessed 10.10.2024.

Microsoft Copilot is based on advanced language models, such as GPT, integrated with Microsoft software, Microsoft Dynamics applications, and GitHub. The primary objective of Copilot is to support users in different tasks, such as automation of document workflow, spreadsheets, code, and business data (Stratton, 2024). The tool provides assistance in Microsoft applications, offering tips, generating content, or automating tool-specific tasks.

Gemini is a new series of Google DeepMind models formerly known as Google Brain. Gemini is integrated with the Google ecosystem, which means its functions are linked to Google services. This makes the tool potentially more effective in tasks requiring real-time access to online data (Saeidnia, 2023). Finally, Perplexity AI was designed to provide hyperlinks to relevant sources along with its responses. It is because this particular tool can search the Internet and offer information based on real-time data as opposed to language models that have only training data to help them (Deike, 2023).

4. Results

Each AI test tool was given at least two identical tasks. The first one was to conduct an SEO audit of https://urk.edu.pl. The other job was to generate content for the description meta tag. Selected AI responses are quoted verbatim, while others have been synthesised. Some responses were subjected to semantic analysis. The results are presented below.

4.1. ChatGPT case study

Prompt 1: Perform an SEO audit of the website at https://urk.edu.pl

Synthesised SEO Audit Tool responses: Although the prompt did not mention the owner of the audited website, the tool identified (URK) based on the content under the URL. All suggestions in the SEO audit report by ChatGPT were generic and universal, also those pertaining to responsiveness, performance, hyperlink quality, and UX. Recommendations in the audit summary were just as universal. All this suggests that the tool provided a general information panel with generic and universal SEO design recommendations rather than SEO audit results defined as outcomes of real-time measurements.

Prompt 2: Generate content example for the description meta tag for the website at https://urk.edu.pl

ChatGPT's response (content example): The University of Agriculture in Kraków offers a broad range of environmental, agricultural, and technical courses. Find out more about our programmes, enrolment, and research activity.

4.1.1. ChatGPT SEO Audit Tool (DIAP Media) Case Study

Prompt 1: Perform an SEO audit of the website at https://urk.edu.pl

The website could not be audited because it cannot be accessed due to directives in the robots.txt file. The directives in the file govern the website's availability to crawlers.

Prompt 2: Generate content example for the description meta tag for the website at https://urk.edu.pl

SEO Audit Tool's response (content example): The University of Agriculture in Kraków offers a broad selection of environmental, agricultural, and technical courses. Find out more about the educational, research, and international opportunities here. Check out the latest news on enrolment and events.

4.2. Microsoft Copilot case study

Prompt 1: Perform an SEO audit of the website at https://urk.edu.pl

Synthesised Copilot's responses: The tool drafted a list of activities, the 'action plan'. It included quality attributes to inspect during an SEO audit with respective test tools. However, the response was brief despite references to websites used to draft it. The structures and lengths of further responses followed a pattern.

Prompt 2: Generate content example for the description meta tag for the website at https://urk.edu.pl

Synthesised Copilot's responses: The tool provided not only the content (tag input) but the entire HTML code. Copilot claimed that the proposed meta description content was short and concise and offered key university details to attract potential candidates and improve the website's search engine results page rank. Proposed content: University of Agriculture in Kraków – we offer a broad selection of courses, modern research facilities, and a friendly environment. Join us and develop your future!

4.3. Gemini Google DeepMind case study

Prompt 1: Perform an SEO audit of the website at https://urk.edu.pl

Synthesised Gemini's responses: The tool reported that advanced SEO tools and detailed content analysis were necessary to conduct a comprehensive and detailed SEO audit. Gemini's audit results were based on a general analysis of available data. They can be a starting point for more in-depth tests.

Prompt 2: Conduct an audit of website content at https://urk.edu.pl

Synthesised Gemini's responses: The tool presented detailed characteristics of individual stages of the SEO audit. The list covered both the analytical (technical) step and conceptual activities (before practical action) to determine the optimisation goals and scope of the audit. Next, it listed the most commonly used content audit tools. The response's closing statement was that a complete content audit requires details of the owner's primary marketing goals,

the target of the content, and the budget. Consequently, Gemini's response seems the most exhaustive under the employed research design.

Prompt 3: Generate content example for the description meta tag for the website at https://urk.edu.pl

Synthesised Gemini's response 1: The tool responded that an incorrect (unclear) prompt was input. The problem lay in using a URL the tool was unable to resolve. The prompt was revised to: Generate a content example for the meta description tag for the website of the University of Agriculture in Kraków.

Synthesised Gemini's response 2: The tool drafted several meta description content examples in several categories. They were accompanied by suggestions for selecting the most suitable one.

4.4. Perplexity AI case study

Prompt 1: Perform an SEO audit of the website at https://urk.edu.pl

Perplexity AI's response: I cannot conduct an SEO audit for https://urk.edu.pl because I do not have access to SEO data analysis or tools for evaluating the website.

Prompt 2: What are the main SEO errors at urk.edu.pl?

Synthesised Perplexity AI’s responses: The most important SEO errors at urk.edu.pl may include various aspects affecting its search engine visibility, such as low-quality content, incorrect keywords, not optimised meta tags, internal linking problems, and user experience (UX) shortcomings. When these errors are identified and addressed, the search engine results page rank of urk.edu.pl can be improved, driving up organic traffic.

Notes on the response: Note that the response to prompt 2 is worded with ‘may include’ instead of ‘include’. It means that instead of results of actual measurements, the tool listed potential errors on the website based on analysis of relevant sources.

Prompt 3: What are the main linking errors at urk.edu.pl?

Synthesised Perplexity AI’s responses: The website at urk.edu.pl may contain various linking errors that could be detrimental to SEO. Here are the most common ones: excess internal links, incorrect anchor texts, and broken links. When these errors are identified and addressed, the SEO effectiveness of urk.edu.pl may improve significantly, and the website's search engine visibility may be boosted.

Notes on the response: Note that the response to prompt 3 is worded with ‘may contain various errors’ instead of ‘contains the following errors’. This means that the tool does not report the errors it identified. Instead, it merely provides general information about the most common linking errors.

5. Discussion

5.1. How ‘typical’ SEO auditing tools work

Tools employed in CEO audits use crawlers. These ‘virtual robots’ collect data, usually in real time and when requested. The process typically yields a synthetic score or quality indicator. The measurements are taken once, and their results represent the ‘here and now’ situation (Król, Zdonek, 2020). In contrast, such tools as Google Analytics collect user activity data on an ongoing basis (McGuirk, 2023). With such data, auditors can identify the most popular websites and the most effective keywords for long-term SEO. Still, Google Analytics data is usually available only to the website’s owner, editor, or administrator. Moreover, they are considered sensitive data (confidential trade secrets) in e-commerce. Some tools, such as SimilarWeb (Website Traffic Checker), can offer visitor statistics for third-party websites. Still, these are usually estimates based on sniffing, and their value is disputed (Król, Halva, 2017).

A comparative analysis and exhaustive SEO competitive analysis are possible for performance, content, responsiveness, usability, and hyperlinks (Edgar, 2023a). These aspects can be measured with easily available SEO tools that use crawlers. Simply put, crawlers search the website similarly to search engine robots (Kausar, 2013). They scan all available resources and collect various types of data on content, link structure, and metadata. After that, SEO tools generate a report of variable levels of detail on quality metrics, SEO problems, and recommended actions. These tools offer results that answer questions about the current state. Their functions can measure the potential for code minification or image file compression for optimised performance; they report how much and in what way files can be minified or compressed. However, such tools cannot generate ‘alternative content’ for textual components of the audited website. Performance audit follows a slightly different path. The tests involve two modes: desktop and mobile. The results come from laboratory tests (lab data) and a typical user environment (field data) (Edgar, 2023b).

5.2. SEO analyses with language models

The literature review shows that LLMs are most often used to obtain proposals for text input that could be published in various sections, components, or parts of the website. SEO auditing is a far less popular use of LLMs (Chodak, 2024). It may be due to their technical and logical structures, which set them apart from other natural language processing systems. How LLMs are designed and work is thanks to the latest achievements in artificial intelligence, such as transformer architecture, which allows them to understand and generate complex texts (Chang, 2024). Put simply and briefly, the logic of LLMs is based on machine learning, transformer architecture, probability, and semantic representation learning (Shanahan, 2024). These mechanisms allow LLMs to analyse relationships between words in an entire text instead

of just adjacent words. This way, LLMs can better understand sentences, especially in the case of complex contexts or ambiguous texts. It still remains text analysis, which means it does not measure technical attributes in real time, such as the measurement of browser loading time. Therefore, LLMs can be and, indeed, are most often used to aid optimisation after the results of an audit with typical SEO tools are known. LLMs can help interpret results (reports) from such tools.

The present and past research shows that LLMs can be useful for SEO auditing, but their capabilities are limited in some areas. Such LLMs as ChatGPT, Microsoft Copilot, Gemini Google DeepMind, and Perplexity AI do not have access to analytical data and quality metrics that are necessary to thoroughly assess a website's quality (Król, Zdonek, 2020). LLMs are unable to browse websites to identify technical errors the way crawlers do it. Therefore, their capabilities to conduct sophisticated technical audits (Technical SEO), such as performance or link audits, are limited (Edgar, 2023a). Moreover, LLMs do not generate SEO reports based on the latest or real-time data because they have no access to input from SEO measurement tools. In light of the above, LLMs seem to be best suited for SEO optimisation rather than automated end-to-end SEO auditing. Still, they are continuously developed, and their analytical capabilities may expand significantly soon.

6. Summary

All the tools employed in this research use artificial intelligence algorithms to perform their tasks. Each is designed to interact with the user, who can ask questions or give prompts and receive responses or results in real time. Their signature quality is the conversational user interface. Although all the tools use artificial intelligence, their characteristics differ as they target different users. ChatGPT and Perplexity focus on generating texts, conducting general conversation, and responding to questions, whereas the SEO Audit Tool and Microsoft Copilot concentrate more on work optimisation and data analysis. In addition, ChatGPT and Perplexity are intended for general use, whereas the SEO Audit Tool and Microsoft Copilot target audiences specialising in specific domains.

The research shows that although LLMs have great potential for generating text for various website components, they cannot replace human creativity and critical thinking, which are indispensable in semantic analysis and SEO strategy building. LLMs provide valuable suggestions and tips, which, nevertheless, need to be verified and critically analysed to adapt them to the actual needs of the website. Still, LLMs' ability to automatise processes and generate text may improve SEO effectiveness, making the website more competitive in a rapidly changing online ecosystem. As AI algorithms grow more sophisticated, SEO may find LLMs critical to keep the competitive advantage and effectiveness of optimisation.

SEO is an essential part of the modern marketing strategy for universities. The right SEO techniques combined with result monitoring, also through regular SEO audits, can bring substantial benefits to universities. Effective SEO efforts can have tangible competitive gains, such as improved search engine visibility, brand image and recognition, and promotion and enrolment effectiveness.

6.1. Practical implications and limitations of the study

The study has demonstrated that LLM-based AI tools do not perform SEO audits. They have no analytical tools for investigating website content in real time. They can, however, list items to analyse during corrective activities. The study shows that LLMs can easily generate content for such elements as meta tags or headings (H1, for example). They can also be used to semantically analyse existing textual elements, such as articles, abstracts, summaries, and others, to be optimised. Therefore, a prompt for an LLM tool should be a request to generate textual content or optimise a specific component rather than perform a complete audit. Therefore, LLMs can be useful for optimisation but not quality assessment before optimisation.

The website administrator or editor sometimes blocks access to some server resources. They can also prevent third-parties from analysing the quality of their website. Therefore, it is not always possible to conduct an SEO audit. The primary reasons are security and performance optimisation (reduced server load and use) but also the intention to 'conceal' innovative design solutions. Consequently, many websites do not allow crawlers to inspect their content. The University of Agriculture's website is one of them. Its robots.txt file contains directives locking crawlers (GPT bots included) out of some sections of the website. This was confirmed by the tools used in the study.

Their responses also confirmed that most of them were generated by LLMs from estimations based on big data analysis rather than real-time measurements. They reported that the directives in the robots.txt file locked out crawlers when they attempted to perform a measurement and view the website's content.

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MANAGEMENT OF SOCIAL CO-PARTICIPATION OF FOREIGN STUDENTS. SOCIOLOGICAL PERSPECTIVE

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Purpose: The expansion of internationalization processes in the world and in Poland has increased the need for research and reflection on the structure, form and needs related to the phenomenon of internationalization. The aim of the article is to undertake a scientific discourse in order to reflect more deeply on the model of social competence management among foreign students in Poland.

Design/methodology/approach: The increasing influx of foreign students from many countries of the world is visible in both urban and university spaces. Quantitative changes in the geographical space (universities, cities) generate a question about a coherent management model at the qualitative level, especially in the areas of social competences among foreign students. In this context, it is worth asking a question about the Polish model of social competence management among foreign students. The model supporting the development of competences will allow for the promotion and further development of internationalization in Poland. In addition, it may encourage graduates from other countries to continue their career plans in the country of study. Incoming migration of young people from other countries, will also translate into economic growth in Poland.

Findings: In the era of technological development, artificial intelligence and mobility, there is also a growing need for research on social competences, among others, among foreign students. It is in this group of young people that various types of attitudes, pressures, expectations and patterns intersect in their biographies. There is no comprehensive research in this area that would enable the development and application of a model of social competence management in the academic environment. Such a model could be implemented in the National Qualifications Framework (NQF) and effectively contribute to the increase in the internationalization of universities in the formal and social dimension (improvement of social and psychological relations (improvement of quality of life)).

Research limitations/implications: In Poland, there is a lack of comprehensive and interdisciplinary research in the field of social competences among foreign students.

Practical implications: Implementation of real and practical activities in the field of university strategy at the national and local level and support for foreign students in their individual biographies and professional trajectories.

Originality/value: Undertaking scientific reflection on the need to develop a coherent and practical model of managing social competences among foreign students in Poland.

Keywords: foreign students, internationalization, universities, social competences, management, diagnosis.

Category of the paper: Literature review. Viewpoint.

1. Introduction

The expansion of internationalization processes in the world has increased the need for research and reflection on the structure, form and needs related to the phenomenon of internationalization. In 2016 alone, the number of foreign students studying at higher level in the OECD increased by 7%, from 3.3 million to over 3.5 million (SOPEMI, 2018).

Foreign students are a specific group of temporary migrants. They belong to the so-called newcomers, i.e. people staying abroad for a certain period of time (on average from 6 months to 5 years). Due to the diverse offer of the higher education system, there is no rule regarding the length of stay, but it should be assumed that the overriding goal of their mobility is education (Bochner, 2006). Research shows that for students deciding to study abroad in the EU, the most important advantage is the opportunity to study in an EU country, international recognition of the diploma and good career prospects after graduation (Stasik, 2017). Students use existing material, institutional, social and pre-arrival competences to build a living space in which they implement biographical patterns of action, understood as the pursuit of their own goals and values.

The phenomenon of student mobility is often associated with the migration of skilled workers (Castles, Miller, 2012), which is why their study is particularly important. Learning mobility becomes an element and an opportunity to support social competences, especially those expected by future employers. Students can become an important resource for well-educated workers, essential for the development of an ageing European economy, especially when their employment is perceived as socially beneficial. Research conducted by the Center for Public Opinion Research in Poland indicates the growing acceptance of both the presence and undertaking employment by foreigners. The research shows that some groups of students (Ukraine, Belarus, Russia, African countries) plan to stay in Poland after graduation. It is relatively likely that people from different regions of Asia will also remain in Poland (Stasik, 2017).

Since 2005 the Study in Poland program has been operating in Poland, providing statistics on the level of internationalization of Polish universities. According to the program data, the internationalization rate in Poland increased from 0.71% in the 2007/2008 academic year to 5.63% in 2007/2008. 72 743 foreign students from 170 countries study in Poland, it is 6950 more than a year ago (an increase by over 10% comparing to 2017/2018 academic year) (Siwińska, 2019). ... Eurostat data indicate slightly lower values (resulting from a different methodological approach in defining concepts, such as student mobility, foreign student or studies abroad (Teichler, 2017), but the growth dynamics are equally intense. The data translate into the institutional level and are manifested using the internationalization rate, which in Poland increased from 0.71% in the academic year 2007/2008 to 5.63% ten years later (Siwińska, 2019). In recent years, there has been a steady increase in foreign students in Poland.

On the other hand, more and more foreigners study and graduate in Poland. In the academic year 2021-22 nearly 89.5 thousand foreign students from 180 countries studied in Poland, which is over 4.7 thousand more than a year earlier (Eurostat, educ_uoe_mobs02, 2022).

The increasing process of mobility, especially of young people for educational purposes in the world and in Poland, has been visible in recent years. Therefore, the question arises about the dilemmas and how to manage both at the level of university administration (host institution) is implemented to improve the process of mobility of foreign students to Polish scientific and research institutions. In the era of competitiveness, the element of foreign cooperation is an integral part of the strategy of all universities. Can we talk about a coherent structure of social competence management among foreign students at universities? Is internationalization carried out only at the level of university structures or does it go out in cooperation with public-private entities (e.g. international corporations, city offices, local companies, business environment institutions). Is there a model of social competence management among foreign students at the level of internal structures in Poland? Are these competences strengthened, and if so, how? What areas of competence require strengthening and support from the host institution.

A review of the literature on foreign students clearly indicates that most research focuses on the issues of acculturation or adaptation and the barriers associated with it. Although the life situation of foreign students has been studied in several smaller studies (master's theses), there has not yet been a broader national study focusing on a broader set of competences (including civic competences). There are few broad, interdisciplinary studies of foreign students analyzing the social determinants of the development of these competences and their relationships with the development of professional competences (e.g. Ye, 2017; Zorofi, Sahranavard, 2011).

The article poses preliminary research questions, which are only an element to undertake further interdisciplinary discussion using research methods and tools within various scientific disciplines:

1. The country of origin of students and their economic situation determine the strength motivating students to develop their own social, academic and communication competences.
2. Features preceding the start of studying (e.g. previous studying experience, family background affect the student's skills and abilities).
3. The smaller the cultural distance between the migrants' place of origin and destination, the fewer opportunities to acquire new skills.
4. The more positive the image of the country studying before leaving, the greater the sense of disappointment and discouragement to develop one's own academic, social and communication competences in the event of a discrepancy between expectations and reality.

5. The country of origin of foreign students differentiates the type of difficulties experienced in the implementation of biographical schemes of action and the use of institutionalized forms of assistance to foreigners.
6. The lower the level of social competences, the higher the level of social alienation of foreign students.
7. Strong social networks with foreigners and other foreign students positively correlate with the increase in social and communication competences.
8. Good material and institutional infrastructure has a positive impact on the development of academic, social and communication competences.
9. The higher the social competences, the higher the communication competences.
10. The higher the academic competences, the higher the social competences.
11. The experience of students with acts of discrimination negatively affects the development of their social competences.

The article is of an illustrative and analytical nature based on the available literature in the field of social sciences and migration and is based on available statistical data.

Structure of the article: the article contains a preliminary analysis and a proposal to undertake further research in the models (areas): – institutional and – biographical and a reflection on the need to develop an interdisciplinary model of managing the social competences of foreign students.

1. Institutional model. External level – (legal) (university development strategies) attitude towards strengthening and proposed solutions to improve the flow of educational migration streams, including the university environment. Examination of current needs and support in the field of improving and developing social competences among foreign students. E.g. involvement of university staff. Is there a model for researching social needs and competences among foreign students before and after the start of a cycle of education in a selected institution at a given university?
2. Biographical model. Internal level – (building relationships and communication networks) student level, e.g. in interaction with colleagues from the host country, city residents, with colleagues from other countries during their stay at university. What is the development of competences during the stay at studies in the host country. Is there a progress or regression and what factors affect the dynamics of changes in the area of various social competences.
3. Summary and conclusions.

2. Review of definitions

In the literature on the subject, many competences can be found (e.g. Grabowska, 2019): linguistic (Chomsky, 1967), communication (Hymes, 1980), cognitive (Piaget, 1972), social and professional (Raven, 1984), self-creating (Dudzikowa, 1993), temporary (e.g. Lens, 2004). In Poland, research is conducted on the intercultural competences of economic migrants in the context of their functioning in various cultural contexts (Grabowska, 2018), didactic and communication competences of teachers (e.g. Strykowski et al., 2007), competences of managers and unemployed people (e.g. Strykowski et al., 2007). e.g. Czechowska-Bieluga et al., 2009) and Polish students and pupils (Hajduk, 2003). So far, however, no research has been carried out on the development of foreign students' competences.

This issue has its source in management disciplines, but for many years research has also been conducted on a sociological basis and in this sense it is associated with considerations of, among others, human capital (Becker, 1994), human capabilities (Sen, 1997), or ability and reflexivity (Archer, 2018). Today, the practice of assessing employees of all industries in terms of their competences is becoming quite common. The hard ones, related to the profession, but also the soft ones – personal (resistance to stress, communicativeness, composure, etc.). Research on employers' expectations shows that the most valued social competences on the labour market (Jagodziński, 2013) are: self-organisation, punctuality and strong motivation to work (Kocór, Strzebońska, 2011), communication competences, including knowledge of foreign languages (Varga, Szira et al., 2016), creativity and self-improvement (Varga, Szira et al., 2016). In turn, studies of students in 11 European countries show that they value competences related to self-organization (time, pace of work), self-improvement, creativity and analytical thinking, i.e. individual competences related to individual characteristics, and other than social competences, such as teamwork and language competences (Little, Braun, Tang, 2008). This means that students underestimate those competences that are so highly valued among employers. These studies did not include foreign students, so it is not known how to assess the competences of this particular group of students.

We define competences as "a set of behaviours that some people master better than others, which makes them act more effectively in a given situation" (Levy-Leboyer, 1997, p. 32 after: Jagodziński, 2013). There is a diversity of approaches and definitions of social competences, but it can be summarized in one proposed by DASCHE (2020): "One and one-dimensional definition for all is neither possible nor desirable. Despite this diversity of social competence characteristics conditioned by the tradition of higher education and its legal context, an important feature of all the above approaches can be seen. It is about recognizing social competences as a meta-competence built on knowledge and skills, enriched with axiological reflection allowing for their independent and responsible application leading to social benefits" (Chmielecka, 2020). It follows from this definition that it is not possible to talk about one

general social competence, but about many of their types. We can mention, among others, competences such as: skills related to social perception (accurate perception of others, e.g. their intentions, and correct assessment of social situations), social sensitivity, empathy interpersonal decentralization:

- Knowledge of social rules and the ability to behave appropriately in social situations.
- Ability to solve specific interpersonal problems and control social situations.
- Skills for coping in conflict and assertive situations.
- Effective self-presentation and the ability to influence others.
- Communication skills.
- Cooperative skills (Knopp, 2013, p. 2).

In interactive terms, the components of social competences are:

- Competences determining the effectiveness of behavior in intimate situations.
- Competences determining the effectiveness of behavior in a social exposure situation.
- Competences determining the effectiveness of behavior in situations requiring assertiveness (Tomorowicz, 2011, p. 92).

In turn, the integrated model of social competences proposed by M. Grzesiak (2021) includes five areas covering different clusters of social competences: marketing, relationships, self-realization, management and spirituality (Grzesiak, 2021, p. 129).

Social competences play a key role in the development of academic and communication competences. Empirical research shows that competences correlate positively with, among others, mental well-being, general life satisfaction, quality of interpersonal relationships, readiness to help others, but also the use of social support, effective strategies for coping with stress, as well as broadly understood adaptation and proper social functioning (Knopp, 2013, p. 2).

3. Institutional model (external level) of social competence research

Current status: data verification attempt

Thinking about the university's strategy in the context of internationalization is a completely new challenge for many Polish public universities. It is rather a standard for Anglo-Saxon universities and the European Union (Domański, 2016, p. 64). In 2011 the Study in Poland project showed that such strategies are very rare (1 in 20 universities), and most of them have an overall university development strategy. Therefore, the university's internationalization strategy is an important indicator of the university's great interest in attracting foreign students.

The practical dimension of further research

A comparative analysis of the content of the strategies obtained in the national dimension will allow for a comparison of their priorities, and will also be the basis for the creation of a scenario of in-depth individual interviews, which will be carried out during the study visit at the employees of career offices dealing with foreign students. These interviews are aimed at deepening the information contained in the strategy, and if it is not developed by the university, obtaining information on the support offered to foreign students and recognizing the problems that universities have in the field of internationalization and issues related to the admission of students from abroad. The following areas of support will be discussed in the interviews: legal, psychological, material (scholarships, access to libraries, sports infrastructure), social (intergenerational activity of foreign students, cooperation with the institutional environment of the university (R&D), building a partner network of 10 in-depth interviews with career office employees responsible for contacts with foreign students: in addition, structured observation will be carried out during studies.

Diagnosis of competences achieved in the education process is the beginning of actions correcting the implemented educational strategies so that they can achieve the desired characteristics (directing them to other paths, strengthening, making them more flexible, etc.). The proposed research will allow to determine the competence attractiveness of higher education and identify sensitive points where expectations deviate from reality, will help to define the factors responsible for strengthening or weakening the competences selected for analysis. Therefore, it is possible to indicate those areas in which academic organizations could support foreign students in their development to a greater extent than before. This applies especially to Polish universities, as research has shown that the quality of administrative services received the most negative ratings (Stasik, 2017). In addition, students from Western Europe, in particular students from Scandinavian countries undertaking medical studies in Poland, misjudged the quality of classes and their development opportunities (Stasik, 2017).

The development of competences depends largely on the material and organizational resources of the university. Therefore, the starting point of the analysis will be to examine these resources and analyze the support system offered to foreign students. The image of students about the country to which they wanted to study is also important, as well as the image of the city in which the university of their choice is located, which consists of such elements as: security, a positive assessment of the situation of the country adopting a lifestyle and culture, openness of residents, scholarship support, the possibility of a further professional career (e.g. Cubillo et al., 2006; Ghazarian, 2016). It can be assumed that these attracting factors can stimulate students to develop their own competences, if this image is confirmed in reality. Otherwise, these factors can lead to a decrease in motivation, frustration and even abandonment of studies and return to the country of origin.

4. Biographical model (internal level) of the study of social competences

Current status: data verification attempt

The process of shaping social competences in academic didactics is passive and apparent. Meanwhile, the deficit of these competences, both on the part of students and lecturers, hinders the process of acquiring knowledge and shaping skills. There is a lack of systemic solutions in this regard. At universities, there is no will and time to talk about social competences (Bojanowicz, 2022, p. 179 for: Chmielecka, Matuszczak, 2020).

The basic function of acquiring and developing competences by individuals is not only to adapt to the social environment, but also to transform it. Meanwhile, in research on social mobility, the greatest attention is paid to the analysis of adaptation strategies that ignore the ability of students to create and transform the material, social and institutional environment to achieve their own development goals. Therefore, the proposed model is not aimed at studying the processes of assimilation or integration, because foreign students are a very mobile group, which often does not associate their lives with the country where they graduated (due to the diversity of this group, we can consider different mobility trajectories: people planning to settle permanently in the country of study to people who are open to further mobility, transforming, for example, into educational hypermobility (Czerska-Shaw, 2017), labor migration, specialized migration, as well as multiple migrations (Salamońska, 2017).

For foreign students from outside the EU and EFTA countries, communication competences are even more important because they have to pay for studying in Poland. Due to the almost non-existent scholarship system in Poland, these are high costs for the family, which is why some students are interested in taking up a job, but the key barrier is the lack of knowledge of the Polish language (Fazlagić, 2018).

Practical dimension of further research

This part of the analysis aims to learn how foreign students perform their roles in the sense of cultural, social and spatial (urban) space, what strategies they choose to build social contacts and social activity, with whom they establish contacts and how they shape their social support networks in the mobility process. In this area, it is interesting what conscious actions students take to build their academic, social and linguistic competences (biographical patterns of action according to F. Schütze, 1984), how they use existing opportunities and resources (material, institutional and social) for this purpose, and how they build resources that increase their intellectual, cultural and social capital. We will also look at the problems they face when entering the roles of students (Znaniecki, 1994), but also at biographical changes and turning points in which they discover their own potential and possibilities.

Analysis of trajectories or external processes and conditions over which the individual has no influence, and which deprive them of the possibility of directing their own undertakings and limit the development of competences, block the possibility of fulfilling the expectations and desires of foreign students. In this model, it is worth reflecting on the cultural conditions (patterns of action) that socialize students in their countries of origin and bring them to Poland. To what extent are these cultural patterns a stimulating factor, and to what extent inhibiting the development of the competences we study?

The purpose of collecting and analyzing data is to gain an emic understanding – in other words, the understanding of the importance of career development from the participants' perspective (Agar, 1996). Research also shows that communication competences significantly affect building social relationships with other students, as well as overall satisfaction with studies (Heikinheimo, Shute, 1986). For most foreign students, language is the main obstacle to adaptation and a factor of acculturation stress (Wilton, Constantine, 2003). Studying in a new, unfamiliar environment and adapting to new language and academic challenges is the main process causing stress and cultural shock of varying intensity for foreign students (Ruddock, Turner, 2007). Lack of knowledge of the local language limits the possibility of participating in cultural events, as well as functioning in everyday life, especially in Poland, where knowledge of English is still insufficient in the society (Popow, 2015). This is important because research shows that students' participation in the cultural and social life of a community (local, urban) strengthens their social, professional and cultural competences, which enable them to participate more fully in group life (Kim, 2001). Institutional model (external level). In this model, the main areas of analysis would be focused around the following issues and questions.

How foreign students perform their roles in the sense of cultural, social and spatial (urban) environment, what strategies they choose to build social contacts and social activity, with whom they establish contacts and how they shape their social support networks in the mobility process. What conscious actions do students take to build their academic, social and linguistic competences (biographical patterns of action according to F. Schütze, 1984), how do they use existing opportunities and resources (material, institutional and social) for this purpose, and how they build resources that increase their intellectual, cultural and social capital. In addition, it is also important to diagnose the problems they face when entering the roles of students (Znaniecki, 1994), but also the biographical changes and turning points in which they discover their own potential and possibilities.

5. Discussion and conclusions

Studies of foreign students usually focus on the analysis of their social and cultural situation in a particular country, usually from a narrow problem perspective. Analyses on the motives for studying at a foreign university (e.g. Ghazarian, 2016), cultural shock related to studying in a foreign country (e.g. Gebhard, 2012), adaptation strategies and implemented support programs (e.g. Hayes, Lin, 1994; Collin, 2012; Santillan, Martin, 2018), stereotypes related to the ethnic origin of foreigners (e.g. Wong, 2004), difficulties and facilitations during studies, future employment plans are undertaken (e.g. Gebhard, 2010).

It should be noted that the subject of research conducted among foreign students was dependent on the specificity of the problems associated with their stay in a given country, and thus – the specificity of a given country in the educational, legal, economic, etc.

Unfortunately, there is a lack of comprehensive models of managing social competences in constructing a specific model of managing these competences for the purposes of both:

1. Development and support for foreign students.
2. Supporting the process of internationalization of the university.
3. Building a positive image in urban space.

For example, it is estimated that if the current policy is maintained, the number of Polish students in 2025 may have fallen by 42% compared to 2005 (Domański, 2014). Therefore, it is necessary to ensure that European universities are competitive and attract an increasing number of foreign students, and this can only happen if the students of these universities are able to develop the competences desired in the international labor market. Therefore, the study of students' competences, factors stimulating or hindering their development, has many convincing pragmatic justifications. It allows to direct the personal development of students, improve the recruitment and selection of people for specific social and professional roles, increase the effectiveness of the tasks undertaken, change the organizational culture of the university, increase the competitiveness of the university using its social potential. Diagnosis of competences achieved in the education process is the beginning of actions correcting the implemented educational strategies so that they can achieve the desired characteristics (directing them to other paths, strengthening, making them more flexible, etc.).

Finally, R. Thomson and R. Taylor (2005) also emphasized the value of mobility in a non-figurative sense, imagining such ideas as cosmopolitanism as a resource in the process of transformation of young people. An important role in building an open Europe based on dialogue and democracy can be played by its future elites studying at European universities, including foreign students.

1. Assessment of the functioning of the institutional and material infrastructure of the university for the development of competences of foreign students.
2. Diagnosis of competences of foreign students and their determinants.
3. Diagnosis of barriers in the development of competences of foreign students.

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WOMEN IN FAMILY COMPANIES THE PERSPECTIVE OF EUROPEAN DIRECTIVE 2022/2381

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Purpose: The author of this publication tried to verify the visibility of women in relation to family companies listed on the Warsaw Stock Exchange (WSE) and compared them to research results that do not separate this group of enterprises, to determine where Polish listed companies are positioned in relation to the targets EU Directive 2022/2381. Also to verify whether it is possible to notice a difference in the level of employment of women in highest authorities in family companies versus others.
Design/methodology/approach: The presented research results is an overview and attempts to analyze of women visibility on the highest authorities of family listed companies on a based on socialisation theory and taking into consideration the criteria of the EU Directive 2022/2381.
Findings: The result of own research showed the visibility of women in the highest governing bodies of family companies listed on the WSE, which is the first step in the introduction EU Directive 2022/2381. Additionally the research results showed that the percentage of women in the highest bodies of family listed companies is significantly higher than in the results of studies that did not distinguish this group of enterprises.
Practical implications: According to the results of own research, in family companies listed on the WSE, there may be a pattern that supports the selection of women for highest authorities, thus it could be helpful in meeting the criteria of the EU Directive 2022/2381 in non-family listed companies.
Social implications: Women's career paths seems to constitute an important topic that requires deep research, as evidenced by the awarding of the Nobel Prize in Economics in 2023 to a professor Claudia Goldin. The data collected in this article illustrates the visibility of women in the highest authorities of listed companies on the WSE, which clearly indicates the need to introduce changes.
Originality/value: According to the author's knowledge, these are the first studies in Poland verifying the participation of women in the highest authorities in relation to family companies listed on the main market of the WSE taking into account the socialisation theory.
Keywords: family companies, woman, socialization theory, corporate governance.
Category of the paper: Research paper.

1. Introduction

With a view to numerous initiatives and programs aimed at opening women's access to the highest positions in business in the European Union, scientific studies show the lack of consistency regarding the impact of women on the effectiveness of enterprises. Some of the results of the conducted research clearly indicate the positive impact of the presence of women in top positions (Bohdanowicz, 2016; de Beaufort, Summers, 2014). Primarily emphasizing the increased level of mutual understanding between stakeholders, increased creativity and innovation, as well as being guided by ethical and moral principles. Others indicate that the influence of women on decision-making is negative or that there are no clear differences between women and men (Wellalage, Fernandez, Thrikawala, 2020; Witkowska, Kompa, Matuszewska-Janica, 2019). The perception of women holding the highest positions in enterprises may also be influenced by the process of socialization, which is significantly different than in the case of men.

Despite of the indicated lack of consistency in the world of science regarding the impact of women on the efficiency of enterprises, the Council of Europe and the European Parliament in the second half of 2022 adopted the Directive 2022/2381 on improving the gender balance among directors of the listed companies and related measures which applies to listed companies whose registered office is located in an EU country. The directive does not apply to micro, small and medium-sized enterprises (SMEs). According to the Directive, by July 2026, the female gender will have to constitute at least 40% of the composition of the supervisory boards or a minimum of 33% of the members of the management board and the supervisory board jointly (Council of Europe, European Parliament, 2022).

In order to be able to study the impact of women on the efficiency of enterprises as well as the possible differences between the sexes, the critical mass theory should also be taken into consideration (García-Meca, Santana-Martín, 2023). The critical mass theory indicates that only when there is a sufficiently high number or proportion of women in boards, will there be a critical mass that can shape decisions and strategic directions adopted at the highest levels of companies (Shahab et al., 2020). What is more, scientific research results identified that the share of women in the authorities of at least 30% is enough to verify their impact on the efficiency of enterprises and is referred to as minority influence (Danbold, Unzueta, 2020; Roth, 2004).

Taking into the account indicated research theories, it is necessary to know the real impact of women at the highest levels of enterprises. The author of this publication tried to verify the indicated visibility of women in relation to family companies listed on the Warsaw Stock Exchange, due to their specificity. This knowledge will not only determine the position of Polish family companies listed on the Warsaw Stock Exchange in relation to the adopted EU Directive but will also help to check whether it is possible to verify their effectiveness in

the context of gender due to the presence of minority influence. According to the author's knowledge, these are the first studies in Poland verifying the participation of women in the highest authorities in relation to family companies listed on the main market of the WSE taking into account the socialisation theory.

2. Literature review

The creators of the theory of socialization believe that each individual builds and develops his/her own concepts of the surrounding reality over time, which will largely be responsible for the later canon of behavior, perception and performance of professional functions, including managerial ones.

The indicated fundamental processes of human socialization take place with the participation of institutions that have the greatest impact on the process of raising children; the family stands on a pedestal due to its strong emotional ties (Erikson, 1968). Family members, jointly engaged in the development of the company, transfer the known patterns of behavior and values to the company, thus creating a unique organizational culture that has a family management style at its core. Hence, the author of this study decided to explore the role of women only in this specific group of business entities.

Looking at the outlined process of socialization of an individual, many scientists believe that it proceeds differently in the case of women and men (Dumas, 1990; Josselson, 1987; Gilligan, 1982). First of all, it should be highlighted that the process of socialization and searching for one's own identity in women is accompanied by a strong need to maintain close ties and significant others. In case of men, on the other hand, it becomes possible to shape their perception system with a sense of independence. Women on the path of searching for their identity feel the need to be part of a larger system that provides a sense of security and support, and the individuals within it are characterized by a certain degree of similarity. Men are looking for themselves through a significant, almost spectacular separation from the larger system and the need to emphasize their differences from others. Women's sense of identity is created on the foundations of understanding, attachment and maintaining strong ties with family members as well as other important people functioning in their lives (Ward, 1987) The key here is communication and a sense of support in close people. Men, on the other hand, will seek their own paths, the choice of which will be made on the basis of their own judgments, where the opinion of others on this subject is not the primary factor that will decide on a given decision.

These differences in the process of socialization and the search for one's own identity in adolescence, as the scientists indicate, translate into a different style of preferred communication and the way women and men solve problems and conflicts in their professional life (Haberman, Danes, 2007; Danes, Haberman, McTavish, 2005; Poza, Messer, 2001).

The dissonance is also visible in the way of thinking, drawing conclusions and making decisions (Harveston, Davis, Lyden, 1997). A woman in a leadership position is charismatic, willing to help other employees and to create opportunities for co-decision (Burke, Collins, 2001). The management method, however, is much less authoritarian and hierarchical than in the case of men and is characterized by a desire to know and understand the situation of employees, understanding, cooperation and long-term relationships (Brush, 1992). An interactive female leader builds her position mainly on long-term relationships and interpersonal bonds, not like a man on the visual attributes of power, thus becoming involved in the lives of individual employees, which can often blur the boundaries between private and professional life (Rosener, 1997). In the context of building their careers, women will adopt many behaviors, work styles and the way of building professional ties from their mentor (Dumas, 1989). This is of particular importance for family businesses in the context of planning and implementing a succession strategy, which will result in the selection of a new leader of the company. The founding father or mother/senior will be the person who will show the daughter in what role she should see herself in her professional life (Dumas, 1990, 1989).

Based on the literature on the subject, it should be stated that historically women were not taken into account when decisions regarding the acquisition of the company were made. In accordance with the prevailing pattern of primogeniture, the eldest son was seen as the only candidate for succession (Keating, Little, 1997; Dumas, 1989). Even if the first offspring was female, she was often not considered as a potential leader anyway, and the founder/senior preferred to sell the company rather than pass it on to the daughter (Stavrou, 1999). In a situation where the family has an elder daughter and a younger son, the son will be prepared as the successor, despite his young age (Barnes, 1988). According to the latest research, a daughter was considered a successor if all offspring were female (Haberman, Danes, 2007; García-Álverez, López-Sintas, Gonzalvo, 2002). The main trend to change this approach may result from both the level of education of women and the growing number of successful women present in business life[1].

Summing up the literature review, it should be noted that the family as the basic unit of social life plays a key role in the socialization processes of men and women, which in the future will determine the styles of management and communication in professional life. These attributes will be more clearly visible in family enterprises than in non-family enterprises due to the close coupling of the family system and the enterprise in one entity (Majda-Kariozen, 2020). However, some obstacles in the functioning and professional development of women in this group of enterprises should be noted, those include difficulty in taking a leadership position by a woman, primogeniture path of succession, lack of visibility, despite possessing education and professional skills, and a significant attitude towards emotional leadership, characterized

[1] Women with higher education in EU-48% and 37%-men and in Poland- 26,9% versus men-19% (Eurostat, 2023; GUS, 2021).

by caring for the well-being of both the family and the company along with its employees. On the other hand, the indicated higher level of education of women as well as their focus on the common good and focus on achieving successes and not only the attributes of power, as well as the participatory style of management may be an ideal complement to the characteristics of family enterprises, thus constituting a good place to their professional development.

3. Research results in the case of the Warsaw Stock Exchange – review

Despite the author's research on the participation of women in the highest management and supervisory bodies in relation to family companies whose shares are listed on the Warsaw Stock Exchange, no research was found. However, it is worth considering the results of the largest empirical research on the issue indicated in an article which was published in Poland in 2021. The highlighted research was conducted on 140 companies listed on the Warsaw Stock Exchange, which at the end of 2019 were included in one of the three indexes: WIG20, mWIG40 and sWIG80. The period from 2010 to 2019 was analyzed. For each of the companies, publicly available data was collected on the composition of the management and supervisory boards at the end of each year, financial results and key balance sheet items as well as changes in share prices. The aim of the study was to confirm or reject the hypothesis that the diversity of authorities in terms of gender is associated with better financial performance, lower risk and a more favorable market valuation (Olszewska-Miszuris et al., 2021). However, before the impact of the diversity of authorities on the financial results was examined, the visibility of women in management and in supervisory boards in the surveyed facilities in the period covered by the study was first approximated. The results from this study are presented in the tables below.

Table 1.
The total composition and percentage share of women in the management boards of companies included at the end of 2019 in the WIG20, mWIG40 and sWIG80 indices in 2010-2019

Management Board										
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	41	45	40	47	52	55	62	69	67	64
Number of men	432	474	474	495	502	507	511	520	508	512
total number	473	519	514	542	554	562	573	589	575	576
share of women (%)	8,7%	8,7%	7,8%	8,7%	9,4%	9,8%	10,8%	11,7%	11,7%	11,1%

Source: Olszewska-Miszuris et al., 2021, pp. 1-42.

Table 2.
The total composition and percentage share of women in the supervisory boards of companies at the end of 2019 in the WIG20, mWIG40 and sWIG80 indices in 2010-2019

Supervisory Board										
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	80	91	88	98	96	113	123	120	119	141
Number of men	660	695	736	740	769	773	768	776	783	769
total number	740	786	824	838	865	886	891	896	902	910
share of women (%)	10,8%	11,6%	10,7%	11,7%	11,1%	12,8%	13,8%	13,4%	13,2%	15,5%

Source: Olszewska-Miszuris et al., 2021, pp. 1-42.

Tables 1 and 2 present the composition of the management and supervisory boards of the analyzed companies in the period 2010-2019 in relation to the participation of women in the indicated bodies. The analysis of the data categorized by the management and supervisory boards shows that over the ten-year period of the study, the participation of women was higher in supervisory boards than in management boards. The share of women in the management boards of the analyzed companies at the end of 2019 amounted to 11.1%. Over ten years, there was an increase of 2.4 pp., from 8.7% in 2010. In the case of supervisory boards, there was an improvement from 10.8% to 15.5%, i.e. by 4.7 pp. It should also be noted that in the period covered by the study, the number of people holding power increased (there was an increase in management boards by 103 positions and supervisory boards by 170). Despite this increase, the majority of positions were filled by men.

Table 3.
The total composition and the percentage share of women in the authorities of companies at the end of 2019 in the composition of WIG20, mWIG40, sWIG80 indices in 2010-2019

The total composition and percentage share of women in company authorities in 2010-2019										
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	121	136	128	145	148	168	185	189	186	205
Number of men	1092	1169	1210	1235	1271	1280	1279	1296	1291	1281
total number	1213	1305	1338	1380	1419	1448	1464	1485	1477	1486
share of women (%)	10,0%	10,4%	9,6%	10,5%	10,4%	11,6%	12,6%	12,7%	12,6%	13,8%

Source: Olszewska-Miszuris et al., 2021, pp. 1-42.

From the data presented in Table 3, it can be concluded that the share of women in the authorities of the surveyed companies at the end of 2019 was 13.8%, which is an increase of 3.8 pp over the decade, from 10% at the end of 2010. It should also be noted that the increase in the involvement of women in the highest organs of the examined entities can be dated from 2015.

Although the described results are the largest study so far on the participation of women in the bodies of companies listed on the Warsaw Stock Exchange, it should be noted that there was no verification of the participation of women in the positions of CEO, Chairman of the Supervisory Board, or shareholder structure. Although the latter variables could change the scope of research, according to the author of this study, those are also an important indicators of the influence of women on the enterprises.

4. Research methodology

Presenting the results of the author's own research, it is worth noting that, to the best of the author's knowledge, these are the first studies in Poland verifying the participation of women in the highest authorities in relation to family companies listed on the main market of the Warsaw Stock Exchange. So far, as was presented in the earlier part of this article, the group of these companies was not distinguished and the results were presented collectively for family and non-family companies.

The research methodology was based on documentation analysis method, based on the formal documentation of companies which have been designated as to be included in the scope of the research. By using this method obtained data was processed and the share analysis was conducted in order to obtain the results presented in the next chapter.

The list of companies listed on the Warsaw Stock Exchange (WSE) subject to empirical analysis was taken from the Thomson Reuters database and included entities belonging to the Warsaw Stock Exchange Index (WIG). This choice was intentional, because the indicated index is the oldest and the widest index published by the Warsaw Stock Exchange, which allows for the mapping of the broadest picture of the market. The first step aimed at separating family companies in accordance with the adopted definition was to understand the composition of the management boards, the supervisory boards and the shareholder structure. The aforementioned definition adopted for the research is- a family listed company is a company in which a family member is the CEO of management board, the management or supervisory structures may include other members of the same family and direct or indirect ownership in the amount of a minimum of 25% of the votes at the general meeting of shareholders belong to a member or members of this family. The mentioned family is the founder of the company and in exceptional cases gained control[2]. Due to the conclusions drawn from the previously described research project- disclosed growing share of woman in companies high authorities from 2015 to 2019, the author of this study attempted to analyze the share of women in the bodies of family companies meeting the above-mentioned definition from 2015 to 2019.

[2] The adopted assumption has its legal justification in the Commercial Companies Code (section II. Joint-stock companies), which states that a shareholder holding at least 25% of votes at the General Meeting of Shareholders has the right to block the decision made by the management board, and also has a real impact on the selection of management board members and may request an independent audit of any transaction.

5. Results

The data from the research and the interpretation are presented below.

Table 4.
The total composition and percentage share of women at the position of CEO in listed family companies in 2015-2019

CEO position					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	3	3	2	1	2
Number of men	51	57	61	64	59
Total number	54	60	63	65	61
Share of women (%)	5,56%	5,0%	3,17%	1,54%	3,28%

Source: author's own elaboration.

Table 5.
The total composition and percentage share of women at the position of Chairman of the supervisory board in listed family companies in 2015-2019

Chairman of the Supervisory Board					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	8	7	9	9	9
Number of men	46	53	54	56	52
Total number	54	60	63	65	61
Share of women (%)	14,81%	11,67%	14,29%	13,85%	14,75%

Source: author's own elaboration.

By analyzing the data presented in tables 4 and 5, it can be seen that the percentage of women holding the position of the president of the management board is decreasing. At the end of the period covered by the study, it is lower by 2.28 p.p. compared to its beginning. With regard to the share of women in the position of chairman of the supervisory board, a stable trend can be stated, in particular in 2016 a clearly drop could be observed. It should also be noted that the percentage of women holding the position of chairman of the supervisory board is much higher than that of the CEO position throughout the entire period covered by the empirical research. Taking into account the percentage of women in this two highest positions in the bodies of analyzed companies in the indicated period, cannot be compared with data that do not take into account the division into family and non-family enterprises presented in previous section, because these variables were not included. Enabling the comparison of highlighted data could indicate the position of family enterprises compared to other listed companies in the context of women's professional path.

Table 6.
The total number and percentage share of women in the management boards in listed family companies in 2015-2019

Management Board					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	13	22	22	23	19
Share of women (%)	12,50%	18,03%	18,18%	19,17%	16,67%

Source: author's own elaboration.

Table 7.
The total number and percentage share of women in the supervisory boards in listed family companies in 2015-2019

Supervisory Board					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	72	63	81	81	81
Share of women (%)	31,03%	24,23%	28,93%	28,13%	30,68%

Source: author's own elaboration.

With regard to the data presented in tables 6 and 7, it should be noted that the share of women in the management boards of the companies analyzed in the initial phase increased and exceeded 19%. However, the last year of measurement shows an opposite situation. Finally, within the five years of observation, an increase of 4.17 p.p. is visible. It is worth noting that it would be much higher if the trend continued until 2019. With regard to the participation of women in supervisory boards, as in the case of holding the position of chairman of the supervisory board, stabilization can be observed, except for 2016, where this share is significantly lower. It is also worth noting that in family companies both the share of women in the management board and in the supervisory board is definitely higher than in the research project presented in the previous section of this article. In particular, the share of women in the supervisory board in the analyzed period was often close to or exceeded 30%. On the other hand, it is worth noting that women were more likely to be found in supervisory boards than among board members in both presented analyses. This observation seems to be extremely important because as the importance of management boards in making decisions by companies is significantly greater in Polish legislation than that of the supervisory board. The required time commitment, responsibility and decision-making are also greater, as well as the related more attractive remuneration.

Table 8.
The total number and percentage share of women among the six largest shareholders in listed family companies in 2015-2019

Women's ownership					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	21	22	23	25	21
Share of women (%)	38,89%	36,67%	36,51%	38,46%	34,43%

Source: author's own elaboration

Table 9.
The total number and percentage share of women as the largest shareholder in listed family companies in 2015-2019

Women's ownership - the largest shareholder					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Number of women	3	3	3	3	2
Share of women (%)	5,56%	5,00%	4,76%	4,62%	3,28%

Source: author's own elaboration.

With regard to the data presented in tables 8 and 9, a downward trend should be noted in relation to the share of women as shareholders of the surveyed family companies, especially including the largest shareholder in the analyzed period (a 2.28 p.p decrease). The results of the shareholding analysis in the analyzed period show the same trend regarding the share of women as the previously indicated share of women in the position of CEO, at the same time indicates three variables in which the share of women in the analyzed period is decreasing. This data, as well as that relating to holding the position of CEO and chairman of the supervisory board, are incomparable to the conclusions from the research project presented in the earlier part of this article, analyzing the situation of women in companies listed in the following indices: WIG20, mWIG40, sWIG80, because they were not included in that analysis.

6. Discussion

In connection with the results of own research, indicating a higher percentage of women in the highest authorities in family companies listed on the Warsaw Stock Exchange, it may seem that this selection model should be explored and should be translated as a set of good practices for the others. Despite the significantly higher share of women in the highest bodies of family companies listed on the Warsaw Stock Exchange, in accordance with the guidelines of the European Parliament and of the Council of Europe, it is still unsatisfactory. The reasons can be found in the differences of the socialization process of women and men described in this article, which may affect the perception of women. There may also be other reasons that qualitative research could explore. Perhaps further research on the visibility of women in the highest authorities should be conducted taking into account new trends on labor market. It would also be interesting to verify the share of women by sector in reference to family companies listed on the Warsaw Stock Exchange. Recommended verification seems to be helpful to develop deeper into the analyzed research problem and present more complex picture.

7. Conclusions

The directive of the European Parliament and of the Council of Europe clearly defines the participation of women in the bodies of listed companies until June 2026. In addition, previously presented scientific theory indicate at what proportion of women in the bodies of companies one can talk about their minority influence on the decisions taken. In Poland, based on the results of the largest analysis, it should be noted that the share of women in both management and supervisory boards of listed companies has been growing slowly, especially since 2015. At the same time, it is far from the guidelines from the European Parliament and of the Council of Europe.

Based on the analysis of family companies listed on the Warsaw Stock Exchange conducted by the author of this article, it should be noted that despite the decrease in the share of women in the position of CEO and in the shareholder structure, their visibility in both management and supervisory boards is significantly higher in each year than in a research project described before. In the case of the supervisory board, this year-on-year result was close to or exceeded 30% at the same time being the highest percentage of women in the highest bodies of companies listed on Warsaw Stock Exchange.

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ESG CRITERIA AS DETERMINANTS OF SUSTAINABLE TRANSFORMATION OF SUPPLY CHAINS

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Purpose: The objective of the study is to identify the scope and impact of ESG criteria on the sustainable development of enterprises from the perspective of supply chains. The problem on which the study focused boils down to answering the questions: What features should characterize the strategy of an enterprise in the context of sustainable development?; What tools and activities are used by enterprises in their efforts to implement ESG criteria from the perspective of the supply chain?
Design/methodology/approach: The research methods and techniques used included, among others: content analysis, cause-effect analysis, selected methods of qualitative and quantitative analysis, which were used to present and discuss the results of the study.
Findings: In the search for methods for operationalizing the implementation of sustainable development assumptions in supply chains, a theoretical and conceptual framework for the development of supply chains based on ESG values was developed. Using the general assumptions of the models, the scope and impact of ESG criteria on shaping the business strategy of enterprises were determined, taking into account the dependencies in the supply chain.
Research limitations/implications: The study has some limitations. While it argues for the rationale for developing sustainable supply chains using selected qualitative analysis methods, it does not use quantitative analysis methods. The contribution to the research design indicates the need for more empirical research on the determinants of ESG disclosures and their implications from a supply chain perspective.
Practical implications: The implications for business representatives primarily concern presenting the essence of actions consistent with ESG criteria, benefits and challenges related to their implementation from the perspective of supply chain relationships and value creation.
Social implications: External stakeholders can gain knowledge about the level and nature of their impact (positive, negative) on the implementation of actions consistent with the sustainable development strategy.
Originality/value: What The models (theoretical and conceptual) of shaping a sustainable supply chain proposed in the article, in accordance with ESG values, may contribute to improving decision-making tools in the field of designing a multi-faceted enterprise development strategy.
Keywords: ESG, sustainable development, sustainable supply chain.
Category of the paper: research paper.

Introduction

The concept of sustainable transformation of supply chains is associated with the conditions of stable socio-economic development, in which the activities of enterprises significantly contribute to improving well-being, while maintaining the need to respect the principles of rational resource management (Garcia et al., 2017; Cosma et al., 2020). The common ground of the new paradigm of development of economic entities are therefore activities at the interface of the following dimensions: economic, social, environmental, spatial and legal-institutional. The basis of the analyzed concept is a systemic approach to the study of individual dimensions and the relationships between them. In Rogall's research (2010) emphasizes that each of the systems develops at a different pace, hence maintaining appropriate relationships between economic, social, environmental, spatial and legal-institutional development is a major challenge in shaping sustainable supply chains. The complexity of this problem is intensified by the multidimensional nature of supply chains very often operating within global supply networks (Laari et al., 2016).

The concept of "sustainable supply chain" appeared in scientific studies in the 1990s (Singh et al., 2022). In his research, van der Vorst, as one of the forerunners, emphasized the need to integrate aspects of sustainable development into supply chain management processes. This led to the formation of the concept of a sustainable supply chain. The first decades of the 21st century are a time when the idea of sustainable supply chains matures and gradually becomes an increasingly important element of business strategies. Given the increasing pressure from customers and investors, the need to care for the natural environment and build resilience to climate change and market turbulence, companies strive to effectively incorporate the postulates of sustainable development into their operations (Geels, 2020; Hsiao et al., 2022). The strategic goals of business activities are consistent with the implementation of the UN Agenda for Sustainable Development 2030 (2015). The document constitutes a new global program of action for sustainable development until 2030. The implementation of the 17 sustainable development goals in combination with the goals of the Paris Climate Agreement (Dz.U., 2017) and the European Green Deal (2019) requires the implementation of sustainable consumption and production patterns, efficient resource management in accordance with the assumptions of the circular economy, a transition to sustainable mobility models, the use of energy from renewable sources, as well as the implementation of low-emission and climate-resilient solutions.

The evolution of attitudes and social behaviors over the past three decades, as evidenced by the results of the Cotton Incorporated Lifestyle Monitor™ Survey (2024), challenges brands and retailers to deliver sustainable products and services. Businesses are connected by flows of materials, information, and capital to their supply chain partners and can be held accountable for the environmental and social performance of their suppliers. In order to implement

sustainability initiatives, companies must expand their focus beyond internal operations to external supply chain partners and a wide range of stakeholders. This study fills the knowledge gap on the sustainable transformation of supply chains with ESG criteria, taking as a key approach to viewing sustainability not only as a concept, but primarily as a new, holistic approach to managing a business from a supply chain perspective.

The integration of sustainability into supply chain management and sustainability reporting are based on the ESG concept, which includes three pillars: environmental, social and corporate governance. ESG is a project concerning actions for the Global Value Chain with specific goals. The publication of ESG data is to ensure comparability and transparency of information provided by companies and to enable investors to make informed decisions about sustainable investments.

According to the adopted thesis, the implementation of ESG criteria should be prepared in accordance with the principles that determine their high effectiveness and usefulness in the context of sustainable transformation of supply chains. The aim of the study is to identify the scope and impact of ESG criteria on the sustainable development of enterprises from the perspective of supply chains. The problem on which the study was focused comes down to answering the questions:

- What features should characterize the company's strategy in the context of sustainable development?
- What tools and activities are used by enterprises in their efforts to implement ESG criteria from the perspective of the supply chain?

Implementing practices consistent with ESG values is a challenge, but it can bring numerous benefits to organizations. Entities are already seeing the potential associated with the transformation towards sustainable supply chains. The models (theoretical and conceptual) of shaping a sustainable supply chain in accordance with ESG values proposed in the article can contribute to improving decision-making tools in the field of designing a long-term development strategy for the company.

Methods

In order to achieve the adopted research objective and answer the formulated research questions, selected research methods and techniques were used. Descriptive analysis was used to define the subject of the study and identify the basic relationships within it. The method of analysis and criticism of literature proved useful for systematizing the current scientific achievements and the state of knowledge on the essence of ESG criteria and factors determining the sustainable development of supply chains.

The literature review was conducted in accordance with the classic approach, i.e.: selection of sources, keyword search, review and selection of articles, in-depth analysis of selected publications in relation to the subject of the study, taking into account, among others, the latest publications and the number of citations. The analyzed scientific articles are indexed in the databases: Scopus, Web of Science, Science Direct and Google Scholar.

The compact scientific publications, reports, expert opinions and scientific articles used in the study were published by renowned publishers and foreign and domestic institutions. The review of the subject literature allowed us to develop a theoretical framework for the development of a model of sustainable supply chains based on ESG values, taking into account the influence factors: external (outside-in perspective), internal (inside-out perspective) and related to both perspectives simultaneously.

The causal-effect analysis identified the implications of sustainability and ESG criteria for shaping the long-term competitive advantage of the company. Then, the requirements and challenges for companies related to the implementation of the EU Directive on Sustainability Reporting and Reporting Standards were identified. Using the analysis and logical construction as well as qualitative analysis, a conceptual framework for the development of a model of sustainable supply chains based on ESG values was developed. Its application requires taking into account many variables, due to the complexity of reporting on sustainability in accordance with applicable standards. Using the general assumptions of the theoretical model and the conceptual model, the scope and impact of ESG criteria on shaping the business strategy of companies were determined, taking into account the dependencies in the supply chain.

Results

For businesses around the world, shaping sustainable supply chains is now a major concern, with many organizations committing to achieving net zero emissions by 2050 (Deloitte, Institute of International Finance, 2023). Research shows that stakeholders are increasingly demanding that businesses become more sustainable and consider their social and environmental impacts (Turzo et al., 2022). Researchers generally agree that consumers are increasingly making purchasing decisions based not only on meeting their own needs but also on environmental considerations (Hope, 2017; Bali Swain, Yang-Wallentin, 2020).

Analyzing theories of economic decisions in relation to bounded rationality, Ekström et al. (2017) and Sonne Nørgaard (2018) confirmed that social and psychological aspects influence purchasing decisions and the level of consumer satisfaction. Generation Z is the most active in this respect. A study conducted by DoSomething Strategic (2022) shows that 76% of respondents from Generation Z have purchased or would consider purchasing a product or service from a company with a good social and environmental impact. At the same time,

94% of respondents from this generation believe that companies are responsible for solving critical environmental and social problems (Cone Communications, 2017). For Generation Y, this percentage was 87%.

Sustainable supply chain management is often defined as the environmentally friendly practices of a company, both internally and externally with supply chain partners (Zhu et al., 2013; De Giovanni, Esposito Vinzi, 2012). According to Yang et al. (2013), environmental initiatives are impossible to implement without the involvement of the supply chain function. As a result, sustainable supply chain management has become a widely discussed issue, combining elements of corporate environmental management and supply chain management (Yang et al., 2013). ESG criteria leading to value-based sustainable development are becoming a key management tool. The analysis of studies and reports on the aspects of sustainable development shows that effective supply chain management is becoming increasingly important for organizations and requires taking into account many factors (Figure 1).

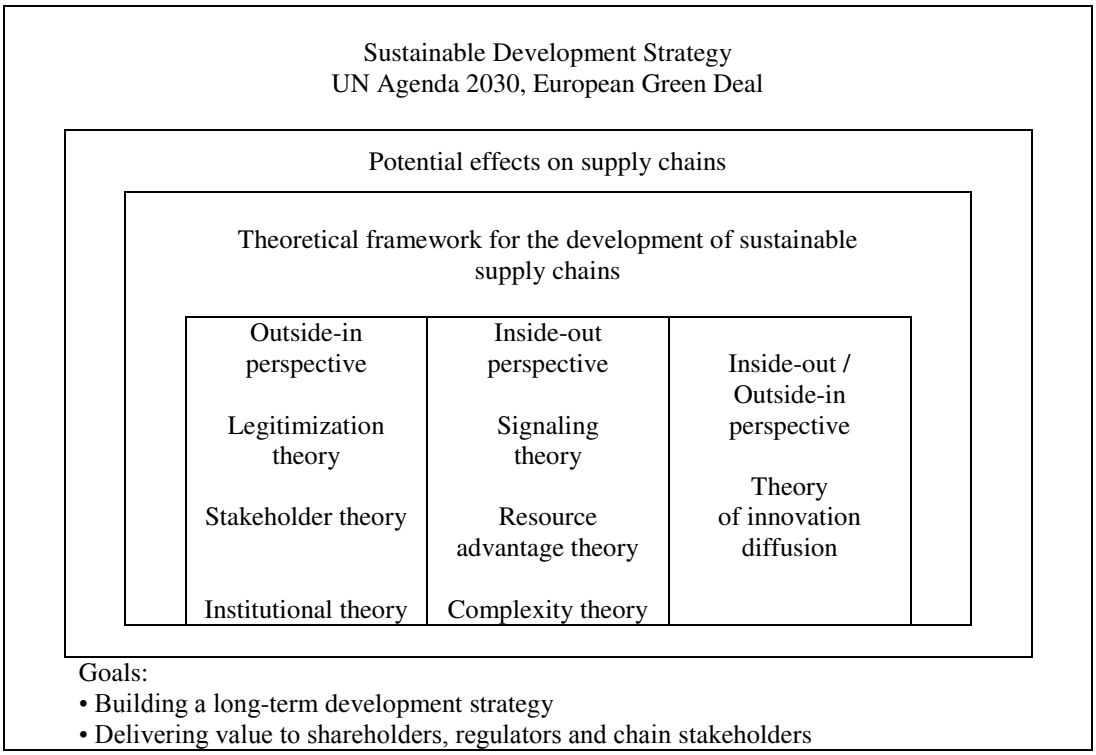

Figure 1. Theoretical Framework for the Development of Sustainable Supply Chains Based on ESG Values

Source: own elaboration based on (Ferreira-Quilice et al., 2023; Khanal et al., 2023).

The theoretical framework for developing sustainable supply chains based on ESG values takes into account external factors (outside-in perspective), internal factors (inside-out perspective), and both perspectives simultaneously. The outside-in perspective assumes that the source of sustainable corporate behavior is outside the company, meaning that they act sustainably in response to external pressures (Ferreira-Quilice et al., 2023; Singh et al., 2022). According to stakeholder theory, firms respond to the demands of their stakeholders in order to gain a competitive advantage and ensure their long-term survival in society (Johnstone, 2018).

This theory is an evolution of the legitimacy perspective, which takes into account the existence of a social contract between firms and society and the resulting expectations towards firms (Danisch, 2021). The response of firms to external pressures is also justified by institutional theory. According to Calabrese et al., (2022) and Johnstone (2018), institutions are socially constructed norms that become normalized as behavior to be imitated. The sustainability of supply chains also results from internal conditions and decision-making processes of the company (inside-out perspective). This perspective adopts the signaling theory, according to which companies send signals to stakeholders about the implementation of sustainable development assumptions, in line with ESG values (Papoutsi, Sodhi, 2020). The resource advantage theory focuses on the ability of companies to gain competitive advantage from valuable resources. According to the complexity theory, the development of sustainable supply chains is more difficult to achieve when the complexity of companies increases. The theory of diffusion of innovation also provides arguments in the field of supply chain development. Adopting the outside-in/inside-out perspective, it focuses on explaining why, how and with what frequency the implementation of new technologies, consistent with ESG values, takes place (Khanal et al., 2023).

Implementing a sustainable development strategy in supply chains, in line with ESG values, determines the appropriate basis for the business case. This strategy is to support building a long-term competitive advantage for the company and meet the growing requirements of both internal and external chain stakeholders.

The review of the literature on the subject shows that the concept of ESG can be analyzed from the perspective of a concept, concept, system, principle, pattern or model combining pillars, dimensions, aspects, factors of an environmental, social and governance nature (Calabrese et al., 2022; Ocicka et al., 2023). ESG as a concept representing the practices and effects of an enterprise's activities of an environmental and social nature comes from the world of finance. Its origins date back to the 1970s, when a small group of investors were interested in the practices of the companies in which they invested (Kaźmierczak, 2022). ESG is a concept according to which entrepreneurs should be guided not only by the pursuit of achieving maximum profit, but also by taking care of the natural environment "E", social responsibility "S" and corporate governance "G" (Table 1).

In the area of protection and counteracting degradation of the natural environment, the following activities were identified as important: assessment of criteria for the implementation of the environmental strategy and policy, environmental management, compliance with the principles of responsibility and care for the environment, and identification of the risk to business resulting from climate change. Issues of social responsibility and human rights include factors such as: relations with market participants (suppliers, customers, partners), working conditions and compliance with employee rights and occupational health and safety rules. Important aspects in this area also include the quality policy pursued both in relation to management procedures and product quality, as well as the company's information

policy and its transparency. Within the third pillar "G", the analysis covers factors such as: the company's management structure, respect for shareholders' rights, respect for information obligations towards all shareholders, decision-making independence and management skills.

Table 1.
Foundations of the ESG concept

Environmental	Social	Corporate Governance
Environmental management strategy Environmental policy Principles of responsibility and care for the environment Energy consumption Pollution emissions Raw material supply Water management Renewable energy	Equal pay for the same positions regardless of gender Compliance with employee rights Security and data protection Quality policy Relations with participants in the value chain	Company supervision Company management structure Respecting information obligations towards all shareholders Respecting shareholders' rights Tax transparency Counteracting corruption and bribery

Source: own elaboration based on (Responsiblee, 2022).

Studies indicate that while the quality and level of corporate sustainability disclosure has improved, the substantive scope of progress remains limited (Bose, Khan, 2022; Silva, 2021). A content analysis of 100 sustainability reports conducted by Silva (2021) found that only 30 made general reference to ESG. Most of the reports lacked metrics to help stakeholders quantify corporate engagement. At the same time, research findings indicate that corporate sustainability contributions are unbalanced. Most corporate efforts have been focused on the economic and environmental aspects of sustainability (Mio et al., 2020). As noted by Khaled et al. (2021) and Pizzi et al. (2020), the social dimension of goals has received much less attention than other dimensions of development. The ability to track environmental, social and governance criteria is crucial for real, measurable improvements in sustainability at national and global levels (Danisch, 2021; Turzo et al., 2022). In their studies, Rosati and Faria (2019) found a positive relationship between the location of companies, national corporate responsibility and sustainability reporting. Furthermore, Calabrese et al. (2022) investigated the relationship between the income level of the country where companies are headquartered and their disclosure of ESG values in their sustainability reports, showing a positive relationship. At the same time, there are studies examining the relationship between companies' sustainability disclosure and greenwashing or tokenism (Mahmood, Uddin, 2021; Journeault et al., 2021).

Building trust in organizations in the ESG area by presenting concrete progress across the value chain and reporting is the basis for redefining the sustainability strategy (Figure 2). Implementing the assumptions of this strategy is to enable the achievement of long-term value for shareholders and a wider group of stakeholders, in accordance with the Corporate Sustainability Reporting Directive, CSRD (2022).

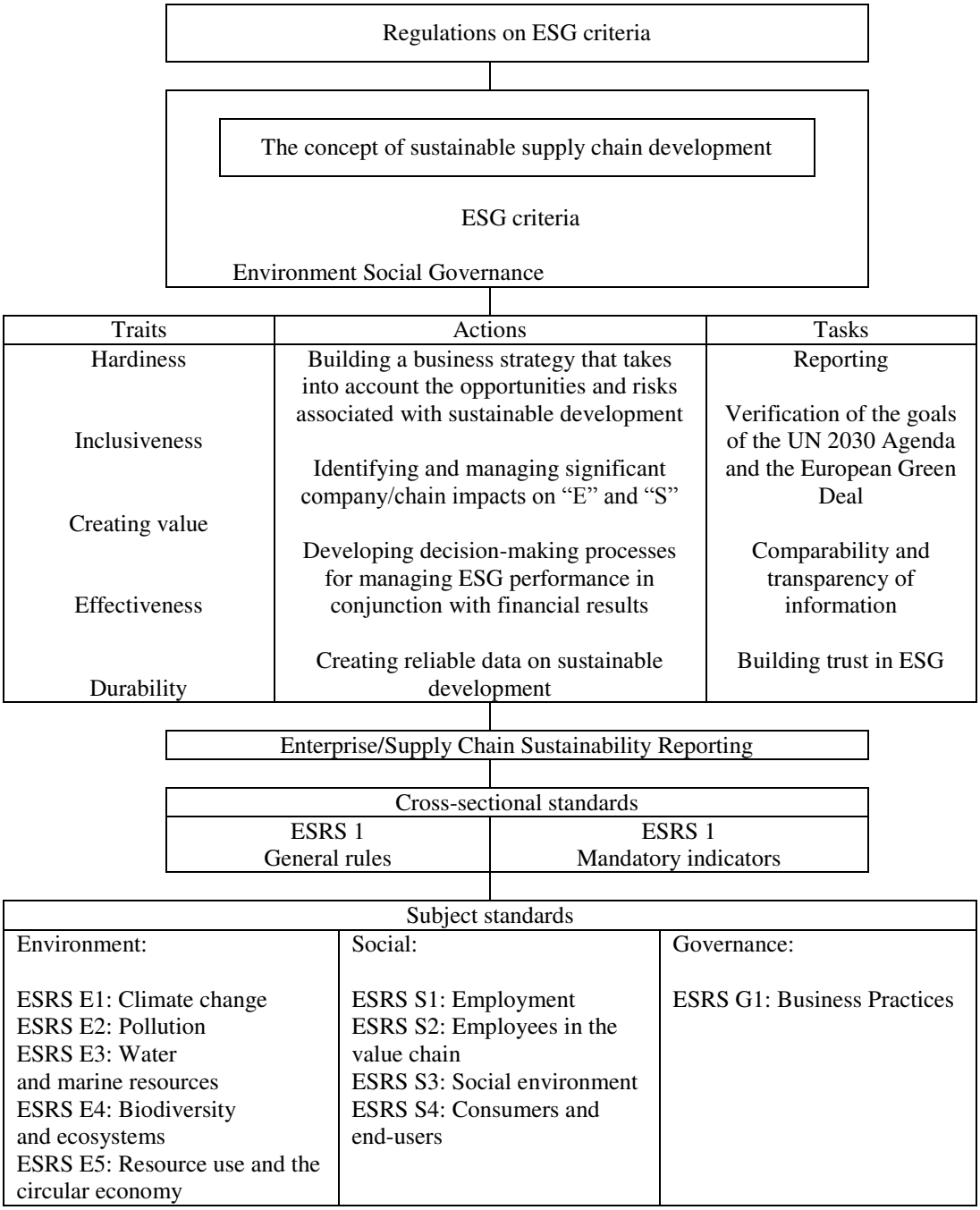

Figure 2. Conceptual Framework for the Development of Sustainable Supply Chains Based on ESG Values

Source: own elaboration.

Materialising environmental, social and governance risks require companies to formalise their sustainable transformation efforts and integrate them into their business strategy, improve communication and increase transparency. The expectation is for consistent, comparable and transparent information on climate and other environmental, social and governance information. According to the directive, management must demonstrate how they have assessed the business opportunities and risks related to sustainability issues (including the company's environmental and social impacts) as well as the potential impact on financial results.

Making business decisions based on sustainability considerations will require information on whether and how the company manages its sustainability performance and why certain actions have been taken.

In the ESG Reporting Guidelines (Krzysztofik et al., 2021), the concept of Environment, Social, Governance is equated with sustainability reporting, understood as the practice of measuring and disclosing accountability to internal and external stakeholders and presenting an entity's ability to achieve sustainable development goals and ways of managing impacts on society. Sustainability reporting is a key means by which the European Commission wants to verify the implementation of sustainable development goals. The publication of ESG data is intended to ensure the comparability and transparency of information provided by companies and to enable investors to make informed decisions about sustainable investments. The principles of disclosure are set out in the European Sustainability Reporting Standards, ESRS (2023).

The sustainability reporting standards consist of a set of cross-cutting standards (ESRS 1 and ESRS 2) and thematic standards in the area of environmental, social and corporate governance. A company will be required to report only those aspects of development, sustainability that are material to it. For this purpose, a dual materiality assessment must be carried out to check which issues are material to the company. However, the dual materiality assessment does not apply to the requirements resulting from ESRS 1 and ESRS 2. As cross-cutting standards, these standards are mandatory for all companies. In the case of the remaining thematic standards (environmental, social, business conduct), after assessing dual materiality, the company determines which elements it should disclose. Dual materiality has two dimensions: impact materiality and financial materiality. A sustainability issue meets the dual materiality criterion if it is impact material, financially material or both. A sustainability issue is impact material if it relates to a significant actual or potential, positive or negative impact of a company on people and the environment in the short, medium and long term. Importantly, a company should not only analyse its activities but also the entire value chain. Impact assessment should take into account:

- scale of impact (how serious the impact is),
- scope of impact (how widespread the impact is),
- irreversibility (whether and to what extent negative effects can be remedied),
- likelihood (in the case of potential impact).

A sustainability report prepared in accordance with the applicable ESRS standard will be subject to mandatory audit.

Discussion

Despite doubts about the disclosure of ESG ratings, researchers (García-Sánchez et al., 2020; Turzo et al., 2022) confirm that pressure from institutions, stakeholders and society is crucial to improving the implementation of sustainable development strategies. ESG ratings are considered indicators of companies' actual behavior in the context of sustainable development (Papoutsi, Sodhi, 2020). By integrating sustainable strategies in supply chains, companies can support the development of a sustainable economy, e.g. by developing products consistent with the goals of a resource-efficient economy or expanding their offer with products and services that protect against the materialization of climate risks. The introduction of practices consistent with ESG criteria will increase the pressure on such activities in relation to other participants in the chain with which the company cooperates. Currently eligible companies will be forced to report ESG indicators generated throughout their business cycle, both upstream and downstream. For companies that are already investing in collecting sustainability data today, this perspective can be a key competitive advantage in the future (Table 2).

Table 2.
Implementation of ESG values in supply chains

Effects	Activities	Challenges
Increased competitiveness	Investing in eco-friendly transport, eco-design	High costs of implementing innovations
Reduced risk related to operations, regulations and reputation	Implementing telematics systems to monitor fuel consumption and CO_2 emissions	Lack of appropriate infrastructure for sustainable logistics
Increased customer loyalty and brand trust	Fleet management systems and route optimization	Increased competition and customer expectations
Saving operating costs	Implementing ESG standards among suppliers and contractors, ESG audits at suppliers	Obtaining certificates
Improved profitability of enterprises	Increasing stakeholder involvement	Changes in legal and political regulations
Increased added value	Supporting local communities	Insufficient knowledge of stakeholders on ESG
Increased employee motivation	Ensuring decent working conditions and safety for employees throughout the supply chain	Building organizational and operational resilience

Source: own elaboration.

Sharing data and analyzing the company's value in terms of ESG criteria is becoming important not only for transparency, but also for sustainable development and building solid business relationships within the supply chain. It is therefore important to:

- select the right suppliers who share the company's values related to sustainability,
- build transparency to effectively recognize and address sustainability challenges,
- optimize resources to minimize waste and improve energy consumption,
- adopt environmentally friendly actions by using sustainable materials and embracing the circular economy.

Investors have come to believe that by applying ESG criteria, they can avoid companies whose practices may be a source of risk. The Sustainability Accounting Standards Board (SASB) has prepared for each industry issues related to sustainable development, divided into opportunities and risks that can have a significant impact on the company's assets and financial situation (SASB, 2021). These issues include: environment, social capital, human capital, business model and innovation, leadership and management. They are a source of comparisons of companies from a given industry in terms of the quality of their ESG policies. Using a risk assessment map related to individual ESG interest areas, prepared on the basis of SASB standards for the clothing industry, Alva Group experts assessed companies in this industry (Mazurowska, Płowska, 2022). The ESG Intelligence Fashion Retailers Q1 2021 report (Alva Group, 2021) included 19 entities in the ranking, assigning them points from +63 (Marks and Spencer) to -52 (Primark), thus clearly communicating the quality of their ESG policy. Marks and Spencer leads the Alva Group's ESG Index for the fashion sector, with new sustainability standards for denim, safe dyes and 86% less water usage than the industry average. Adidas' community integration and relationship building initiatives have earned it a 2nd place spot on the ESG Index.

Areas of particular improvement in the fashion industry include processes and oversight mechanisms to ensure the health and safety of supply chain workers, respect for human rights and decent working conditions, as also confirmed by Clarity AI research. The Key ESG Learnings and Best Practices in the Fashion Industry (Clarity AI, 2024) report uses a proprietary ESG risk assessment methodology to present the results of a four-year study that analyzed over 280 organizations. The aim was to identify companies that have made the most significant improvements in terms of sustainability and to provide recommendations on how to improve performance. SMCP SA (France) reported best practices in improving its ESG performance. These mainly concerned progress in environmental and social standards aimed at improving the health and safety of workers in its supply chain. SMCP implemented environmental criteria in the selection process of its suppliers and sourcing partners. By enforcing key supply chain standards, actively monitoring working conditions, and working with suppliers to address issues, the company is better positioned to protect long-term shareholder value. It also declared that it will include human rights criteria, including the prevention of forced labor, in the monitoring process of its suppliers and sourcing partners.

In Poland, the fashion industry has been appreciating LPP's activities for several years as one of the companies that best report on the implementation of the sustainable development strategy in accordance with ESG criteria. The 2023 sustainable development report prepared by LPP, taking into account the double materiality analysis, was the first step towards achieving compliance of the reporting process with the CSRD directive (LPP, 2024). The company is implementing a number of activities in the "E" area, including projects supporting the transition to a low-emission and circular economy. The positive assessment by the Science Based Targets initiative (SBTi) of the decarbonization goals adopted by the company has also set long-term

plans for reducing the Group's greenhouse gas emissions. In the most challenging scope 3, by increasing the use of preferred raw materials with a lower carbon footprint, LPP reduced emissions per unit of purchased product resulting from the purchase of goods and services by 6.12%. In turn, in scopes 1 and 2, covering direct and indirect emissions related to the use of vehicles and own buildings, i.e. offices and warehouses, LPP committed to reducing emissions by 42% by 2030 compared to the base year of 2021. Actions aimed at achieving this goal are to include, among others, reducing the consumption of electricity and heat, decarbonizing the power grid, electrifying the car fleet and, above all, switching to renewable energy sources. In a situation where the company does not have the option of choosing so-called green energy, such as in its own brand stores, it focuses on monitoring and reducing its consumption. The popularization of the idea of the circular economy, including the "second clothing circulation" remains one of the key challenges, mainly due to the scale and costs of developing texile-to-textile recycling technology. An example of a partnership aimed at reducing the use of primary resources is the cooperation between LPP and the Polish start-up Use Waste, implemented since 2022. In the report, LPP also indicated its involvement in the implementation of projects from the "S" area. In 2023, in accordance with the OECD guidelines for multinational enterprises, the map of the most significant risks related to human rights and workers' rights was updated. A survey was conducted on risks, remedial and corrective actions in the field of human rights and workers' rights among suppliers in India, Pakistan and Bangladesh.

Summary

The study identified the factors that determine the sustainable development of supply chains. The scope and impact of ESG criteria on shaping the business strategy of companies, taking into account the relationships in the supply chain, were determined. Our findings show that there is a tendency to undertake activities in supply chains consistent with ESG criteria, which not only contribute to the implementation of sustainable development goals, but also create clear financial value. The analysis of the content of corporate reports confirms that companies prioritize environmental issues, including reducing CO_2 emissions. Companies operating in the supply chains of environmentally sensitive industries, such as fashion, are striving to improve their actual sustainability performance and reporting. Despite efforts to improve these conditions, the complex web of suppliers, subcontractors and workers in the fashion industry poses challenges. Key issues include worker health and safety, fair wages and the prevention of child and forced labour. Furthermore, because the industry tends to source from lower-cost countries, production often takes place in regions with lax labour regulations and enforcement. This creates reputational risks and can lead to increased scrutiny and costs,

including regulatory fines and supply chain disruptions. In conclusion, the study showed the need to adopt and prioritize sustainable practices throughout the supply chain, deepen cooperation with stakeholders and align business strategy with ESG criteria.

The presented results of the study contribute to the further development of scientific research and provide several practical implications.

In terms of designing further directions of scientific research on sustainable development, the research implications concern issues related to sustainability reporting, taking into account the value chain. The contribution to the research design also indicates the need to expand empirical research on the factors determining the disclosure of information consistent with ESG criteria and their consequences from the perspective of the supply chain.

The results have several practical implications for various stakeholders. First, given the importance of the topic of sustainable development and the obligation to report both upstream and downstream of the supply chain, policymakers and national regulators should encourage companies to take steps to integrate sustainable development into their business strategy. Second, external stakeholders can gain knowledge about the level and nature of their impact (positive, negative) on the implementation of activities consistent with the sustainable development strategy. The implications for business representatives primarily concern the presentation of the essence of activities consistent with ESG criteria, the benefits and challenges related to their implementation from the perspective of supply chain relationships and value creation.

Despite its theoretical and practical implications, this study has some limitations. While it argues for the validity of actions to develop sustainable supply chains using selected qualitative analysis methods, it does not use quantitative analysis methods. This is primarily due to the limitations in obtaining consistent data for companies, taking into account both upstream and downstream relationships. At the same time, it may pose a challenge for future research due to the obligation to report on sustainability based on accepted standards.

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SPICES AND HERBS NOMENCLATURE – CURRENT RESULTS AND TRENDS. ROLE AND IMPORTANCE IN DEVELOPING THE QUALITY OF SPICES AND HERBS

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Purpose: Spices and herbs are a unique product in many different branches of industry. They are used as ingredients that improve the quality of final products, both food, cosmetics, pharmaceuticals and others. This article was created for review purposes. It presents the existing great voluntariness in defining spices and herbs. The article points out the differences in the approach to defining these kind of products and gathers herbs and spices into groups with similar properties. Articles' goal was to show significant differences in the approach to products referred to as spices in various fields and scientific disciplines. Terminology is particularly important here due to the role of the definition, which is to unambiguously explain the concept.
Design/methodology/approach: Most of the relevant existing definitions of spices and herbs are collected, their proper use and differences among them were discussed. The presented definitions have been found in official documents and in scientific papers, where they have been formulated by modern researchers. The semi-systematic/narrative review approach was used for examined subject.
Findings: Article presents the existing great voluntariness in defining spices and herbs. The existence of those definitions of this group of products and its various divisions has consequences not only for consumers but also for researchers of natural plant products.
Practical implications: The collected literature data allowed to indicate differences in the existing definitions and divisions of herbs and spices and confirmed the great diversity of this group of products. Researchers dealing with plant products must be very methodical and at the same time critical of scientific work in this field. This is particularly important in connection with the increasingly innovative use of herbs, spices and their ingredients.
Social implications: Attention to nomenclature and knowledge of the possible divisions of herbs and spices may become crucial for producers and consumers. It can influence on consumers and producers behavior on the spice and herbs market.
Originality/value: There is no such list in Polish and world literature.
Keywords: spices, herbs, definition, divisions of spices and herbs.
Category of the paper: Literature review.

Introduction

Spices and herbs occupy a unique place among products intended for consumption. They are most often used in nutrition in small quantities, and they determine the properties of the entire product. They are mainly used to shape the sensory properties of food in gastronomy, home cooking and the food industry. However, research, as well as knowledge about their previous use in various cultures, indicate a much wider range of possibilities of their use, not only as products shaping the sensory qualities of food.

Currently, this group of food products is gaining in importance due to intensive research on ingredients and the search for new compounds with bioactive effects that can be used as modern therapeutic agents, ingredients of functional foods and in cosmetology, which aims to reduce synthetic ingredients in cosmetics (Łuczaj et al., 2012; Serwańska-Leja, Czaczyk, 2016). Spices may also have additional properties, such as having a positive effect on the human body and preservatives for food (Martínez-Graciá et al., 2015; Senay, 2020; Sulieman et al., 2023).

In the literature there are many definitions and divisions of spices. The authors use various terms and expressions that are created for the needs of specific studies. The aim of this paper is to review the definitions and concepts of herbs and spices and their divisions.

The originality of the presented material lies in comprehensive approach the current state of knowledge on existing divisions, nomenclature and concepts of spices and in the absence of such an approach in Polish and foreign articles. The semi-systematic/narrative review approach was used for examined subject, because various organizations and authors created spices and herbs definitions during long time. These terms have evolved and this has negative implications for the researched topic as it introduces confusion in issues related to spices and herbs.

Spices definitions – literature review

According to historical and archaeological sources, spices and herbs have been used in food and medicine since ancient times (Tapsell et al., 2006; Sachan et al., 2018; Van der Veen, Morales, 2015). Most scientists define spices as plant-based products, although they may have a more complex composition and contain other substances in addition to plant-based ingredients, as in spice mixtures (Śmiechowska et al., 2021). Table 1 presents definitions of herbs and spices proposed by selected authors and organizations.

Table 1.
Definitions of herbs, spices due to selected authors and organizations

Author	Definition
Codex Alimentarius, International Food Standards FAO/WHO (Codex Alimentarius)	In the 'Salts, sauces, salads and protein products' 12.0 category, it includes substances added to foods to enhance flavor and taste. The category 12.1. – 12. 10. listed: Salt and salt substitutes, Herbs, spices, seasonings, and condiments (e.g. seasoning for instant noodles), Vinegars, Mustards, Soups and broths, Sauces and like products, Salads (e.g. macaroni salad, potato salad), Yeast and like products, Soybean-based seasonings and condiments, Protein products other than from soybeans.
Directive 2004/24/EC of the European Parliament and of the Council of 31 March 2004 (Directive 2004/24/EC)	Herbal substances: any, mostly whole, divided or cut plants, parts of plants, algae, fungi, lichens in unprocessed form, usually dried, sometimes fresh. Some extracts that have not undergone any particular treatment are also considered herbal substances. Herbal substances are precisely defined by the part of the plant used and the botanical name according to the binomial system (genus, species, cultivar and author); Herbal preparations: preparations obtained by subjecting herbal substances to a treatment such as extraction, distillation, pressing, fractionation, purification, concentration or fermentation. These include crushed or powdered herbal substances, tinctures, extracts, oils, squeezed juices, and processed extracts.
European Spice Association (ESA) (European Spice Association)	Culinary herbs and spices are edible parts of plants which are traditionally added to foodstuffs for their natural flavouring, aromatic and visual properties. Mixture of herbs and spices (type blends) contain only herbs and spices, if necessary, is allowed using the anti-caking agents. Mixtures type seasoning is a mixture of acceptable nutrients that are included as necessary for the purposes for which they are intended as: taste, nutritional quality, functionality of food improvement. Typically it contains one or more herbs and/or spices and other substances that enhance aroma and flavor. The category includes spices with functional ingredients, e.g. thickening hazards, emulsifiers, preservatives, dyes, and anti-caking hazards.
ISO (ISO, 1995)	Spices and condiments: Vegetable products or mixtures thereof free from extraneous matter, used for flavouring, seasoning and imparting aroma in foods. The term applies equally to the product in the whole form or in the ground form.
Oxford English Dictionary (OED)	Herbs - Any soft-stemmed, aromatic plant used fresh or dried to flavour and garnish dishes, and sometimes for medicinal effects. Not clearly distinguished from spices, except that herbs are usually the leaves or the whole of the plant while spices are only part of the plant, commonly the seeds, or sometimes the roots or rhizomes.
Encyclopedia Britannica (Encyclopedia Britannica)	Spices are the fragrant or pungent products of such tropical or subtropical species as cardamom, cinnamon, clove, ginger, and pepper; spice seeds include anise, caraway, cumin, fennel, poppy, and sesame. Herbs are the fragrant leaves of such plants as basil, marjoram, mint, rosemary, and thyme. A pot herb is any plant with stalks and leaves that can be boiled as a vegetable or used in soups and stews (in larger amounts than herbs used for flavouring).
American Spice Trade Association (ASTA) CFR – Electronic Code of Federal Regulations Title 21 (2023) Spices include the spices listed in 182.10 and part 184 of this chapter (ASTA Definition)	The term spice means any aromatic vegetable substance in the whole, broken, or ground form, except for those substances which have been traditionally regarded as foods, such as onions, garlic and celery; whose significant function in food is seasoning rather than nutritional; that is true to name; and from which no portion of any volatile oil or other flavoring principle has been removed.
Polish Classification of Goods and Services - PKWiU 10.84. (PKWiU)	Spices include spices, vinegar, sauces, mustard flour and meal, mustard, processed spices and spice mixtures, and salt.
Low Dog T. (Low Dog, 2006)	Spices – dried seeds, fruits, buds, root, or bark of a plant or tree used to flavor food. Spices and culinary herbs differ mainly in their source; Culinary herbs typically come from the leaves of plants, while spices come from the bark, stem, fruit, buds, or seeds.

Cont. Table 1.

Martínez-Graciá et al. (Martínez-Graciá et al., 2015)	The terms "herbs" and "spices" have more than one definition in common languages, but the most commonly used are those that refer to herbs that are extracted from the green parts of the plant, such as the stem and leaves. They differ from other plants used in food in that they are used in small quantities to import flavor rather than substances into food. Spices differ from herbs in that they are not produced from the green parts of the plant, but from other structures such as seeds, flowers, fruits, roots or even the bark of various plants.
Embuscado, M.E. (Embuscado, 2015)	Most spices are plant-based products. Spices come from parts of the plant other than the leaves, while herbs come from the leaves of the plant. Spices and herbs can be divided into different groups based on taste, taxonomy, or the part of the plant they come from.
Balkrishna, A. et al. (Balkrishna et al., 2023)	Spice is a dried aromatic or pungent plant substance such as root, stem, bark, leaves, bud, flower, fruit, seeds, etc., used as a flavor modifier in many culinary practices. A historical wisdom supports their use as an ingredient for flavoring the food and medicinal uses in various kind of healing systems.

Source: own study based on (Newerli-Guz, 2018).

It follows from the definitions given above that authors have a diverse approach to this basic question: What the herbs and spices are?

Codex Alimentarius separates substances added to foods to enhance aroma and flavor and includes salts, spices, soups, sauces, salads and protein products. These are classified as salt and salt substitutes, herbs, spices, vinegars, mustards, mayonnaise, soups and broths, sauces and similar products, salads, sandwich spreads, yeast and similar products, soy-based condiments, and protein products from non-soy sources Codex Alimentarius).

The concept of spices is therefore much broader because it includes not only spices such as plants and/or their parts used to improve palatability, but all other food products that are used to shape the palatability of food. Martínez-Graciá et al. (2015) and Embuscado M.E. (2015) list herbs next to spices and define them as products obtained from green parts of plants, most often leaves and stems, which can be used fresh or dried. Herbs can be used both for medicinal purposes and as spices, but their status in each purpose is different. The World Health Organization -WHO defines herbal medicine as the practice of herbs, herbal materials, herbal preparations and finished herbal products containing as active ingredients plant parts or other plant materials or combinations thereof (World Health Organization, 2000). The European Commission explain the meaning of herbal medicinal products as any medicinal product containing exclusively as active substance one or more herbal substances, one or more herbal preparations or a combination thereof (Commission Decision, 2018).

ESA - European Spice Association defines culinary herbs and spices as edible plant parts traditionally added to foods for their natural aroma, aromatic and/or visual properties. The ESA Culinary Herbs and Spices List contains the most commonly sold dried herbs and spices along with their most commonly used botanical names in Europe. The form of these herbs and spices, i.e. whole, chopped, ground or otherwise, has no significance in this list. Not all of these ingredients are available in all European countries and some ingredients may be used by customers for non-culinary purposes (European Spice Association, 2018). The ESA definition (Table 1) includes culinary herbs and spices, but they differ in the sources

they come from. Culinary herbs usually come from plant leaves, while spices come from bark, stems, fruits, flowers or seeds (Low Dog, 2006).

Presented in Table 1 definition of spices indicated under number 10.84 in the Polish Classification of Products and Services and those covered by the term ESA seasoning.

Divisions of herbs and spices

There are many various divisions of herbs and spices in the literature. The most commonly used divisions of herbs and spices are presented in this review. There are i.a. a taxonomic division, a division based on plant organs, a division based on the bioactive components of herbs and spices and a culinary division, and many others.

1.1. Taxonomic division

The botanical taxonomy of plants places most spices and herbs in the group Angiospermae. This group plays a crucial role in current terrestrial ecosystems, as it provides food for humans and feed for animals and has big economic importance in the development of various industries, not only the food industry. This group is dominated by Mesangiospermae, among which the two most important lineages eudicots and monocots were formerly distinguished. There is still a debate among scientists about the phylogenesis of plants. Due to the widespread division of angiosperms into monocots and eudicots, this division is still used in many publications. However, classification systems for angiosperms created since the end of the 20th century no longer include eudicots as taxon. The most important are the division according to Reveal (Reveal, 2008), the classification of the Angiosperm Phylogeny Group: APG IV (Byng et al., 2016) and the phylogenetic analysis of Yang et al. (Yang et al., 2020).

1.2. Division of herbs and spices according to their organs

One of the most frequently used divisions of plants, especially in trade and medicine, is the criterion based on the used parts of the plant. We distinguish leaf, floral, seed, bark, rhizome and root herbs and spices (Table 2).

Table 2.
Division of herbs and spices according to the used part of the plant

Part of the plant	Herbs /spices samples
flower buds/flower	elderberry (*Sambucus nigra* L.), saffron (*Crocus sativus* L.), saffron sorel (*Hibiscus sabdariffa* L.), clove (*Syzygium aromaticum* (L.) Merr. & Perry)
seeds	black cumin (*Nigella sativa* L.), white mustard (*Sinapis alba* L.), Malabar kardamom (*Elettaria cardamomum* L.), fenugreek (*Trigonella foenum-graecum* L.), Indian sesame (*Sesamum indicum* L.)
fruits	anise (*Pimpinella anisum* L.), caraway seed (*Carum carvi* L.), coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), black pepper (*Piper nigrum* L.), wild rose (*Rosa canina* L.), vanilla (*Vanilla planifolia* Andrews)
berries	lingonberry (*Vaccinium vitis-idaea* L.), raspberry (*Rubus idaeus* L.), chokeberry (*Aronia melanocarpa* (Michx.) Elliott), cranberry (*Vaccinium macrocarpon* Aiton), blueberry (*Vaccinium myrtillus* L.)
bulbs	onion (*Allium cepa* L.), garlic (*Allium sativum* L.), chives (*Allium schoenoprasum* L.), leek (*Allium ampeloprasum* L.)
leaf	basil (*Ocimum basilicum* L.), mugwort wormwood (*Artemisia absynthium* L.), savory (*Satureia hortensis* L.), dill (*Anethum graveolens* L.), marjoram (*Origanum majorana* L.), thyme (*Thymus vulgaris L.*), lemon balm (*Melissa officinalis* L.), peppermint (*Mentha piperita* L.), rosemary (*Rosmarinus officinalis* L.), sage (*Salvia officinalis* L.), laurel (*Laurus nobilis* L.)
rhizome/root	horseradish (*Armoracia rusticana* G. Gaertn. et al.), wasabi (*Eutrema japonicum* (Miq.) Koidz.), ginger (*Zingiber officinale* Roscoe), licorice (*Glycyrrhiza glabra* L.), angelica (*Angelica archangelica* L.), calamus (*Acorus calamus* L.), stinkweed (*Ferula assa-foetida* L.), turmeric (*Curcuma longa* L.)
bark	Ceylon cinnamon (*Cinnamomum verum* J. Presl), cassia (*Cinnamomum cassia* (L.) J.Presl), Burmana cinnamon (*Cinnamomun burmanii* Nees ex Blume)

Source: own study based on (Mashabela et al., 2022).

1.3. Division of herbs and spices according to aroma and taste

According to their aroma or taste, spices and herbs can be divided into 4 groups: spicy spices, mild-taste spices, aromatic spices, and aromatic herbs and vegetables (Table 3). This division can be called the culinary division, because of their use in the dish preparation process.

Table 3.
Division of herbs and spices according to aroma and taste

Spice type	Herbs/spices samples
spicy spices	black pepper (*Piper nigrum* L.), cayenne, chilli (*Capsicum annuum* L.), black mustard (*Brassica nigra* L.), mustard – product from mustard seeds
mild-taste spices	sweet pepper (*Capsicum annuum* L.), coriander (*Coriandrum sativum* L.)
aromatic spices	clove (*Syzygium aromaticum* (L.) Merr. & Perry), caraway seed (*Carum carvi* L.), fennel (*Foeniculum vulgare* Mill.), nutmeg (*Myristica fragrans* Houtt.), Ceylon cinnamon (*Cinnamomum* spp.)
aromatic herbs and vegetables	thyme (*Thymus vulgaris* L.), basil (*Ocimum basilicum* L.), mint (*Mentha spp*.), sage (*Salvia officinalis* L.), bay leaf (*Laurus nobilis* L.), marjoram (*Origanum majorana* L.), Ascalonian garlic (*Allium ascalonicum* L.), onion (*Allium cepa* L.), garlic (*Allium sativum* L.)

Source: own study.

In some studies, the culinary division presented in Table 3 includes spices that affect the color of the dish and lists spices such as: turmeric (*Curcuma longa* L.), sweet pepper (*Capsicum annum* L.), saffron (Crocus sativus L.), kokum fruit (*Garcinia indica* Choisy) (Balkrishna et al., 2023; Chittaragi, Menon, 2023).

1.4. Classification of herbs and spices according to their main chemical constituents

Bioactive ingredients (Fig. 1) found in spices and herbs in different quantities determine their sensory, health-promoting and other important properties.

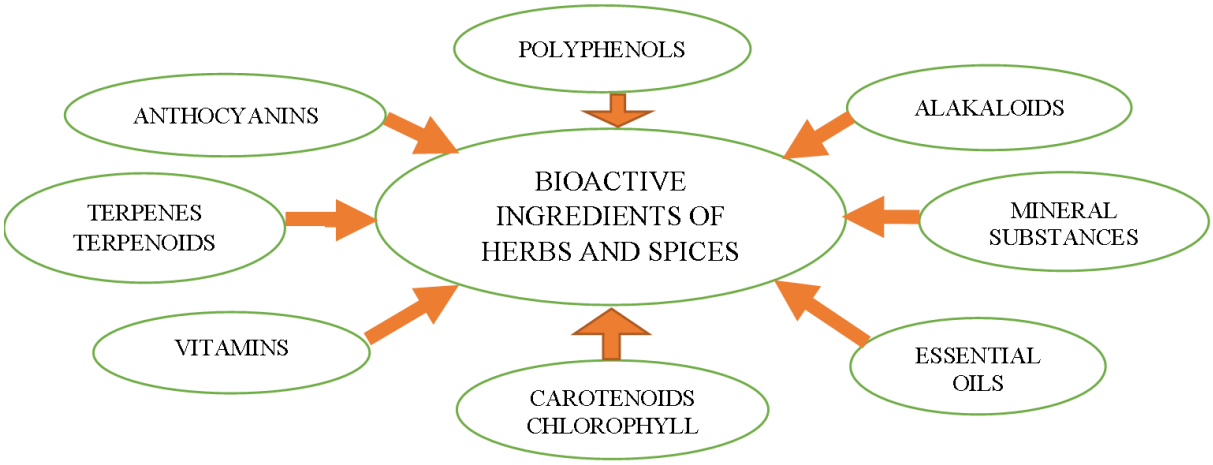

Figure 1. Bioactive ingredients of herbs and spices.

Source: own study.

Polyphenols

Polyphenols are a group of bioactive compounds found quite abundantly in herbs and spices. Over 900 mg/100g fresh weight of polyphenols contain oregano (*Origanum vulgare* L.), rosemary (*Rosmarinus officinalis* L.), thyme (*Thymus vulgaris* L.) and cinnamon (*Cinnamomum verum* J. Presl). Herbs and spices are dominated by phenolic acids and flavonoids. Some spices also contain other subgroups of polyphenols such as furanocoumarins in parsley (*Petroselinum crispum* Mill.), hydroxycoumarins in cinnamon (*Cinnamomum aromaticum* Nees), hydroxyphenylpropenones in ginger (*Zingiber officinale* Rosc.), curcuminoids in (*Curcuma longa* L.) (Opara, Chohan, 2014).

Alakaloids

Alakaloids are secondary metabolites with a strong effect on the body. Biogenetically, their precursors are amino acids and they form the basis for the classification of alkaloids (Zandavar, Babazad, 2022). A large group of alkaloids found in spices and culinary herbs are pyrrolizidine alkaloids (PA) and their N-oxides (PANO). In a study by Kaltner et al. (Kaltner et al., 2020), the lowest mean PA/PANO content was obtained for pepper (0.1 µg/kg). A low average content was determined in thyme, dill, chives, marjoram and herbs de Provence

in the range from 49.1 to 83.4 μg/kg. High average content above 100 μg/kg was determined in parsley (189 μg/kg), savory (150 μg/kg), cumin (641 μg/kg) and oregano (3140 μg/kg).

The authors believe that moderate use of PA/PANO-containing spices does not pose a health risk. In addition, it was found that the content of PA/PANO is influenced by the harvest period and the geographical origin of the spices. The highest amount of PA/PANO was found in honey and herbal teas (EFSA, 2017). That is why the European Union (EU) has introduced content limits for pyrrolizidine alkaloids in food products (Commission Regulations (EU) 2020/2040, 2020).

Another group of alkaloids that is an impurity in herbs and spices are tropane alkaloids (e.g. anisodamine, atropine, homatropin and scopolamine). This group of alkaloids can be detected in spices and herbs if they become contaminated with other plants during harvesting or processing. Again, the EU has introduced content limits for tropane alkaloids in food products (Commission Regulations (EU) 2021/1408, 2021).

One of the most commonly used spices - black pepper (*Piper nigrum* L.) important in food technology on an industrial scale, in gastronomy and home cooking, and long pepper (*Piper longum* L.) contain the pyrimidine alkaloid piperine. Piperine has been used medicinally and is even used as an insecticide (Szallasi, 2005; Lu et al., 2016). Capsaicin is present in peppers (*Capsicum annum* L.) and chili peppers (Srinivasan, 2016). Capsaicin is classified as an alkaloid even though it is not a proper alkaloid, because of absence of nitrogen in the ring, but the presence in the side chain. The feature that these alkaloid plants have in common is that they give dishes a sharp, stinging taste. Capsaicin like piperine has also been used in medicine.

Terpenes and terpenoids

Terpenes and terpenoids are among the volatile constituents of essential oils. Chemically, terpenes are derivatives of isoprene and are called isoprenoids. Terpenes depending on the number of isoprene units into hemiterpenes (C5), monoterpenes (C10), sesquiterpenes (C15), diterpenes (C20), triterpenes (C30), tetraterpenes (C40). Terpenes include myrcene present, e.g. in laurel leaf *Laurus nobilis* L., limonene present e.g. in caraway *Carum carvi* L., α and β pinene present e.g. in coriander *Coriandrum sativum* L. Terpenoids are aerobic derivatives of terpenes and can occur as alcohols, aldehydes, esters, ethers, ketones and phenolic compounds. Examples of terpenoids are: carvacrol, citronellal, geraniol, linalool, carvone, menthol, and thymol (Masyita et al., 2022).

Carotenoids

Carotenoids are compounds commonly found in nature and are synthesized primarily in organisms with the ability to photosynthesize like plants, algae, and cyanobacteria. The importance of carotenoids is related to the possibility of transformation into retinoids, i.e. vitamin A, which is essential for the human body. About 50 carotenoids have been identified, but the most important for humans are α-carotene, β-carotene, lycopene,

β-cryptoxanthin, zeaxanthin and lutein, as well as phytoene and phytofluene (Meléndez-Martínez et al., 2022). Epidemiological studies have shown that diets rich in carotenoids are associated with a lower risk of breast, cervical, ovarian, colorectal, cardiovascular and eye cancers (Milani et al., 2017). Studies show that the highest number of carotenoids is found in leafy spices. The highest amount of β-carotene was found in coriander leaves, curry leaves, mint, and green chili (Aruna, Baskaran, 2010). Coriander leaves are particularly rich in β-carotene, which is also confirmed by the research of Ashokkumar et al. (Ashokkumar et al., 2020). Recently, a high content of carotenoids has been determined in dried peppers (Ponder et al., 2021). Spices and herbs rich in carotenoids can also be included in the group of color-influencing (Arimboor et al., 2015).

Anthocyanins

Anthocyanins are widespread in the plant world. The most common are malvidin, petunidin, pelargonidin, peonidin, cyanidin and delphinidin. These compounds are classified as flavonoids, and their presence gives plants specific color and flavor characteristics. Anthocyanins give the red, blue and purple colors to some vegetables, fruits and seeds. A high content of anthocyanins is found in flowers, which have recently found great use in compositions of herbs and spices and are used to decorate dishes. Among the edible flowers most often used for culinary purposes and for processing, *Hibiscus rosa-sinensis* L., *Punica sekretum* L., *Tropaeolum majas* L., *Cucurbita maxima* Duchesne, *Rosa chinensis* Jacq, *Myosotis sylvatica* Hoffm, and others (Pires et al., 2012). Flowers, apart from their aesthetic appearance, are also responsible for the specific taste and smell of the food served. Consumers perceive flowers by their attractive appearance, size, shape, taste, smell and color. Color plays a very important role in food and nutrition and is an organoleptic property of edible flowers. The color of flowers depends primarily on the content of carotenoids and anthocyanins. However, it must be remembered that edible flowers must meet safety standards, just like all food products. The consumer must have no doubt that flowers may pose a threat (Śmiechowska, Matyjaszczyk, 2020).

Chlorophylls

Chlorophylls are naturally occurring pigments that are responsible for the various shades of green in plants. Chlorophyll is not a homogeneous substance and occurs in several forms, the most important of which are chlorophyll a and b. Herbs and leaf spices contain the most chlorophyll, such as marjoram, oregano, mint, sage, basil and others. There is a relationship between the chlorophyll content and the level of nitrogen fertilization. This may explain why plants from organic farming contain less chlorophyll than those from conventional crops (Hallmann, Sabała, 2020). The chlorophyll content is also influenced by the intensity of sunlight and the length of exposure to sunlight. Fresh leaf of herbs and spices contain more chlorophyll. Processing processes, depending on the processing method, reduce the chlorophyll content

(Thamkaew et al., 2021). Research shows that chlorophyll has many health benefits due to its structural similarity to human blood and its good chelating ability. It has antimutagenic and anticancer properties. Chlorophyll helps neutralize the pollutants we inhale every day, making it a good supplement for smokers. It effectively provides magnesium and helps in blood transport. It has also been found to be useful in the assimilation and chelation of calcium and other minerals. It has been observed to have great potential in stimulating red blood cells to improve oxygen supply. Chlorophyll is also used to color food after extraction from plants with organic solvents (Kizhedath, Suneetha, 2011).

Mineral substances

Spices are a source of mineral compounds, which is confirmed by research conducted on commonly consumed spices such as ginger (*Zingiber officinale* Roscoe), cinnamon (*Cinnamomum verum* J. Presl.), black cumin (*Nigella sativa* L.), fenugreek (*Trigonella foenum-graecum* L.), cardamom (*Elettaria cardamomum* L.), cloves (*Syzygium aromaticum* (L.) Merr, Perry) and saffron (*Crocus sativus* L.). The results revealed that the tested spices are a diverse source of macronutrients and microelements. The content of Ca, K, Mg, Na, P and S as well as Co, Cu, Fe, Mn and Zn, which are important in the diet, was tested. The ash and fiber content also varied (Al Dhaheri et al., 2023). Spices are also monitored for the content of toxic elements that threaten human life and health. In Italy, tests were carried out on the content of Cd, Pb, As, Hg in spices such as cumin, cloves, saffron, coriander, black pepper, cinnamon, fenugreek and sesame seeds and others. Most spice samples did not exceed the limits applicable to these elements in European Union regulations, except for two samples with increased Pb content (Cicera et al., 2022).

Vitamins

Vitamins are organic compounds that are mostly not synthesized in the human body, but are necessary for its proper functioning. Spices are not food products that can be treated as the main source of vitamins in the diet, because they are added to dishes in small amounts, usually "quantum satis" to achieve the expected sensory characteristics. Fresh herbs and spices, especially in the form of leaves, contain more vitamin C than dried ones. The level of vitamin content is influenced by the type and method of drying. Studies have shown that the herb dried in the air in a shaded, well-ventilated room at a temperature of 25-32°C for 10 days lost over 80% of ascorbic acid (Capecka et al., 2005). Moshari Nasirkandi et al. (Moshari-Nasirkandi et al., 2023), examining the properties of spices from the *Lamiacae* family, found that the level of vitamin C is influenced by plant genetic factors, climate, weather and environmental factors. Environmental stimuli include light intensity and temperature. This research is important because *Lamiacae* group includes very popular herbs and spices such as *Salvia* sp., *Mentha* sp., *Thymus vulgaris* L., *Lamia alba* and others. In spices such as ginger root (*Zingiber officinale* Roscoe), turmeric (*Curcuma longa* L.), cloves (*Syzygium aromaticum* (L.) Merr, Perry) and

black pepper (*Piper nigrum* L.) in Nigeria, in addition to vitamin C, vitamins B1, B2, B3, B6, B9, B12 and β-Carotene and α-Tocopherol (Ayoade et al., 2023).

Essential oils

Essential oils are secondary metabolites produced by plants as mixtures of volatile organic compounds. The significant importance of these compounds as "*Quinta essentia*" was discovered by the famous alchemist and physician Paracelsus (1493-1541). There are many definitions of the term "essential oil", but the most frequently cited is the one recorded in the European Pharmacopoeia, which states that an essential oil is: "a product obtained from a natural raw material of plant origin, either by distillation with water or steam, or from the epicarp of Citrus sp. fruit by a mechanical process or by "dry distillation" (European Pharmacopoeia). The essential oil is then separated from the aqueous phase by physical methods" (De Souza et al., 2023). Essential oils have very different biological activities (Table 4), which depend on many factors such as: plant variety and species, harvest period, part of the plant from which the essential oil is obtained, methods of obtaining the oil, and the geographical area of origin of the plant (León-Méndez et al., 2019).

Table 4.
Bioactive effects of essential oils of selected herbs and spices

Bioactive effects of essential oils	**Examples of herb and spices essential oils**
Antibacterial	*Thymus vulgaris* L., *Cinnamomum verum* J. Presl, *Syzygium aromaticum* (L.) Merr, Perry, *Piper nigrum* L., *Mentha sp., Rosmarinus officinalis* L.
Antiviral	*Origanum vulgare* L., *Artemisia vulgaris* L., *Allium sativum* L., *Cuminum cyminum* L., *Curcuma longa* L., *Syzygium aromaticum* (L.) Merr, Perry
Antifungal	*Cinnamomum verum* J. Presl, *Origanum vulgare* L., *Curcuma longa* L., *Myristica fragrans* Houtt., *Syzygium aromaticum* (L.) Merr, Perry
Insecticides and repelent	*Coriandrum sativum* L., *Cymbopogon nardus* (L.) Rendle (Lemon grass), *Ocimum* spp.
Anticancer activity	*Zingiber officinale* Roscoe, *Peppers spp., Rosmarinus officinalis* L., *Curcuma longa* L., *Nigella sativa* L., *Syzygium aromaticum* (L.) Merr, Perry, *Piper nigrum* L.
Anti-inflammatory activity	*Pimenta dioica* (L.) Merr., *Ocimum basilicum* L., *Piper nigrum* L., *Capsicum spp., Syzygium aromaticum* (L.) Merr, Perry, *Trigonella foenum-graecum* L., *Zingiber officinale* Roscoe
Antioxidant	*Syzygium aromaticum* (L.) Merr, Perry, *Zingiber officinale* Roscoe, *Origanum majorana* L., *Myristica fragrans* Houtt., *Rosmarinus officinalis* L., *Curcuma longa* L., *Thymus vulgaris* L.
Anti-mutagenic activity	*Syzygium aromaticum* (L.) Merr, Perry, *Calendula officinalis* L., *Salvia officinalis* L., *Scutellaria baicalensi*,

Sources: own study based on: (Mashabela et al., 2020; León-Méndez, 2019; Akram et al., 2020; Patil, 2020; Garnier, Shahidi, 2021; Talib et al., 2022).

Consumers are becoming more and more aware and are looking for food that does not contain synthetic preservatives. This role is fulfilled by herbs and spices containing essential oils with multidirectional effects, including those that act as natural preservatives. Essential oils are also used in the food, pharmaceutical, cosmetic and perfumery industries as well as in aromatherapy (Żukowska, Durczyńska, 2024).

1.5. Division of herbs and spices according to their effects on the body

Since ancient times, herbs and spices have been used in herbal medicine. In Asian countries such as China and India and in African countries such as Zambia, Tanzania and Uganda, support for herbal medicine is based on cultural acceptability because herbal remedies have been around for centuries. The increase in support for herbal medicine is due to the fact that plants are perceived as healthier than conventional biosynthetic drugs. However, herbal products are not control and supervised in all countries, which may lead to threats to life and health (Msomi, Simelane, 2018). That is why we have recently seen an increase in interest in herbal medicine. Research is conducted to examine the composition and content of bioactive substances and their effects on the human body. Figure 2 shows the main health properties of herbs and spices.

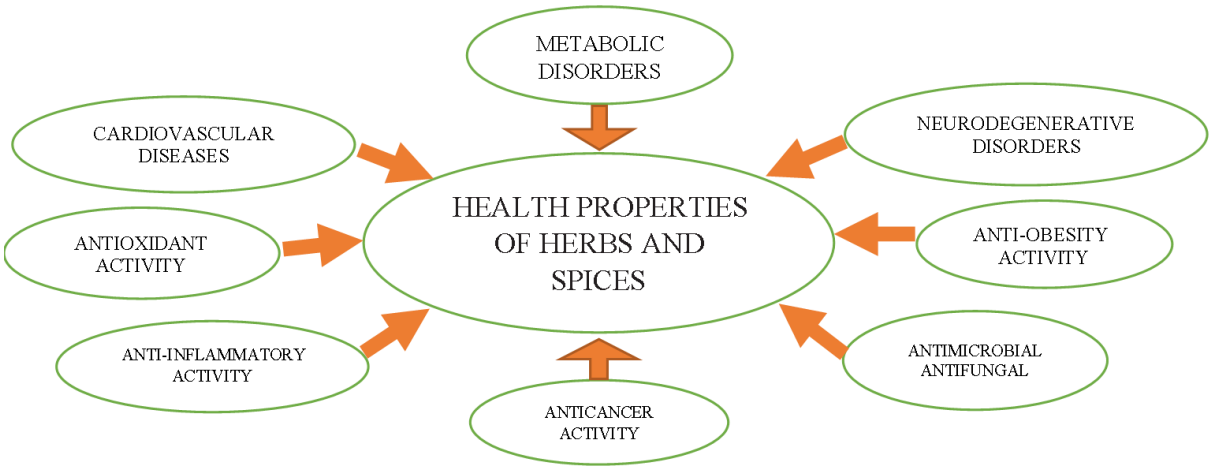

Figure 2. Division of herbs and spices according to their health properties.

Source: own study.

Metabolic disorders

One of the serious health problems of modern society is metabolic syndrome. Clinical research suggests that a diet rich in herbs and spices may have a positive effect on factors related to metabolic disorders. Spices such as cardamom can reduce inflammation markers, and cinnamon, ginger and turmeric reduce blood lipids (Mackonoichie et al., 2018). Moreover, in the case of chili, ginger and cinnamon, there is evidence of a beneficial effect of culinary doses of spices in the prevention of related disorders such as obesity and diabetes. A beneficial effect on reducing obesity rates has been demonstrated for spices such as basil, cinnamon, cardamom, coriander, ginger and black cumin (Deekshith et al., 2021). In turn, the effect on diabetes was demonstrated for coriander, cumin, oregano, rosemary, thyme and tarragon. However, the effect on hyperlipidemia was demonstrated for herbs: basil, bay leaves, coriander, fennel, oregano, rosemary, sage and thyme (Bower et al., 2016).

Cardiovascular diseases

The latest research shows that greater cardamom (*Elettaria Cardamomum* L.), coriander (*Coriandrum sativum* L.), turmeric (*Curcuma longa* L.) and ginger (*Zingiber officinale* Roscoe) can be effectively used in the prevention and control of cardiovascular diseases (Rastogi et al., 2017; Tsui et al., 2018).

Antioxidant activity

In recent years, there has been a significant increase in interest in natural antioxidants for use in food as a replacement for potentially harmful synthetic antioxidants such as BHA and BHT. Natural antioxidants have been shown to have several biological properties, such as anticancer, antimutagenic, antidiabetic, hypolipidemic, and anti-inflammatory properties, as well as preventing the oxidation of lipids in food (Hossain et al., 2023). The source of these natural antioxidants are spices. Research shows that spices belonging to the *Lamiacae* family (oregano (*Origanum vulgare* L.), thyme (*Thymus vulgaris* L.), rosemary (*Rosmarinus officinalis* L.) have a higher antioxidant potential than spices belonging to the *Apiacae* family caraway (*Carum carvi* L.) and lovage (*Levisticum officinale*) (Ulewicz-Mogulska, Wesołowski, 2023). Moreover, it has been shown that spices from organic farming have a higher antioxidant potential than spices from conventional farming (Hęś, 2022). Studies have also shown that spice mixtures have a synergistic effect and thus cause a greater antioxidant effect (Hossain et al., 2023).

Anti-inflammatory activity

Many years of research indicate that the main risk factors for most chronic diseases are infections, obesity, alcohol, tobacco, radiation, environmental pollution and diet. These factors cause acute and chronic inflammation and, as a result, lead to many chronic diseases. Epidemiological studies indicate that the cancer incidence in countries such as India, where spices are consumed daily, is much lower (94/100 000) than in countries where spices are not consumed, such as the United States (318/100 000), suggesting a potential role of spices in cancer prevention. Studies have shown that nutraceuticals derived from spices such as cloves, coriander, garlic, ginger, onion, pepper, turmeric, etc., remarkably prevent and treat various chronic diseases by targeting inflammatory pathways (Liu et al., 2017). Research shows that a diet rich in spices such as *Curcuma longa* L., *Capsicum annuum* L., *Zingiber officinale* Roscoe, *Syzygium aromaticum* (L.) Merr, Perry, *Nigella sativa* L. and *Piper nigrum* L. can reduce inflammation and have a preventive effect on diseases. related to inflammation. Although these spices have been traditionally used for centuries to treat inflammatory diseases, their therapeutic use in preventing or treating inflammatory diseases requires further in-depth research (Srinivasan, 2022).

Anticancer activity

Cancer is one of the main causes of death and therefore research in recent years has been focused on finding measures that will contribute to the treatment and prevention of these diseases. Recent research shows that ginger, pepper, rosemary, turmeric, black cumin and cloves have chemotherapeutic and chemoprophylactic properties. Ginger and black cumin have the highest anti-cancer activity, targeting many of the hallmarks of cancer. Induction of apoptosis is the most common pathway activated by various spices in the Mediterranean diet to inhibit cancer (Talib et al., 2022).

Antimicrobial and antifungal activity

One of the causes of diseases is food poisoning caused by food spoilage. To counteract these negative phenomena, various methods are used to extend the shelf life of food and limit the growth of bacteria that cause food spoilage. Many spices such as cloves, oregano, thyme, cinnamon and cumin have been shown in studies to have significant antibacterial and antifungal effects against food spoilage bacteria such as *Bacillus subtilis* and *Pseudomonas fluorescens*, pathogens such as *Staphylococcus aureus* and *Vibrio parahaemolyticus*, harmful fungi such as *Aspergillus flavus* and even antibiotic-resistant microorganisms (Regulation (EC) No 852/2004…). New trends in food production turn towards completely natural products. Herbs and spices and extracts obtained from them meet these criteria. The effectiveness of the antibacterial effect was confirmed for *Urtica dioica* L., *Capsicum annuum* L., *Crocus sativus* L., *Nigella sativa* L. on the growth of *S. aureus*. Moreover, essential oil components obtained from *Origanum vulgare* L.*, Origanum dictamnus, Mentha piperita* L.*, Lavandula ×intermedia, Zataria multiflora* Boiss*,* have been reported to be effective against *S. aureus* (Berber et al., 2022). In a literature review by Mashabela et al. (Fisher, 2019, pp. 390-394) highlighted cumin *Cuminum cyminum* L., which is used as a preservative against *Bacillus subtilis*, *E. coli* and *Saccharomyces cerevisiae*. Cumin also has exceptional antimicrobial activity against *Agrobacterium tumefaciens*, *Pseudomonas oleovorans*, *S. cerevisiae*, *Trichophyton rubrum* and *Bacillus licheniformis*. Spices: *Cinnamomum verum* J. Presl, *Piper nigrum* L., *Rosmarinus officinalis* L., *Zingiber officinale* Roscoe and curry leaves (leaves of the *Bergera koenigii* L. plant) are also used as preservatives (Fisher, 2019, pp. 390-394). One of the spices with enormous health potential is black cumin (*Nigella sativa* L.), whose properties and possible applications are being researched (Ahmad et al., 2013).

Neurodegenerative disorders

Neurodegenerative disorders (Alzheimer's disease, Parkinson's disease and dementia) are diseases associated with aging. It was found that cumin (*Cuminum cyminum* L.), black cumin (*Nigella sativa* L.), black pepper (*Piper nigrum* L.), curry leaf (*Bergera koenigii* L.), fenugreek (*Trigonella foenum-graecum* L.), fennel (*Foeniculum vulgare* Mill.), cardamom (*Elettaria*

cardamomum L.), cloves (*Syzygium aromaticum* (L.) Merr, Perry) and coriander (*Coriandrum sativum* L.) have neuroprotective potential in age-related neurological disorders (Norouzkhani et al., 2022). In a review of research conducted on the use of spices and their extracts in Alzheimer's disease (AD), special attention was paid to saffron as a promising spice for future research in the treatment of AD, as well as to four other known spices - turmeric, pepper, ginger and cinnamon (Mirmosayyeb et al., 2017).

1.6. Division of herbs and spices according to the cultivation system

Obtaining herbs and spices can be done using various methods. The main methods include: traditional agricultural crops, ecological (organic) production, integrated production and conventional agricultural production. In many countries, mainly developing ones, herbs and spices are the primary source of medicines and health care, especially in rural areas. Herbs and spices for citizens of these countries most often come from home and farm cultivation, and were most often intended for consumption by a given social group (Adnan et al., 2022; Khakurel et al., 2022). A similar situation occurs in Africa, where wild spices, i.e. collected spices, constitute approximately 48% of all spices of local origin (Olife et al., 2013). In addition to this activity, herbs and spices are grown in these countries for processing and export companies (Wondimnew, 2024). Due to the globalization of food systems, the level of traditional food consumption is decreasing and conventional production carries various types of risks (Dijazed et al., 2019). Agriculture and food systems undoubtedly face a number of serious challenges, from climate change and various forms of environmental degradation to the health and well-being of farm animals, farm workers and farmers (Sumberg, Giller, 2022). Moreover, some technologies used in conventional production raise various types of doubts or are prohibited in the European Union (Schweiggert, Schieber, 2007). The search for new alternative agricultural practices has drawn attention to organic farming, which is gaining in importance. Organic farming is environmentally friendly, relying on renewable resources from farms to maintain biological processes and ecological balance (Reganold, Wachter, 2016). Organic cultivation of medicinal plants is becoming more and more important because, according to research, they contain more bioactive ingredients (Ponder et al., 2021; Hallmann, Sabała, 2020; Hęś, 2022). Alternative agricultural technologies also include integrated agriculture. Integrated plant production is a modern agricultural production system ensuring high quality food, using in a sustainable manner technical and biological progress in cultivation, plant protection and fertilization, and paying special attention to environmental protection and human health. The assumptions of the integrated plant production system are consistent with the principles of integrated plant protection, which allows for ensuring acceptable levels of residues of plant protection products, heavy metals, nitrates and other elements and harmful substances (Kokoszka, 2023; Sekeran et al., 2021).

1.7. Division of herbs and spices according to processing technology

Fresh herbs and spices quickly lose their properties and are therefore preserved using various methods. The most common method of preserving herbs and spices is drying (Fig. 3). The drying process can be carried out traditionally by air drying or using thermal methods (Janjaj et al., 2008). Studies have shown that when dried, herbs and spices lose most of their antioxidant activity. It was found that fresh herbs and spices showed a large accumulation of polyphenolic compounds (Bieżanowska-Kopeć, Piątkowska, 2022).

Before the process of preserving herbs and spices begins, the raw material must be cleaned of mechanical impurities, such as sand, fragments of leaves and stems. This can be achieved by sifting on sieves or using special separators or filter cyclones (Mrozek-Szetela et al., 2020). Microbiological contamination of herbs and spices may cause human diseases. Bacteria can enter the plant material from soil, water and air. Some of the microbiological contamination may be reduced in the blanching process, which is used before the actual drying of herbs and spices. The quality of dried herb is also very dependent on other factors such as the type of herb, harvest time, post-harvest practices, age of the plant and storage conditions (Duncan et al., 2017).

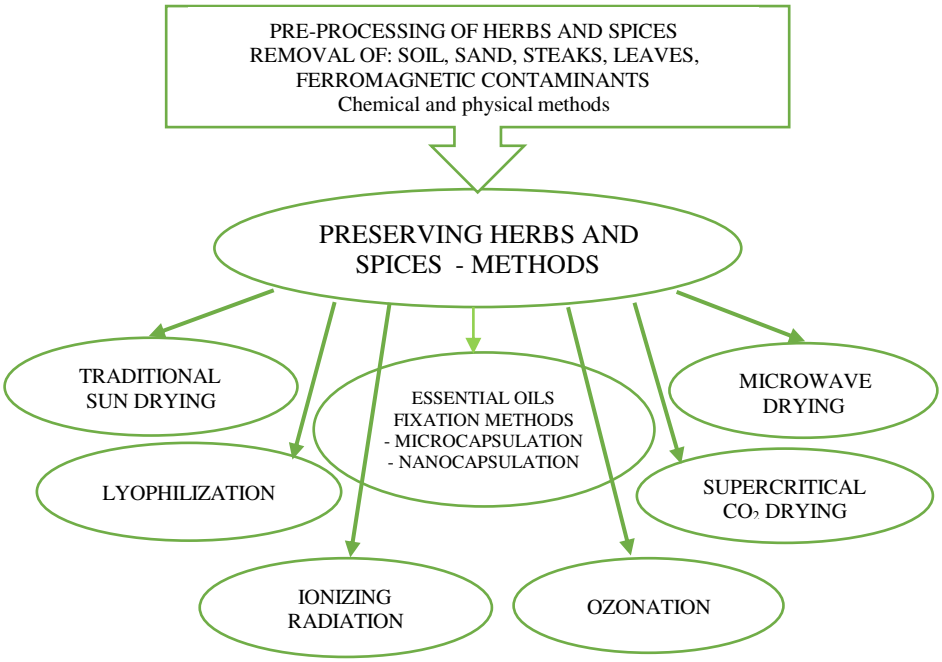

Figure 3. Selected methods of preserving herbs, spices and essential oils.
Sources: own study.

Other methods include hydrostatic pressure or treatment with high-pressure carbon dioxide (Thamkaew, 2021). These methods are not highly rated because they change the color of the raw material and affect the aroma, which involves the loss of a significant amount of essential oil. It is much more advantageous to use freeze-drying and microwave drying (Kubra et al., 2016). Ozonation of plant raw materials is also an effective method of removing

microbiological contaminants from most herbs (Mrozek-Szetela et al., 2020). In recent years, drying technology has been using methods that have the least impact on color and aroma. These include hybrid methods that combine several methods supported by solar energy, microwaves and other drying sources (Jin et al., 2018).

Physical methods of decontamination of spices, herbs and other plant raw materials include irradiation. Gamma rays are often used to inactivate microorganisms when microbial contamination is high. However, this technology is characterized by low consumer acceptance and legal restrictions in various countries (Schottrof et al., 2021).

One of the basic values of herbs and spices is to give food products specific sensory properties. However, essential oils are unstable and very susceptible to changes caused by external factors such as light, temperature, oxygen and humidity. In order to reduce these unfavorable changes, essential oils are extracted by hydrodistillation, solvent extraction, supercritical CO2 extraction or others. The extracts obtained in this way are subjected to microencapsulation or nanoencapsulation. Encapsulation methods involve coating solid, liquid or gaseous particles with special substances that isolate the contents of the capsule from the external environment. Natural or synthetic polymer films are used as coating material (Sousa et al., 2022). Microcapsules with essential oils and other bioactive ingredients obtained from plants are used in the food, cosmetics and pharmaceutical industries (Żukowska, Durczynska, 2024).

Discussion

Along with the development and progress of civilization in various areas, we observe a growing number of terms, especially in the sphere of science. It is believed that knowledge is the basis for development, and this applies to both the knowledge-based society and the knowledge-based economy (Carillo 2015). That is why it is so important, especially in science, to use terms that are unambiguously defined and do not mislead the participants of the scientific discourse.

The purpose of this article was to review the definition of the term "spices". It turns out that this concept is defined and understood in various fields of science and activity in very different ways. Most often, spices are defined as substances of plant origin (Table 1). However, in some fields of science and areas of the economy, inorganic and organic chemical compounds and substances of animal origin have also been allowed to use this concept.

The term “spices” is approached very broadly by Codex Alimentarius (1995) (Table1). The European Spice Association (ESA) in an addendum to the definition of spices adds that the category includes spices with functional ingredients, such as thickeners, emulsifiers, preservatives, colorants and anti-caking agents. However, this addition is inconsistent with the

definition of spice as a product of plant origin, since the substances listed are mostly strictly inorganic and organic chemical compounds. A list of these substances is included in the current list of food additives (Current EU approved additives and their E Numbers). Among the substances there is e.g. carminic acid, cochineal, carmine (E120) - an organic chemical compound, a natural carmine colorant extracted from dried, ground insects called cactus maggots (Dactylopius coccus) (Dapson, 2007). Also, Embuscado (2015) points out in his article that condiments do not have to be exclusively plant products but can contain other ingredients.

Nowadays, food technology, culinary and home cooking mostly use seasoning mixtures in which salt is one of the most important ingredients. Sodium chloride, known as table salt, is a product with a huge range of applications in many areas of the economy such as the food, pharmacy, cosmetology, paint and other industries. Given the scope of salt production and its use in the economy, it is difficult to assume that it can only be classified as a condiment. In 2023, total global salt production was estimated at 270 million tons (Shahbandeh, 2024). Salt as a condiment is used according to the quantum satis (as needed) principle. However, it is important to be aware that the amount of salt consumed is not indifferent to health, and excess salt can pose a threat to the cardiovascular system, kidney function and lead to the development of diseases. Therefore, the efforts of nutritionists and dietitians are aimed at reducing salt amounth in the daily human diet and food products, including spices, especially spice blends (Hendriksen et al., 2015; Śmiechowska, Drozd, 2021).

The problem with excess salt in spice blends also concerned the authenticity of the spices, as the spice blends contained more salt than herbs and vegetables, which is considered an adulteration (Śmiechowska, Drozd, 2021). Therefore, nutritionists pointed out that the proper effect of bioactive compounds contained in spices is abolished by excessive salt. The medical community views spices mainly in terms of their bioactive components, which have been used as therapeutic agents for centuries. In modern medicine, many spice-like plants are primarily used prophylactically, such as cinnamon and other bitters in the prevention of type 2 diabetes (Garza et al., 2024). Therefore, the medical, pharmaceutical and, in part, cosmetology communities use divisions of spices that target their medicinal properties, as discussed in detail in sections 3.4 and 3.5 of this paper. The issue of authenticity and methods of identifying adulteration is a very difficult task in the case of spices, especially spice blends. The harmfulness of spice adulteration has already been demonstrated for such popular spices as pepper and cinnamon (Newerli-Guz, Śmiechowska, 2022).

Adulteration is a serious problem in herbs and spices. The European Commission has published the results of the first coordinated control plan on the authenticity of herbs and spices launched by Directorate-general for Health and Food Safety and carried out by 21 EU Member States, Switzerland and Norway. Based on the analyses, the overall rate of suspicious samples was 17% (329 out of a total of 1885 samples analyzed) (Herbs and spices, 2019-2021). The most adulterated of the tested samples was oregano. As many as 48% of the tested samples were contaminated. The matter is serious because adulterated herbs and spices may pose various

types of threats to the food produced and may also cause health consequences (Embuscado, 2019; Newerli-Guz, Śmiechowska, 2022).

The International Organization of Spice Trade Associations (IOSTA) which plays an important role on the international spice market, among others, developed and published guidelines for spice and herb growers explaining how to prevent contamination and other problems affecting the cultivation and trade of spices (Fisher, 2019).

To improve the safety of herbs and spices, the EU also launched the "Securing the spices and herbs commodity chains in Europe against deliberate, accidental or natural biological and chemical contamination" (SPICED) project under the 7th Framework Programme. The overall objective of the EU project SPICED was aimed at securing the spice and herb food chains from primary production through to consumer-ready food against major natural, accidental or deliberate contaminations. Within SPICED, the focus was on low-moisture food ingredients such as dried herbs and spices (SPICED, 2017). The results of the SPICED Project constitute an important and timely contribution to the protection of the environmental and food safety aspects of spices and herbs, by supporting the effective environmental protection of consumers against possible risks arising from accidental or intentional contamination of spices and herbs (Székács et al., 2018). Therefore, it is logical that divisions and characterizations of raw materials and products, including spices, are created for the needs of various fields of science and broad economic activity, with a particular focus on the food industry. Slightly different against this background are the activities of some authors who create names and definitions for their own purposes. Sometimes they are critical in nature such as the approach to the definition of herbs and spices by Martínez-Graciá et al. (2015), who pointed out that spices are made not only from the green parts of plants but include other elements such as seeds, flowers, fruits, roots and even plant bark. This definition is very accurate, as herbs indeed involve elements of above-ground plant parts. In addition, still Low Dog (2006) and Jiang (2019) will separate among the herbs the so-called culinary herbs, which are used mainly for imparting sensory qualities to dishes. The culinary division of herbs and spices is intended to identify those that affect the flavor and aroma of dishes. Its purpose is to facilitate work in gastronomy and home cooking, and can also be used in the development of new spice blends for specific dishes (Table 3).

The terms herb and spice are often used interchangeably, but we should be aware that they are not the same concepts. Herbs and spices differ in the way they are obtained (because they are come by from different parts of the plant) and in the way they are processed (because we treat fresh, delicate leaves differently than seeds, stems, rhizomes and roots). In this group of food products, in addition to herbs and spices, there are also spice (culinary) herbs. Spice herbs can be defined as herbaceous plants intended for culinary purposes.

In reviewing this study, the authors drew attention to another aspect that has not yet been raised by other authors. Namely, herbs and spices intended for medical and pharmaceutical purposes should meet the requirements for raw materials and medicinal products. On the other

hand, herbs and spices intended for direct consumption, for culinary purposes and in food processing should meet the requirements like all food products, since different requirements and standards are applied for medical products and food products.

What distinguishes spice herbs from herbs intended for medicinal purposes? Culinary herbs are subject to the same controls as all other food products in accordance with Regulation (EC) No 178/2002 (Regulation 178/2002, 2002) and Regulation (EC) No 852/2004 (Regulation 852/2004, 2004) and Commission Regulation (EU) 2023/915 (Commission Regulation 2023/915, 2023). In turn, herbs intended for medicinal purposes are subject to the same control as all medicinal products (Bent, 2008; European Pharmacopoeia).

Conclusions

The multitude of spices, herbs, and the possibilities of their use in food preparation, cosmetics and medicine and other fields make them more recognizable all over the world.

This article was created for review purposes. It presents the existing great voluntariness in defining spices and herbs. The presented definitions have been found in official documents and in scientific papers, where they have been formulated by modern researchers.

The collected literature data allowed to indicate differences in the existing definitions and divisions and confirmed the great diversity of this group of products. The most commonly used divisions of herbs and spices are presented in this review, along with those proposed by the authors. The article was intend to put in order those terms for educational purposes.

Their proper naming, characterization and assignment to particular types is very important. Especially for authors of scientific articles in which research results obtained in a modern way should be properly interpreted. Attention to nomenclature and knowledge of the possible divisions of this group of products may become crucial for researchers dealing with plant products. They must be very methodical and at the same time critical of scientific work in this field.

Nowadays, most articles about plant-based products, including herbs and spices, concern their beneficial effects on the human body and the possibility of their use in various branches of industry.

Herbs and spices intended for medical and pharmaceutical purposes should meet the requirements for medicaments, the same products for food processing and consumption, should meet the standards for food.

Among the many advantages of these products, we should not overlook their negative features. We should be aware that spices may also contain different anti-nutritional ingredients in the form of secondary metabolites such as oxalates or phytates (Ghosh Das, Savage, 2012; Borquaye et al., 2017) and can cause adverse effects on human health, including allergies.

Acknowledgments

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E-COMMERCE CUSTOMER SERVICE A CHALLENGE FOR CITY LOGISTICS

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Purpose: The aim of the article was to analyse and attempt to determine the scale of the use of new technologies in e-commerce customer service and to present trends and challenges in this area in city logistics. In addition, the article characterises the development of the e-commerce market between 2020 and 2023 and introduces the silhouette of the e-commerce customer.
Design/methodology/approach: A literature analysis, case studies and empirical data from industry reports and self-observation were used to develop the article.
Findings: The research concluded that new technologies are now an integral part of the e-commerce customer experience. Trends accompanying e-commerce in relation to city logistics, according to the author, are increased demand for 'last mile' delivery, green logistics and sustainable transport, automation and robotisation, flexible delivery models (crowdsourcing) and personalisation of services. Challenges facing modern urban logistics are the increasing demands of consumers, the complexity of delivery in 'last mile logistics', the need to adapt urban infrastructure to the changing environment, and environmental and regulatory constraints.
Research limitations/implications: The data collected and presented in the article on the development of e-commerce in Poland and globally covers the years 2020-2023.
Practical implications: The solutions presented in the article can improve the efficiency of logistics processes, optimise urban infrastructure, introduce technological innovations and support sustainable urban development. Furthermore, the information can support both companies and local governments in responding to the growing challenges of e-commerce customer service.
Social implications: The article can be used to improve the quality of life in cities, increase the availability of services, develop local markets and increase the awareness and involvement of residents in sustainable development activities.
Originality/value: The value of the article stems from its interdisciplinary nature - combining topics related to logistics, technology, ecology and urban planning. Its audience can range from private sector professionals, public policy makers and academics working together on solutions for sustainable development and urban management in the context of e-commerce development.
Keywords: customer service, city logistics, new technologies, e-commerce, development.
Category of the paper: Research paper.

Introduction

In recent years, the intensive growth of e-commerce, particularly evident between 2020 and 2023, has influenced the transformation of city logistics. With the increase in online ordering, customer needs for last-mile logistics service have increased, challenging cities in terms of infrastructure, ecology and delivery efficiency. The aim of this article is to provide an original analysis and attempt to determine the scale of the use of modern technology in e-commerce customer service and to identify trends and challenges in urban logistics. The article is enriched not only by new empirical data, but also by conceptual insights into the challenges for the future of cities and logistics.

The article adopts a diverse research methodology including literature analysis, case studies and empirical data from industry reports, which are complemented by the author's observations. The hypothesis is that technologies such as automation, robotisation, sustainable transport and crowdsourcing models not only contribute to improving delivery efficiency, but can also change the way we think about urban logistics from an environmental and social perspective. The novelty of the publication's findings lies in its interdisciplinary approach - integrating knowledge from the fields of logistics, technology, ecology and urban planning - a unique combination with relevance for both the private sector and urban policy.

The research presented has important practical implications that can contribute to optimising logistics processes and improving urban infrastructure management. In addition, the article can support local government units and companies working in the field of e-commerce customer service, as well as raise awareness among local residents about sustainability measures. With its innovative approach, the work brings value to professionals, public policy makers and academics involved in the development of city logistics in the age of digital transformation.

Characteristics of e-commerce

Electronic commerce, or e-commerce, is the exchange of goods, services and information using a computer network. According to Syarif et al. (2020), e-commerce is a subset of e-business including: commerce, business partnerships, customer service and recruitment. Therefore, e-commerce is considered to be not only web technology, but also database, technical data in databases, email and other non-technical forms of computers (product delivery systems and payment instruments). The Internet and information technology have contributed to technological advances, including the development of e-commerce. Today's Internet-enabled mobile devices have enabled consumers to access the online marketplace in real time.

As a result, they can shop from anywhere, at their convenience Wang et al. (2023) emphasise that e-commerce is the process of buying - selling goods and services over the Internet using electronic communication technology and information processing. Koe et al. (2020), defined e-commerce as the conduct of digital business transactions using the Internet.

The global value of the e-commerce market grew rapidly in 2020, following the outbreak of the Covid-19 pandemic, reaching US$10.36 trillion at that time. The E-commerce Statistics portal valued the global e-commerce market at USD 4.9 trillion in 2021 and more than USD 6.5 trillion in 2023, representing 22% of all global retail sales (E-commerce in Poland, 2020). Analysts at Marketsplash predict that e-commerce worldwide will grow at a 14.7 per cent CAGR (average annual growth rate) and will reach USD 27.15 trillion in 2027 (Vuleta, 2022). The emarketer.com portal reported that 78% of e-commerce users worldwide in 2023 shopped using mobile devices (70% opted for tablets, 67% for desktops or laptops). Among the most selected and purchased products online globally in 2023 were apparel, footwear, electronics, cosmetics, food products, books and multimedia. The average spend per online transaction was around US$2.6. The 2023 Worldwide E-commerce Forecast report stated that the main motivators for shopping in the global e-marketplace were accessibility (twenty-four hours a day), convenience and the ability to compare different offers at the same time. According to the Emarketer portal, 73% of global shoppers used different distribution channels throughout the shopping process. The most popular forms of payment in e-commerce according to emarketer.com included: credit cards (53%), digital payment systems (43%), debit cards (38%). On the other hand, the most popular shopping platforms were: Amazon, eBay, Alibaba (Emarketer Reports, 2023).

In Poland, the first online shops and auction platforms were established in the second half of the 1990s. Initially, online shopping was not popular. The sceptical attitude towards this form of shopping was due, among other things, to concerns about the safety of the money spent and the long waiting time for goods (Leloch et al., 2023). Today, the situation is very different. According to a Gemius report from 2023 (Gemius Report, 2022), online shopping has gained trust among the majority of Poles. This was linked to improved delivery services. 79% of respondents taking part in the survey conducted by the creators of this report declared that they had made an online purchase at least once in 2022 (51% of whom were women). This report also highlights that today's e-commerce users are mainly those born between 1995 and 2012 (Generation Z) (Miernik, 2024) and between 1980 and the end of the 20th century (Generation Y) (Bandura, 2022). Maksymilian Śleziak of the Ageno portal points out that Polish e-commerce is one of the fastest growing markets in Europe. He published the results of a quantitative study, which shows that 30 million people used the internet in Poland in 2023. 79% of them shopped online, of which 75% chose Polish online shops and 25% foreign ones. It was estimated that in 2023, the average Pole spent around PLN 1,600 per month online. 67% of respondents admitted that they used online shopping at least once a week. In addition, the authors of the study emphasised that 67% of the people surveyed were encouraged to shop online by the price, which they believed was lower online than in stationary shops (Śleziak,

2024). According to the Harbingers portal, the value of the Polish e-commerce market in 2023 was approximately PLN 120 billion. Economists predict that this value will increase in 2024 (E-commerce, 2024). In turn, PwC (a global firm offering audit, tax, advisory and consulting services) forecasts that the Polish e-commerce market will reach a value of 162 billion PLN by 2026 (Cheng et al., 2020; Report on the growing importance of e-commerce in Poland and Europe, 2023). The most popular e-commerce products in Poland in 2022 were: clothing, footwear, cosmetics, books, pharmaceutical products, sportswear, household appliances and white goods, and in 2023 they will be joined by food products. The characteristics of online consumers in Poland in 2023 are shown in Figure 1 (E-commerce in 2024 Trends, opportunities and threats, 2024).

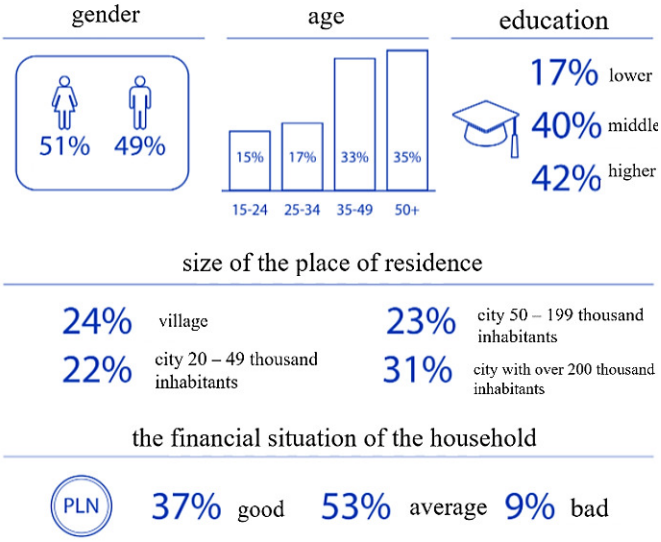

Figure 1. Characteristics of online consumers in Poland in 2023.

Source: E-commerce w 2024 roku Trendy, szanse i zagrożenia (2024), The text comes from: https://harbingers.io/blog/e-commerce-w-2024-roku-trendy-szanse-i-zagrozenia, 27.04.24.

According to this report, 'E-commerce in 2024 - trends, opportunities and threats', the most frequently selected forms of delivery in Poland in 2023 were parcel machines (86% of respondents chose this type of delivery) and home/work courier delivery (62%). For online purchases, survey respondents were most likely to pay using quick transfers through payment services, mobile payments (BLIK) and payment by card (Figure 2).

Figure 2. Distribution of survey respondents' answers on their favourite payment methods between 2000 and 2023.

Source: Stankowska (2023). Key statistics of the e-commerce market in Poland in 2023 and 2024. The text comes from: https://edrone.me/pl/blog/statystyki-e-commerce-polska

Among the various platforms, according to e-commerce statistics published on drone.pl in 2023, Poles most often chose: Allegro (86% of consumers), OLX (39%), Zalando (20%), Amazon (15%), Aliexpress (15%) (Stankowska, 2023).

The history and development of e-commerce is closely linked to e-commerce transactions and business models. The literature most commonly distinguishes six: Business-to-consumer (B2C), the most common form of e-commerce, in which companies sell directly to consumers using online trading platforms, websites and mobile applications. Business-to-business (B2B) involves companies selling goods and services to other companies (bulk purchases or supplier relationships). Consumer-to-consumer (C2C) occurs when consumers sell products or services to other consumers via online trading platforms, classified ads or auction sites. Consumer-to-business (C2B), the sale of products or services by consumers to businesses. Refers to independent contractors, consultants and small businesses selling specialist goods and services to them. Business-to-administration (B2A), the sale of goods and services to companies, government agencies or other public sector organisations. Includes: online tax return and procurement systems. Consumer-to-administration (C2A) is a model in which consumers interact with government agencies or other public sector organisations through online portals (paying taxes or accessing government services) (Lemańczyk at al. 2020). It is now increasingly being said that the B2B model is gradually replacing the human-to-human (H2H) model. It puts, at the focal point, the human being. This is because people want to be part of something big, have feelings and experience a whole range of emotions. They do not want to be excluded from wider activities, they want to be noticed and feel that their voice is important. Additionally, they want to understand and be individuals who make mistakes. The main focus of this model is that every business is made up of people. There is no business without people. The brands of companies become close to people and are actually friends that we like and come back to (Czerska, 2020; Revolution in marketing - H2H instead of B2B?, 2019; Oktaviani et al., 2022).

New technologies in e-commerce

According to Sonata (2019), e-commerce has grown rapidly in recent years and has become a significant part of the internet. Therefore, business organisations are changing their technology on a daily basis, to what is known as smart technology (Wang et al., 2023). Businesses are outdoing themselves in implementing new solutions, including those using AI (artificial intelligence). According to Ravindar et al. (2022), AI has become the answer to the problems of e-commerce organisations. It has made it possible to reach a wider audience, including those who are communicatively excluded or disabled. According to the 2023 Technology Trends Outlook report, the use of AI in e-commerce in 2022 contributed to the generation of $4.4 trillion in economic value. Analysts from McKinsey, on the other hand,

have indicated that this functionality will result in an additional 40% increase in economic value in 2024 compared to 2023. Which, in their view, will translate into more money being invested in companies to implement and develop artificial intelligence in e-commerce (E-commerce in 2024 Trends, Opportunities and Risks, 2024). AI in e-commerce is being used, among other things, to present personalised recommendations and display automated suggestions in the search engine related to their previous preferences (typed in the search engine). An example of the use of AI in e-commerce is the presence of virtual assistants that guide e-commerce users through the entire shopping process. Solutions of this type are used by The North Face, among others (AI in e-commerce. How artificial intelligence is changing the online retail industry, 2022). AI in e-commerce is combined with other technologies, for example virtual reality (AR). This allows online customers to try on products before they buy them, at home without having to turn up at a shop. CCC offers online customers to virtually try on shoes in an app, while Vision Express offers glasses. These solutions are popularly used by the fashion and interior design industries (E-commerce in 2024 Trends, opportunities and threats, 2024). Another technology using AI in e-commerce is NLP (Natural Language Processing). The process of using this technology involves accurately understanding the user's intentions and correctly processing the query in the browser (search engine) (Sleziak, 2024). Another technology is Visual Search (image search), which, using AI, provides an alternative to traditional search. It involves the user uploading a photo or screenshot of the item being searched for to the search engine, and the AI-based algorithm, after analysing what the image represented, is tasked with presenting the same or similar items to the user. The visual search option is offered by CCC, among others. Increasingly, text- or image-based search is being replaced by so-called voice search, which also works on the basis of AI. Chatbots are also an AI-based technology used in the e-commerce industry. They work by automating customer service by responding immediately to their needs. In addition, AI in e-commerce is used for website personalisation and ‘product recommendation engines’ (Panasiuk, 2022). This activity involves displaying dedicated product recommendations to users, tailored to their current needs (Bawack et al., 2022). The ageno.co.uk portal counted as the most important mobile technologies in e-commerce: PWA- web applications, provide users with an experience (user experience) similar to native mobile applications (responsiveness, speed, offline operation and the ability to save to the device's home screen). As another, he mentioned headless technology, which makes it possible to design a separate view of the webshop, mobile app and smartwatch version while operating them through a single backend system. In third place were: TikToks, reels and videos, which, according to the portal's authors, outclassed traditional inserted photos. According to data, the ageno.co.uk portal, reels accounted for 30% of the time spent by Instagram users in 2023. The portal's creators predict that in 2024, this value will increase by another several dozen %. Another technology used in e-commerce is Live

commerce, channels for selling products during a live broadcast. Also referred to as teleshopping 2.0, they are commonly used by the fashion and beauty industries (Sleziak, 2024). Therefore, it can be argued that social media play a special role in e-commerce today: Facebook, Instagram and Tik-Tok. These are platforms, creating spaces for the exposure of product offers, where demand is generated. The metaverse, also called Web 3.0, is a virtual, three-dimensional space based on a combination of technologies (augmented reality, blockchain, AI, IoT and digital twins). It works by building a reality that attempts to replace the physical dimension of social and economic interactions. This is a new era of virtual interaction in which cryptocurrencies and blockchain play a significant role as infrastructure to support unique digital economies (Nedunuri, 2023). This technology enables global borderless transactions and decentralised exchange of value using tokens (electronic devices issued by banks that generate codes to authenticate online operations) (Token - what is it and how does it work?, 2023) and NFTs (non-fungible tokens-unique cryptographic tokens created through blockchain technology) (Non-Fungible Token: What is it and how does it work?, 2023) as means of digital ownership. Examples of companies that have implemented the metaverse in e-commerce are: Flipkart, Gucci, Nike (Kuraś et al., 2024). The integration of payment systems to enable seamless transactions plays an important role in building metaverse.

E-commerce customer service - trends and challenges for city logistics

With the rapid growth of e-commerce, consumer demands for customer service are increasing, which directly influences changes in urban logistics. Both online and in the urban space, customers expect ever faster, more flexible and sustainable deliveries, which poses new challenges for logistics companies. According to the creators of the e-commerce trends 2024 blog, the main e-commerce trends for 2023 include: subscription commerce. It works by selling products or services at regular intervals in exchange for a recurring subscription fee. This type of distribution enables companies to receive a steady profit and gives them the ability to accurately estimate demand. Which can translate into reduced costs of acquiring new customers and increased loyalty of existing customers. The authors cited Netflix, Amazon Prime, Spotify, Office 365 and BeGlossy as examples of companies that have built their success on this type of commerce. They also pointed out that subscription sales work well for fast-moving consumer goods (FMCG): food products, cleaning products, cosmetics, water filters, contact lenses, pet food or accessories. Another trend in e-commerce is the sale of second-hand products (re-commerce). The popularity of buying second-hand items, according to the blog's authors, is linked to the increasing environmental awareness of consumers. Re-commerce is a trend that has recently become very visible in the fashion industry (success of the platforms:

Vinted, Zalando Pre-Owned). Another trend described is ecological e-commerce. Representatives of generations - millenials (generation Y, gradually entering the digital world) (Kaszuba-Piżuk, 2022) and gen Z (the digital world has always existed for them, what is more, they are the generation growing up in a world of modern technologies) (Rojewska, 2024) - are particularly sensitive to ecological issues. Therefore, they specifically point out that e-commerce should be based on ecological forms of delivery and continuous work on reducing returns (Sleziak, 2024). As well as reverse logistics, which in e-commerce consists of managing the process in which customers send back purchased products to the seller. Today's e-commerce users expect easy and hassle-free returns (Louis, 2024).

The dynamic development of e-commerce affects logistics, including city logistics. Today, the phenomenon of globalisation, structural and technological change is intensifying in urban areas. The flows of people and goods contribute to air pollution, congestion, traffic bottlenecks, noise and accidents in cities. According to Kalbarczyk (2019), urban logistics is a tool to solve a variety of difficulties in urban agglomerations. Nowakowska-Grunt et al. (2017), on the other hand, defined urban logistics as the process of managing the flow of: materials, cash and information in accordance with the needs and for the development of the city and taking into account the problem of environmental protection, under the assumption that the city is a social organisation oriented towards satisfying the needs of its customers - city residents. The infrastructure of city logistics consists of the following infrastructures: transport (e.g. roads, junctions), storage processes (e.g. depots, warehouses with equipment), telecommunications and data transmission in the city (Matusiak, 2022). City logistics is an important element of customer service in e-commerce. The realisation of one of the last distribution legs of an online customer's ordered product ‘last mile logistics’ is mainly carried out within cities. The level of end-customer satisfaction, fast delivery (same-day delivery), the possibility of flexible choice of time and place of collection (e.g. pick-up points, parcel vending machines) and real-time tracking of shipments are today's standards accompanying e-commerce customers. It can be concluded that city logistics in e-commerce is an intermediary, fostering the implementation of these standards with efficiency, rationality of operational costs using new technologies. In urban logistics, they are used, among other things, to automate warehouses (warehouse management systems -WMS), optimise delivery routes using algorithms (Internet of Things -IoT and artificial intelligence -AI), monitor and analyse data in real time.

Warehouses and storage are an integral part of e-commerce, without them it would be impossible for this industry to function. Efficient inventory management makes it possible to minimise costs, store and ensure product availability to customers. According to CBRE (Commercial Real Estate Services- a real estate advisory company), the Polish warehouse market is one of the fastest developing in Europe. In 2023, the total warehouse space in Poland

will increase by 12 per cent compared to 2022 and will amount to approximately 30.5 million sqm. The increase in e-commerce has translated into increased demand for warehouse space, especially in cities (urban warehouses and logistics-microhubs). In 2023, 780,000 sq m of warehouses were leased in Warsaw, 655,000 sq m in Katowice and 578,000 sq m in Wrocław. According to autopay.pl, warehouses located in strategic locations: close to major urban centres and transport hubs have gained in importance (Development of e-commerce as an opportunity to strengthen the warehouse market, 2024). This has made it possible to reduce lead times, which is extremely important, for example, in services such as same-day delivery. An example of a company that implements solutions of this type is Amazon, which has developed and continues to develop a network of microhubs in city centres around the world. This enables it to deliver quickly and reduces the need for large logistics centres outside cities (1000s of jobs. Amazon has launched its 11th logistics centre in Poland in the Silesian Voivodeship, 2024). The e-commerce portal included among the most popular forms of delivery in urban logistics in 2023: Out-of-home (OOH), the possibility to pick up an order at parcel machines or partner points. Click & collect, purchasing a product online and picking it up at a selected stationary shop (can be combined with parcel machine collection). An example of such a solution is the trekking shop outdoorzy.pl. Beneath the stationary shop is their 'own' parcel machine, where customers can collect products ordered online. Q-commerce, a sales model that involves the delivery of products in a maximum of a few tens of minutes after placing an order. Usually these are suppliers employed in the catering industry (Pyszne.pl, UberEats or Glovo moving by bicycle, scooter or on foot within cities). Associated with this type of delivery are so-called dark stores - micro-distribution centres, resembling shops filled with fast-moving goods (e.g. groceries), used for online orders. The authors of the article 'E-commerce in 2024 - trends, opportunities and threats' (E-commerce in 2024 Trends, Opportunities and Threats, 2024) predict that in 2024, excessive waiting times for the customer could mean up to 24 hours. In line with customer expectations, e-shops should aim for same-day delivery. This will make consumers feel satisfied with their shopping experience, which will translate into building a relationship between the customer and the shop (E-commerce in 2024 Trends, opportunities and risks, 2024). According to a report published on harbingers.io/blog/e, 86% of online shoppers in 2023 chose parcel machines as the delivery method they used most often. This was 12 p.p. higher compared to 2022. In contrast, the least frequently chosen form of delivery in 2023 included delivery to postal outlets (Figure 3).

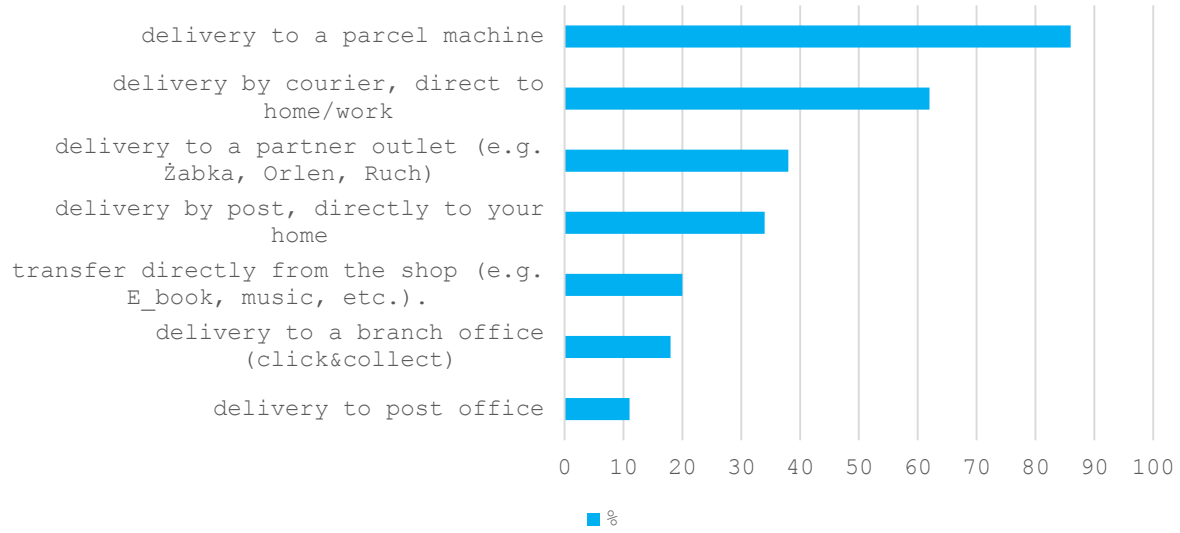

Figure 3. Distribution of respondents' answers to the question on the most preferred form of delivery when shopping online.

Source: E-commerce in 2024 Trends, Opportunities and Threats (2024). The text comes from: https://harbingers.io/blog/e-commerce-w-2024-roku-trendy-szanse-i-zagrozenia

Parcel lockers and pick-up points are an integral part of the modern urban logistics landscape. These innovative solutions have enabled customers to pick up their orders flexibly. Instead of the parcel being delivered directly to the customer's home, the order can be picked up at a time and place convenient for the customer, minimising the problem of failed delivery attempts. Parcel machines in Poland are exceptionally popular, with as many as 99% of participants in a survey conducted by Colliers in 2023 using them. According to forecasts, this market will continue to grow rapidly, reaching a stock of 45,000 machines in 2024. According to the authors of the report: 'Parcel Machines 2.0: Development, innovation, future' (Chmielewski et al., 2024), there were 38,000 parcel machines in Poland in 2023. The leading company in terms of the number of machines in Poland as of 2021 is InPost. The authors of the report state that Poles most often order clothes, shoes and books to parcel machines. They point out that 65% of all machines are located in urban municipalities and only 17% in rural municipalities.

The use of electric cars, cargo bikes or autonomous delivery vehicles and drones is cited as an example of the realisation of green e-commerce in urban areas (realisation of the last stretch of distribution - last mile logistics). This is primarily in response to the need to reduce CO2 emissions and regulations on car traffic restrictions in city centres. In Europe, there are a number of projects aimed at implementing, for example, cargo bikes in the operation of city logistics. One example of the implementation of a 'cargo bike' in city logistics is the city of Slupsk and a project called CoBiUM - Cargo Bikes in Urban Mobility, funded by the European Union. Companies using the advantages of cargo bikes in Europe are: Bubble Post from Belgium (Ghent), Hajtas Pajtas from Hungary (Budapest) or Ordr from the Czech Republic (Prague) (Starczewski, 2022). Autonomous technologies, such as autonomous delivery vehicles

and drones, are innovative solutions that could revolutionise urban logistics. Their implementation will enable unmanned deliveries, which can reduce operational costs and increase efficiency. An example of the testing of this technology in the US is Nuro, which has received approval to begin testing R3 autonomous delivery vehicles in four Bay Area cities (Korneluk, 2024). Amazon Prime Air, on the other hand, is developing the delivery of parcels to end customers using delivery drones. Their aim is to speed up deliveries to hard-to-reach areas (e.g. congested cities) (Fedoruk, 2023). Real-Time Delivery Management is another facility that allows logistics companies to track vehicles and shipments and optimise delivery routes based on current road conditions and traffic forecasts. Thanks to this technology, it has become possible to inform customers about the status of their order. UPS has implemented 'ORION' (On-Road Integrated Optimisation and Navigation), which uses real-time data to optimise delivery routes (UPS enhances ORION with delivery route optimisation, 2020). Another trend in urban logistics that is also being implemented within e-commerce is crowdshipping platforms (Szymanowska, 2016). Deliveries within these platforms are based on collaboration with local couriers, who can be regular delivery people in exchange for remuneration. These types of solutions allow for fast delivery in congested urban areas, where traditional logistics companies may struggle to arrive on time. Stuart, a company operating in Europe, offers a crowdshipping platform that allows e-commerce companies to use a network of local couriers. This solution works well for express deliveries in congested cities where traditional logistics companies have limited availability (Logistics for a sustainable world: consistent, efficient and reliable, 2023).

Discussion

The article is mainly based on literature analysis, case studies and data from industry reports, which is a certain limitation in terms of the representativeness of the results. The data on the development of e-commerce and the impact of new technologies are for the period 2020-2023. However, it should be stressed that these data are derived from available industry reports, which do not always capture all aspects of local markets and specific urban contexts. There is a lack of data from quantitative methods (interview questionnaire, surveys). These data could deepen the understanding of urban logistics needs and challenges from different perspectives. This is important especially in relation to 'last mile logistics', which is sometimes implemented differently depending on urban structure, regulations and consumer expectations in different regions. However, in the author's opinion, the data in the article can provide valuable insights into the technology (automation, robotisation, crowdsourcing delivery model and personalisation) inherent in e-commerce logistics services, especially in the context of city logistics. The article concludes that modern technology contributes to delivery efficiency

to meet growing consumer demands for fast and environmentally friendly delivery. A new finding is the identification of the importance of 'green logistics' and sustainable transport in delivery in urban spaces, which can drive future research on urban infrastructure adaptation. In the author's view, traditional approaches to logistics service need to be modified and adapted to the challenges of modern cities. The data from the article can be used to optimise logistics processes, improve the quality of life in cities and implement environmentally friendly solutions, which is important not only for logistics but also for urban planning and sustainable development. The conclusions drawn from the article show that e-commerce is a catalyst for the development of urban logistics, which has theoretical implications for logistics and urban planning researchers.

Summary

Observation of the e-commerce environment, analysis and synthesis of the collected information of the impact of technology on e-commerce customer service indicate a continuous process of improving and increasing the level of automation of digital marketing activities in the e-commerce industry. This includes advanced e-commerce platforms, as well as customer relationship management (CRM) systems and analytical and marketing tools. Technology is an essential element of any online business (chatbots and voice assistants are an everyday reality in e-commerce).

Providing the highest possible level of customer service in e-commerce is also a challenge and one that is constantly changing in urban logistics, especially in the 'last mile' section. Today's consumers expect ever faster, more flexible and convenient forms of delivery, which challenges e-commerce companies to adapt city logistics to these growing demands (parcel machines, e.g. InPost). Real-time fleet management, allows customers to track their orders, reinforcing their sense of control over the entire shopping process and increasing their level of trust in online retailers. In the future, technologies such as autonomous vehicles and delivery drones, being tested by e-commerce market leaders, will play an increasingly important role in meeting the expectations of end consumers. However, it is important to remember that these innovations come with challenges. Examples include the personalisation of services, the expectation of fast and low-cost delivery while taking care of the environment, the handling of returns. The development of city logistics integrated with new technologies is not only a question of optimising delivery processes, but above all of improving customer service. In the world of e-commerce, where customer loyalty increasingly depends on the quality and speed of delivery, companies need to bet on innovative solutions that not only meet growing expectations, but also build lasting relationships with customers. The future of customer service in e-commerce will therefore depend on the ability of companies to combine technological

efficiency with a personalised approach to each customer's needs. The introduction of modern solutions, such as intelligent traffic management systems, the designation of dedicated delivery zones and the creation of micro-warehouses in city centres, is becoming necessary to keep traffic flowing and reduce the environmental impact of transport. At the same time, increasingly stringent environmental and regulatory constraints are forcing companies to invest in sustainable solutions such as electric vehicle fleets, cargo bikes and pedestrian deliveries. Many cities are introducing low-emission zones and restricting the entry of internal combustion vehicles into city centres, requiring companies to adapt their logistics operations to the new requirements.

These regulations, although initially costly, are helping to improve air quality and the overall quality of life in cities, while providing an opportunity for innovation and the development of more sustainable business models.

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CARBON FOOTPRINT MANAGEMENT BASED ON LCA CALCULATIONS IN ARCHICAD FOR A HYPERLOOP STATION

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Purpose: The purpose of this study is to determine the carbon footprint of a Hyperloop station by integrating Building Information Modeling (BIM) with Life Cycle Assessment (LCA).
Design/methodology/approach: The research quantifies carbon dioxide emissions at all stages of the Hyperloop station's life cycle—from design and construction to operation and demolition. It focuses on identifying key sources of emissions and developing strategies to minimize their environmental impact. Detailed tracking of material flows during construction allows for assessing the sustainability and durability of the building materials used. A digital model was created in Archicad, defining the environmental properties of materials. Energy performance was estimated both graphically and analytically to showcase the carbon footprint and assess environmental indicators.
Findings: The integration of BIM and LCA supports environmentally friendly decision-making throughout the project life cycle. The study identifies environmental hotspots and promotes the adoption of greener alternatives. It demonstrates that using these tools provides dynamic, real-time feedback during design stages, which is essential for minimizing environmental footprint and ensuring compliance with EU directives.
Research limitations: The research does not explicitly address potential limitations; however, the accuracy of the carbon footprint estimation may depend on the quality of data and assumptions used in the BIM and LCA models.
Practical implications: This research could influence public and corporate policy decisions by highlighting the importance of sustainable building practices. By reducing environmental impact, it contributes to improving the quality of life and aligns with broader societal benefits under EU sustainability directives.
Originality/value: The study is original in its integration of BIM and LCA for a Hyperloop station, promoting environmentally friendly decision-making throughout the project life cycle. It not only adheres to stringent environmental standards but also sets benchmarks for future sustainable infrastructure projects. This approach aids in minimizing environmental footprint and ensuring compliance with EU directives through dynamic, real-time feedback during the design stages.
Keywords: Hyperloop station, carbon footprint management, BIM, LCA, global warming potential (GWP).
Category of the paper: Research paper.

1. Introduction

The development of the Hyperloop, a revolutionary transportation system that leverages low-pressure tubes and electromagnetic propulsion (Prymon-Ryś et al., 2023), has emerged as a significant innovation, especially in the context of the 2022 energy crises. This innovation underscores the urgent need for economically viable and environmentally sustainable transportation solutions (Bhuiya et al., 2022). As such, a thorough LCA of the Hyperloop is essential to substantiate its sustainability claims and to ensure that its implementation aligns with global environmental goals.

This study employs LCA to evaluate the environmental impacts associated with building materials, transport logistics, and operational energy use, all integrated with BIM to create a dynamic framework for assessing environmental impact. This approach is in line with the European Union's Green Deal directive and adheres to standards such as EN-15804+A1 (Hollberg et al., 2020). The research reveals significant variations in GWP of different materials; for example, Aerated Reinforced Concrete and Precast Concrete contribute substantially to GWP, while Natural Stone exhibits lower impacts, and Glued Laminated Timber demonstrates carbon sequestration capabilities (Dias et al., 2020).

Operational energy, particularly from heating and lighting, is identified as a major contributor to GWP, posing challenges in meeting the EU's 2024 standards. The study also highlights the limitations inherent in relying on specific LCA databases, which may not fully reflect diverse geographic and ecological conditions (Zhang, Cai, Braun, 2022). Consequently, future research should expand to include a broader range of databases and environmental indicators. Implementing the findings of this study can significantly reduce carbon emissions in the construction and operation of Hyperloop stations. It emphasizes the necessity of sustainable construction practices and technologies, such as the use of renewable energy sources and low-carbon materials.

The integration of BIM and LCA is shown to enhance the environmental performance of construction projects, despite current software limitations (Santos et al., 2019)., Based on the LCA of the Hyperloop station conducted in accordance with the EN-15804+A1 standard, the data was implemented into the Archicad program to evaluate the environmental impact from material production to disposal or recycling (Najjar et al., 2019; European Committee for Standardization, 2019). While the Hyperloop suggests lower operational emissions compared to traditional transport systems (Shinde et al., 2019), these benefits may be offset by the emissions from all associated infrastructure.

Therefore, this study further examines the integration of BIM and LCA in the design of a Hyperloop Station to comply with the EU's stringent sustainability directives (Patz, 2022). Using Archicad, and data from the Ökobaudat (Theißen et al., 2020) and Defra (Tribby, 2023) databases, the study assesses environmental impacts across all lifecycle stages, crucial for

aligning infrastructure projects with sustainability goals and improving decision-making through dynamic feedback during design. Additionally, the study investigates innovative construction materials and methods to significantly reduce the carbon footprint of large-scale infrastructure projects. Through a literature review, it evaluates materials that fulfill functional requirements while minimizing environmental effects, such as alkali-activated concrete, fiber - reinforced concrete, geopolymer concrete (Chottemada, Kar, Maeijer, 2023, Amran et al., 2019; Nematollahi) and timber-concrete composite systems, which are expected to decrease ecosystem impacts. Furthermore, the study examines the operational energy of traditional buildings, focusing on heating and ventilation, to ensure compliance with the EU's nearly zero-energy building standards and considers the operational energy's impact on overall GWP, particularly in regions with high-carbon intensity energy mixes.

2. Literature review

Global climate efforts have progressed through UNFCCC COPs since 1995, with COP 26 operationalizing the Paris Agreement's 1.5°C target, driving stricter CO2 reduction in the building sector. The EU has led with directives to boost renewable energy in buildings and decarbonize by 2050 (de Oliveira et al., 2023). Influenced by Danish initiatives, the European Union implemented stringent LCA standards for sustainable construction, as emphasized by the 2021 EU Directive 2010/31/EU. This directive mandates nearly zero-energy building standards to minimize operational energy and promote sustainable construction methods (Arrigoni et al., 2020). This directive is supported by Green Public Procurement initiatives that set LCA benchmarks for construction materials and whole buildings throughout Europe (Scherz et al., 2022).

In 2019, building material production contributed 28.2 million metric tons of CO2, with concrete and steel responsible for 90% of these emissions. Timber, though only 10% of emissions, offers a significant reduction potential due to its lower carbon intensity (120 kg-CO2/m²) compared to steel and concrete. Achieving net-zero embodied carbon by 2050 is unlikely under current practices, even with low-carbon alternatives. However, increasing timber use in construction could reduce emissions by 35%, with additional reductions possible through design optimization and longer building lifespans. Increased timber demand can also enhance forest carbon uptake by rejuvenating aging forests, potentially increasing carbon sequestration by 60% by 2050 (Watari, Yamashita, Cabrera Serrenho, 2024).

Emphasizing holistic sustainability, the focus in Europe has expanded to include the entire lifecycle of building materials, from pre-use to maintenance. For instance, prefabricated timber houses in Germany have been show to exhibit lower GWP and reduced acidification impacts, contributing to sustainability from production through disposal (Ruocco, Melella, Sabatano,

2023). As shown in Figure 1, the IEA EBC Annex 72 project examines the environmental impact of a building by harmonizing Life Cycle Assessment (LCA) approaches globally. There a reference building was used to explore national discrepancies in methodology.

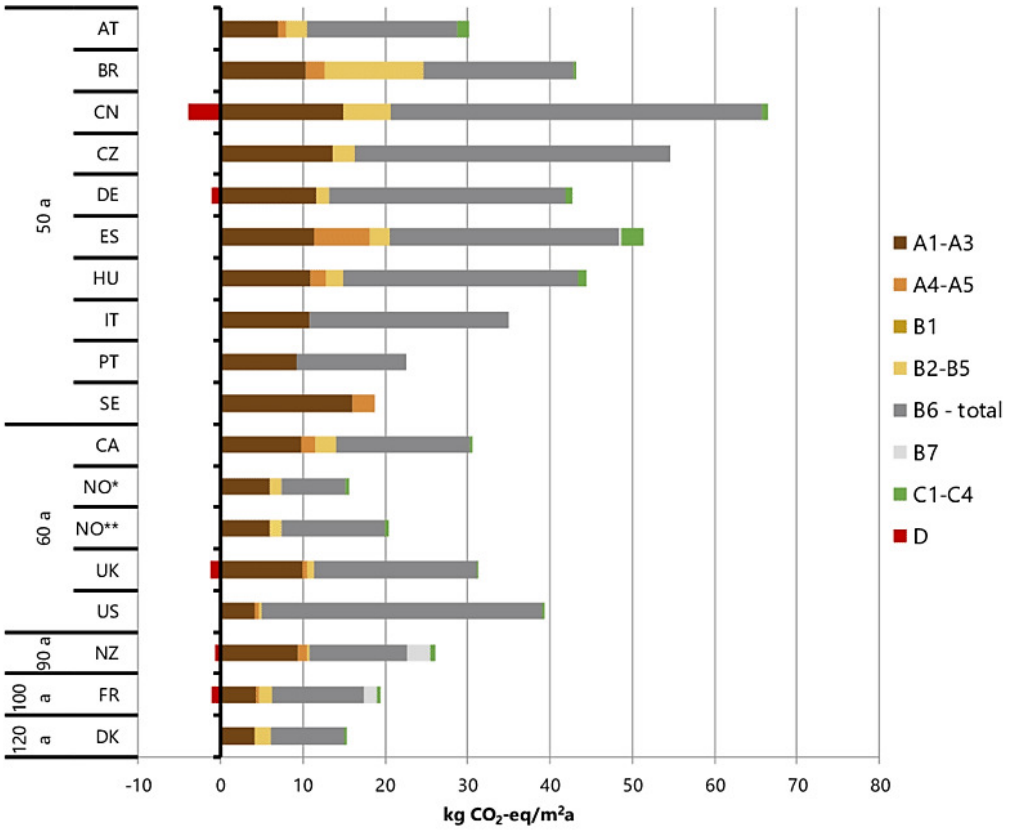


Figure 1. GHG emissions from the reference building "TJ-CSY-11," measured in kg CO2-eq per m² per year, were evaluated using the national/regional methodologies of the listed countries.

Source: (Frischknecht et al., 2020).

Figure 1 illustrates the CO2-equivalent emissions per square meter per year (kg CO2-eq/m²*a) across various countries, highlighting the environmental impact at different stages of a building's life cycle. The emissions for each country are broken down into specific modules, including material production, transportation, construction, use, and end-of-life disposal. The life cycle begins with modules A1-A3, which cover the production of building materials. This is followed by modules A4-A5, focusing on the transportation of materials and the construction process. Module B1 represents the use phase that does not involve energy consumption, while modules B2-B5 include activities such as maintenance, repair, replacement, and refurbishment. The total energy consumption during the use modules is captured under B6, while B7 accounts for water consumption during this phase. Modules C1-C4 refer to the end-of-life stage, encompassing deconstruction and disposal of materials. Lastly, modul D represents potential benefits beyond the system boundary, such as recycling or energy recovery.

Figure 1 also highlights the differences in emissions associated with each stage, which can be influenced by national practices, building material choices, and energy mixes. For example, Denmark exhibits the highest overall emissions, primarily driven by energy consumption during the building's use phase. In contrast, countries like Austria and Brazil demonstrate a more balanced distribution of emissions across all life cycle stages. Notably, Norway and Sweden show lower emissions during the use phase, likely due to more energy-efficient buildings or a cleaner national energy mix (Obrecht et al., 2019).

The variation in greenhouse gas (GHG) emissions, such as those seen in Austria's "be2226" office building, which range from 10 to 71 kg CO2-eq/m²*a, highlights the influence of national LCA databases that reflect unique production conditions and energy mixes (Frischknecht et al., 2020). These differences, exemplified by differences in GHG emissions per kg of building material and national electricity mix intensities, underscore the need for standardized LCA methodologies to ensure comparability across different settings.

Overall, innovative construction materials and methodologies are enhancing the construction industry's ability to build structures such as Hyperloop stations, with significantly reduced carbon footprints. While the construction industry heavily contributes to carbon emissions through material production and transportation, the use of alternative materials and designs can mitigate up to 90% of these emissions during critical phases (Sizirici et al., 2021). Life cycle assessment, especially of concrete, is essential for understanding and reducing greenhouse gas emissions across different construction phases (Arrigoni et al., 2020).

Denmark has set a progressive benchmark by aiming to limit the GWP of new buildings to 7.5 kg CO2-eq/m²*a by 2029, a goal that could influence broader EU policies. BIM with LCA has proven to optimize environmental impact assessments in construction projects, enhancing data accuracy during the design phase. This integration is further developed by tools that assess the global warming potential of buildings, emphasizing the need for detailed environmental monitoring (Hollberg et al., 2020). For instance, the University of Seville, in collaboration with Datacomp, utilized the Advanced Reports plugin for BIMvision in the Urban BIM project to evaluate environmental efficiency of buildings. Indicators such as carbon footprint and embodied energy were used, illustrating how digital models can generate comprehensive environmental reports (Carvalho et al., 2021).

Literature review reavealed that elevators and escalators play a significant role in the overall Total GWP. Therefore it is crucial to include the carbon footprint of these elements from production to disposal. A study highlighted that the major contributors to carbon dioxide emissions were the manufacturing stage (41.31%), followed by operation and maintenance (57.32%), with installation and demolition contributing minimally (0.92% and 0.44%, respectively). On average, the annual carbon dioxide emissions were estimated at about 27.18 kgCO2 per ton·kilometer. The study emphasized that the primary factors influencing these emissions included electricity consumption, the use of various metals like low-alloy steel and chrome steel, and components like printed circuit boards (Ang et al., 2022).

3. Materials and methods

3.1. Life Cycle Analysis

The LCA was applied in this study to evaluate the Hyperloop Station, assessing environmental impacts in accordance with EN-15804+A1 standards (Vladimirov, Bica, 2019). This assessment covers all phases, from raw material acquisition to operation, including maintenance and energy use, thereby providing a comprehensive analysis of environmental impacts. The process concludes with the end-of-life phase, encompassing demolition and material recovery, utilizing Module D of LCA to evaluate net impacts (Mesa, Fúquene-Retamoso, Maury-Ramírez, 2021).

Moreover, integrating technologies such as 3D architectural software into the LCA enhances the accuracy of environmental evaluations, linking decisions during maintenance to the overall sustainability and underscoring the importance of each phase in reducing both environmental and economic impacts (Vishnu, Padgett, 2020). The formula for calculating the carbon footprint (CF) of construction projects through LCA is expressed as follows:

$$CF = \sum_{i=1}^{n} (EF_i \times AD_i) \tag{1}$$

where:

CF is the total carbon footprint,

EF_i is represents the emission factor of the i-th activity,

AD_i is the activity data for the i-th activity,

n is the number od the activities considered.

Calculating the carbon footprint of construction projects through LCA, quantifies total greenhouse gas emissions as CO2 equivalents, starting with defining scope and collecting data on material and energy use (Figure 2) (Waldman et al., 2020).

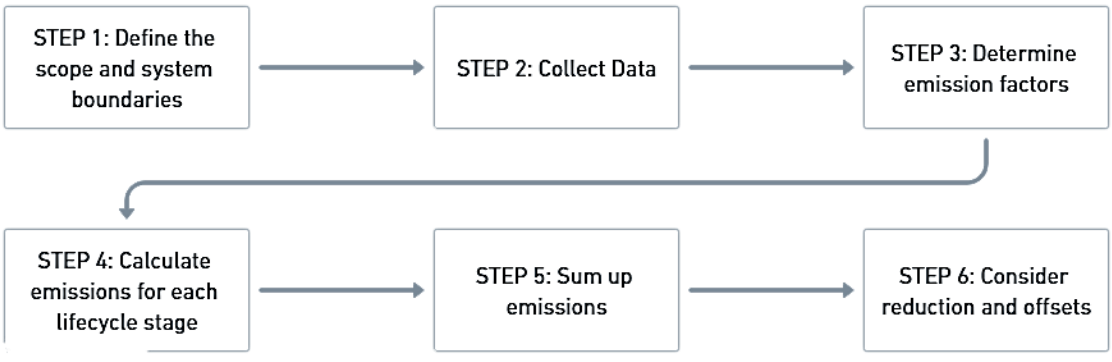


Figure 2. The stages of calculating the carbon footprint.

Source: own elaboration.

This method tracks emissions from material extraction to demolition, with a focus on detailed assessments of processing and operational energy. In Figure 2, the stages of calculating the carbon footprint are illustrated, providing a detailed overview of the process from data collection to final emission calculations, further highlighting the importance of each stage in the overall reduction strategy. Strategies for emission reduction include adopting renewable energy sources and selecting low-carbon materials, with the feasibility of carbon offset mechanisms providing a comprehensive approach to mitigation. Continuous improvements in LCA methodologies, through annual evaluations and updates, enhance data precision and support effective mitigation strategies (Shekhorkina et al., 2020; Yue et al., 2022).

3.2. Tools for calculating

The design of the Hyperloop station emphasizes scalability, accessibility, and environmental sustainability, incorporating comprehensive soil and utility assessments. Drawing on traditional railway architecture, the Station features clear pathways and signage to enhance passenger flow and accessibility. Its tiered spatial layout includes accessible entrances and ample parking at ground level, facilitating efficient circulation and integrating safety measures for high traffic volumes. Additionally, an adjacent hotel offers synchronized services with the Hyperloop, enhancing traveler convenience through sustainable practices. The Station's underground levels focus on passenger safety and experience. The first underground level houses amenities and security infrastructure, while deeper levels ensure smooth transit, and the lowest level features advanced safety systems like vacuum chamber gates (Stryhunivska et al., 2020). Emergency management is well-integrated, ensuring efficient evacuation and maintaining safety in crises, with automation technologies such as biometrics boosting operational safety (Stryhunivska et al., 2020; Haack, Schreyer, 2006). This approach demonstrates a strong commitment to maintaining high safety standards and operational efficiency throughout the Hyperloop network.

BIM was implemented in this study due to its high level of interoperability, which enabled the integration of various disciplines involved in the project and all information generated throughout the building's life cycle into a single virtual model of the Hyperloop station (Sampaio, Gomes, Farinha, 2021). This station model was developed using ArchiCAD, a software that supports Building Information Modeling (BIM) technology. By integrating Life Cycle Assessment (LCA) within the BIM environment via ArchiCAD, the study achieved a more consistent and accurate evaluation process.

The workflow for the model analysis was divided into three main stages. First, the models were created using ArchiCAD in the "Plan" data format (PLN). The second stage focused on the LCA itself, utilizing a workflow where LCA was conducted using the DesignLCA plug-in within the ArchiCAD environment, focusing on accurately deriving mass balances from the model. A critical aspect of this process was the use of high-quality environmental data from the

Ökobaudat and Defra databases. These databases were integrated into the DesignLCA tool to provide precise data on CO2 emissions related to material quantities used in the project.

Ökobaudat and Defra provided comprehensive and reliable data essential for evaluating the environmental impacts of building materials. Their integration into the LCA ensured accurate and current CO2 emission data, aligning the study with international sustainability standards like Germany's BNB and DGNB (Theißen et al., 2020). This approach enabled precise assessment of the Hyperloop station's materials, emphasizing durability and supporting strategies to minimize environmental impacts and maintenance needs.

The final stage involved evaluating the results. The outputs from DesignLCA underwent a manual error analysis. Any identified issues or anomalies were documented and resolved, either by rerunning the analysis after troubleshooting or by manually incorporating any missing data using well-established methodologies. The refined results were then used to formulate both general and specific conclusions, which informed the final recommendations. The optimized computational workflow enabled by ArchiCAD ensures that LCA calculations were seamlessly integrated, leading to reliable outcomes. This approach not only enhanced the accuracy of environmental impact assessments but also improved the project's sustainability by enabling a detailed analysis of materials and processes directly within the BIM model.

The operational energy use analysis for the Hyperloop Station was conducted using ArchiCAD, focusing on precise thermal modeling of the building. Key parameters such as wall thickness, thermal conductivity, and window area were thoroughly examined to optimize energy consumption for heating and cooling. ArchiCAD facilitated the simulation of heat transfer, which is crucial for understanding energy flow within the building and adjusting systems to match real operational conditions. Integrated environmental data within the model ensured the building's compliance with sustainable construction standards. This allowed for the design of heating and ventilation systems that minimize CO2 emissions while maintaining user comfort. Additionally, the application of advanced technologies, such as triple-glazed windows and photovoltaic panels, was carefully evaluated for their effectiveness in reducing energy consumption and their impact on the overall carbon emissions balance during the station's operation.

Because module A4, the transportation of materials to the construction site, is customized for each specific location, it was necessary to calculate it independently. This calculation utilized a thorough literature review on the linear relationship between fuel consumption and cargo weight during long-distance transportation. Extensive empirical analysis was conducted using Mercedes-Benz Actros-1840 truck tractors to establish this relationship. The correlation coefficient rXY was used to identify the connection between two key variables: the mass of the transported cargo in tons (X) and the fuel consumption per 100 km (Y) in intercity transport per one truck. This coefficient, rXY, helps determine the statistical relationship between these variables. The regression equation derived from this analysis was:

$$Y = 21{,}331 + 0{,}3906X \tag{2}$$

where:

Y is total fuel consumption per one truck per 100 km of intercity transport,

X is mass of cargo that one truck is carrying.

It demonstrates a linear relationship, with the confidence test affirming the statistical significance of the correlation coefficient (Khabibullozoda, Goriaev, 2021). The assessment of additional space needed for the packaging of building materials is a crucial component in counting emissions. This study employs a model to estimate the total packaging volume, calculated based on study showcasing the amount of packaging waste generated during construction activities. Predominantly the types of packaging materials which were identified were cardboard, plastic, and wood. These are often found in mixed waste containers upon the completion of construction (Narcis et al., 2019). Them the proportionate increase in the volume of packaging associated with the use of prefabricated materials, as well as the enhanced packaging of traditional materials, is quantified.

To accurately estimate the required additional space for these materials, a ratio is derived from the total construction area to the volume of packaging waste. Specifically, for the Hyperloop Station with a surface area of 29,352.02 m², and a comparison construction work area (CW1) covering 15,065.51 m², the total waste volume from CW1 was 2534 m³ (Sáez et al., 2019).

1. Calculate total mass of cargo:

$$M = \left(\frac{V_{CW1}}{A_{CW1}} \times A_{HS}\right) \times \sum_{i=1}^{n} (\rho_i \times q_i) \tag{3}$$

2. Determine number of truck trips:

$$N = \frac{M}{W_{avg}} \tag{4}$$

3. Fuel consumption calculation:

$$Y = \left(21.331 + 0.3906 \times W_{avg}\right) \times N \tag{5}$$

where:

V_{CWI} is Total waste volume from CW1.

A_{CWI} is Area of CW1.

A_{HS} is Area of the Hyperloop station.

ρ_I is Proportion of each material type in the total volume of waste.

M is Total mass of transported cargo in tons.

N is Number of truck trips required to transport all materials.

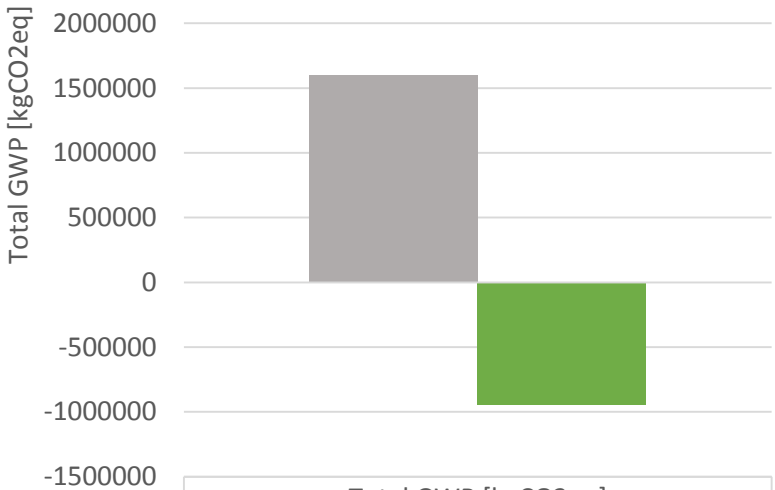
Y is Total fuel consumption for all trips in liters per 100 km.

The estimated volume of waste for the Hyperloop Station is calculated to be 4937 m³. This estimate serves as the basis for determining the proportion of packaging materials, which is crucial for calculating the final mass of the packaging within the total waste volume. According to the literature, the average density of materials such as wood in pallets is 496.12 kg/m³ (Schweinle et al., 2020), plastic (based on an average of 176 types) is 1306.75 kg/m³, and cardboard is 970 kg/m³ (Rudenko, 2019).

The next step in the calculations involves determining the total mass of cargo that needs to be transported. This mass is derived by scaling the waste volume from a comparison construction work area (CW1) to the area of the Hyperloop station and then multiplying it by the sum of the proportions of each material type within the total waste. After establishing the total mass, the number of truck trips required for transportation is calculated by dividing the total mass by the average weight capacity of a truck. Finally, the fuel consumption for all trips is calculated using a formula that accounts for both a base fuel consumption value and an additional factor related to the truck's average weight capacity, multiplied by the number of trips. This comprehensive approach provides an accurate estimation of the resources required for transportation, including the total mass, logistics, and fuel consumption.

4. Results

The study demonstrated that the Hyperloop Station requires significant quantities of materials, leading to substantial environmental impacts. It was found that materials such as Aerated Reinforced Concrete and Precast Concrete have high Global Warming Potential (GWP), contributing significantly to the station's overall carbon footprint. In contrast, materials like Natural Stone and Expanded Clay hollow blocks were shown to have lower GWPs. Additionally, the use of Concrete ECOPact was highlighted for its reduced GWP, indicating progress in sustainable building practices (Zīmele et al., 2019).



	Total GWP [kgCO2eq]
Precast concrete slab	1600430
Glued laminated timber	-945862

Figure 3. Potential GWP Offset using glued laminated timber.

Source: own elaboration.

Moreover, Glued Laminated Timber demonstrates a potential for carbon sequestration (Figure 3), drastically reducing the industry's overall carbon footprint and driving global demand for sustainable timber (Balboni, 2022).

Figure 4. Visualization of the total impact on GWP of the most polluting segments of Hyperloop Station.

Source: own elaboration.

Materials like Aerated Reinforced Concrete provide structural solutions with lower environmental impact, while Natural Stone and Expanded Clay blocks contribute both aesthetic and functional benefits with minimal ecological footprints (Figure 4). The use of advanced materials like Concrete ECOPact exemplifies significant strides in reducing ecological impacts while enhancing building performance.

Based on the methodology outlined in the previous section, the estimated volume of waste for the Hyperloop Station was calculated to be 4937 m³**.** This estimation was derived using the ratio of total construction area to the volume of packaging waste, as detailed in the Materials and methods section. Furthermore, the transportation logistics of these materials are analyzed based on data from 237 truck courses, which revealed an average cargo weight of 11.61 tonnes. By dividing the total mass of building materials, including their safety packaging, by this average cargo weight, the number of truck excursions required to transport all materials to the construction site is calculated. These calculations are then integrated into a linear regression model. The entire regression model is multiplied by the amount of truck trips, while parameter X equals the average cargo weight. It was presumed that materials would be transported from an average distance of 100 km from the construction site. However, it is important to note that this distance could substantially vary due to the diverse locations of warehouses and manufacturing facilities for building materials.

Operational energy consumption greatly impacts the global warming potential (GWP) of buildings, pointing to the necessity of holistic environmental assessments that consider all lifecycle phases to avoid transferring burdens elsewhere (Kim et al., 2022). Poland's high carbon intensity at 1.0595 kgCO2-eq per kWh is mainly due to its reliance on coal and limited renewable energy sources, which significantly affect its emission rates (Balaras et al., 2023). In the case of the Hyperloop Station, operational energy, especially from heating, hot water and ventilation systems are major contributors to its total GWP, highlighting the need for energy-efficient solutions in design and operation (Figure 5).

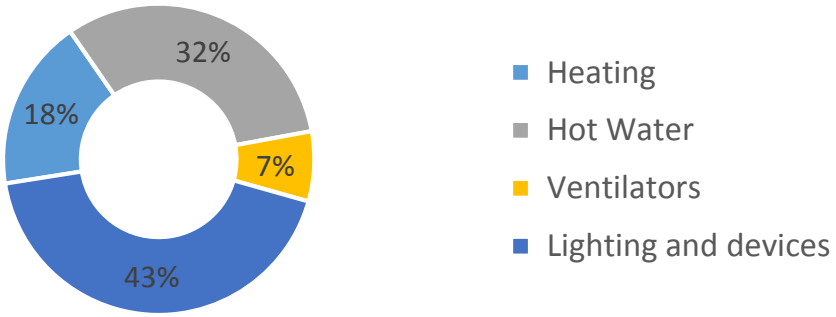


Figure 5. Utilization of Operational Energy at the Hyperloop Station.
Source: own elaboration.

A study on the Hyperloop Station's carbon footprint showed that elevators and escalators, based on a dataset of 400,000 annual rides, emit 393,457 kgCO2eq. This figure combines with the station's other operational energies for a total of 916,221 kgCO2eq. Integrating renewable energy and efficient systems into such transportation hubs could drastically lower these emissions.

The study analyzes Total GWP in respect to Cradle to Grave (A1:D) (Bhatt, Bradford, Abbassi, 2019) method for various building lifecycle stages, including Product stage (A1:A3), use phase (B1:B5), end of life (C1:C4) and benefits (D), construction process (A4, A5), operational energy use (B6), normalized per area per year to establish an LCA threshold (Figure 6).

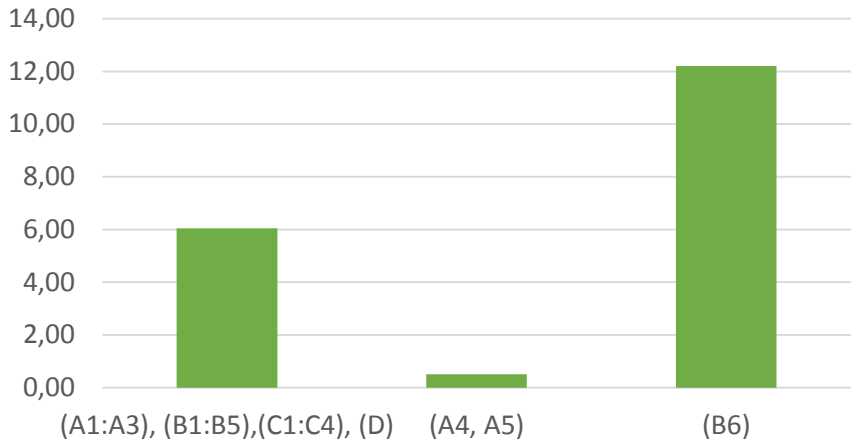


Figure 6. Total emissions during LCA phases.

Source: own elaboration.

The total GWP threshold is identified at 18.77 kg CO2-eq/m²*a, with operational energy use being the most impactful at 12.21 kg CO2-eq/m²*a, underscoring its significance during the building's operational phase. Other components collectively add 6.05 kg CO2-eq/m²*a and transportation and construction processes contribute minimally with 0.54 kg CO2-eq/m²*a (Figure 7).

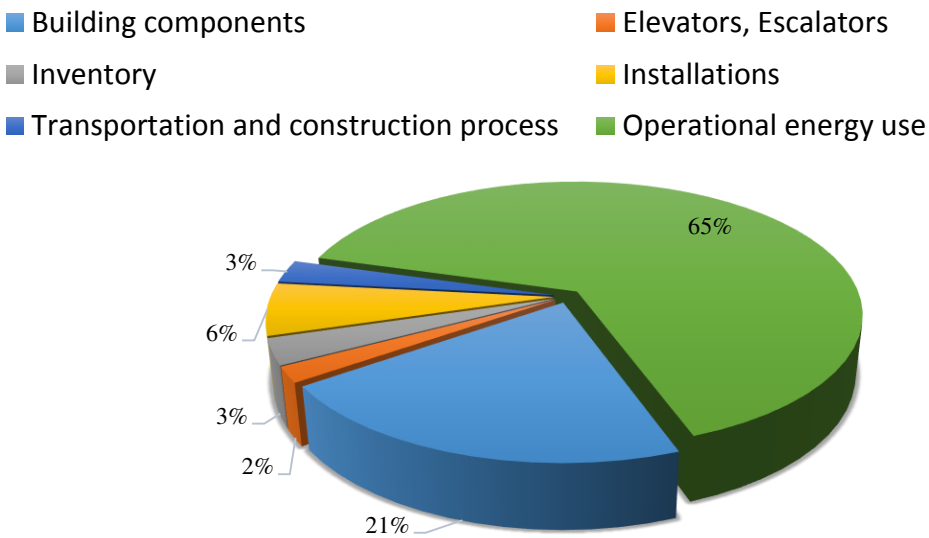


Figure 7. Total emissions from individual sources.

Source: own elaboration.

In Europe, LCA requirements for buildings are defined by guidelines and standards focused on enhancing construction sustainability. The European construction product directive mandates the quantification of environmental performance, integral to European Standards or Technical Assessments, and emphasizes Environmental Product Declarations for building certification across EU countries (Rosario et al., 2021). Additionally, the European Union guidelines mandate that from 2021 onward, new buildings must adhere to nearly zero-energy standards, thus placing a higher relative importance on the impacts of construction, disposal, and embodied emissions throughout the entire life cycle of a building (Weissenberger et al., 2014). This shift highlights the need for LCA to not only focus on operational energy but also to encompass a broader environmental assessment, as shown in Figure 8.

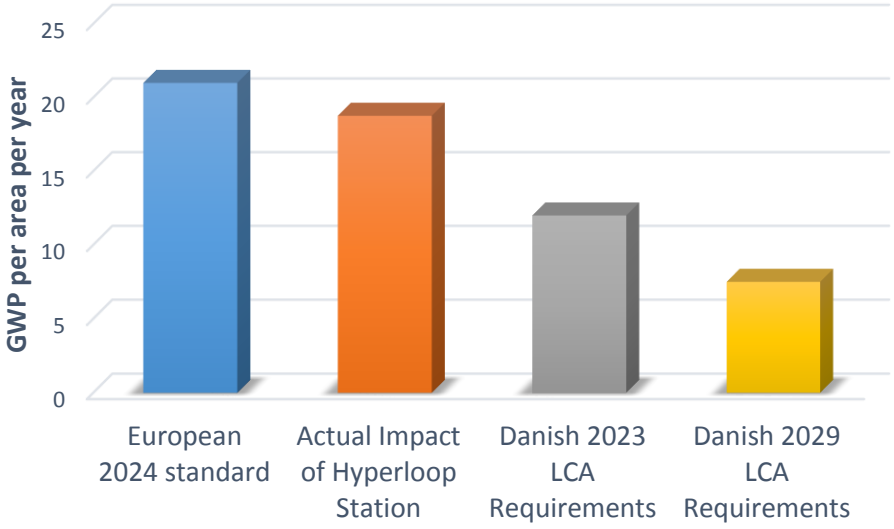


Figure 8. Comparison of the LCA threshold of the Hyperloop Station to various requirements. Source: own elaboration.

Notably, the Hyperloop Station, with its GWP of 18.77 kg CO2-eq/m²*a, starkly exceeds Danish requirements and barely fits below EU 2024 standard (Figure 8). This underscores significant challenges in aligning cutting-edge infrastructure projects with national environmental targets. This highlights the urgent need for improved construction practices and technologies that can meet stringent LCA criteria without compromising the functional and structural integrity of innovative transport solutions.

5. Discussion

Integrating BIM with LCA from the design phase is crucial for aligning projects like the Hyperloop Station with EU sustainability directives, facilitating real-time feedback for environmentally friendly choices and early hotspot identification. This approach, adhering to

standards like EN-15804+A1, promotes greener alternatives throughout the project lifecycle, yet the study reveals a GWP of 18.77 kg CO2-eq/m²*a for the Hyperloop Station. This figure underscores the significant challenges in meeting the EU's stringent CO2 emission standard of 21 kg CO2-eq/m²*a by 2024, particularly in light of Denmark's even more ambitious 2029 target of 7.5 kg CO2-eq/m²*a.

The unexpectedly high GWP, even with sustainable materials, necessitates re-evaluating construction material choices, as Aerated Reinforced Concrete still contributes significantly to emissions despite its eco-friendly marketing. This finding highlights the need to explore alternatives like alkali-activated and glass fiber-reinforced concrete, though their absence in environmental databases like Ökobaudat reveals a critical assessment gap. Materials such as Glued Laminated Timber, with negative GWP due to carbon sequestration, are emerging as essential in sustainable construction, potentially reducing carbon footprint through timber-concrete composite systems and plant fiber blocks. Operational energy consumption remains a significant factor in a building's environmental impact, emphasizing the need for integrated life cycle assessments balancing both operational and embodied energy to optimize sustainability.

The study of Hyperloop Stations reveals limitations due to potential inaccuracies in reflecting diverse geographic and ecological conditions. The assumed average material transport distance of 100 km, which can vary widely, impacts the accuracy of environmental assessments. Additionally, the focus on structural elements in the digital twin model in Archicad overlooks other contributors to the carbon footprint, such as electronics and decor. Future research should include diverse LCA databases and broader geographic assessments to enhance the validity and applicability of the findings.

Moving forward, exploring alternative, sustainable materials and integrating a broader range of environmental indicators will be crucial for enhancing the environmental performance of infrastructure projects like the Hyperloop Station. Expanding LCA databases to include regional variations and conducting longitudinal studies on energy use and material durability will improve the accuracy and relevance of sustainability assessments. Additionally, developing and standardizing tools that combine BIM, LCA, and sustainability metrics will enable comprehensive and consistent assessments, facilitating real-time design optimizations.

Collaboration among policymakers, industry stakeholders, and researchers is essential for adopting sustainable practices in construction. Utilizing the BIM-LCA framework in pilot projects with innovative materials will showcase the practical benefits of these approaches, encouraging wider adoption. Effective dissemination of findings through industry platforms will further accelerate the uptake of sustainable technologies. Additionally, integrating natural lighting, efficient waste management, and environmentally friendly materials, alongside certifications like BREEAM and LEED, can enhance sustainability credentials. The incorporation of 4D technology for infrastructure management can further optimize

maintenance and reduce carbon footprints, positioning projects like the Hyperloop Station as leaders in sustainable transit solutions.

6. Conclusion

This study quantifies the environmental impact of Hyperloop Stations through the integration of BIM and LCA, revealing significant differences in GWP among building materials. Notably, materials like Aerated Reinforced Concrete and Precast Concrete were identified as having high Global Warming Potential (GWP), significantly contributing to the station's carbon footprint. In contrast, materials such as Natural Stone and Expanded Clay hollow blocks exhibited lower GWPs, presenting more sustainable alternatives. The use of Concrete ECOPact, which demonstrates reduced GWP, was highlighted as a significant advancement in sustainable building practices. Additionally, Glued Laminated Timber offers carbon-negative benefits through potential carbon sequestration, further reducing the industry's overall carbon footprint.

While building materials were a notable factor in the station's overall environmental impact, the operational energy consumption of the station, particularly for heating, hot water, and ventilation systems, emerged as a major contributor to GWP. This issue is exacerbated by Poland's high carbon intensity, complicating compliance with EU sustainability standards. The Total GWP was calculated at 18.77 kg CO2-eq/m²*a with operational energy being the most significant contributor at 12.21 kg CO2-eq/m²*a. This figure exceeds Danish requirements and barely meets the EU 2024 standards, underscoring the challenges in aligning cutting-edge infrastructure projects with national environmental targets.

The integration of BIM with LCA facilitates real-time environmental decision-making throughout the project lifecycle, ensuring adherence to EU directives and setting a benchmark for sustainable infrastructure projects. The research underscores the necessity of adopting renewable energy sources and energy-efficient designs to achieve meaningful reductions in carbon emissions. Future research should expand LCA databases and environmental indicators to improve assessments across diverse geographic and ecological contexts. Additionally, exploring more sustainable construction materials and recycling techniques can enhance the environmental performance of Hyperloop and similar infrastructure projects, aligning with sustainability goals and reducing the environmental impact of large-scale construction. By addressing the environmental challenges of both construction and operational phases, this study provides practical insights into sustainable construction practices, emphasizing the critical role of integrated technologies in developing eco-friendly infrastructure.

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DETERMINANTS OF ACTIVITY AND THE IMPACT OF EXISTING THREATS ON THE STATE OF THE POLISH HEATING INDUSTRY

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Purpose: The purpose of this article is to identify existing threats to the operations of local district heating companies, as well as to indicate their impact on the condition of the Polish heating industry.
Design/methodology/approach: The stated aim was achieved through the use of a method of desk data analysis (desk research). The study used information from the activity reports of 158 local district heating companies.
Findings: The research conducted made it possible to systematize the current threats and their impact on the operation of the heating in Poland in the era of energy transition. They also showed the ability of managers of local district heating companies to recognize existing risks.
Research limitations/implications: The obtained research results concern the identification of threats by local heating companies in the period before the occurrence of emergency events (pandemic and war in Ukraine). It is advisable to repeat the research after the stabilization of prices on fuel markets.
Originality/value: In a cognitive sense, the results of the study identify the hierarchy of threats to the operations of local district heating companies. They also prove the correctness of management's identification of risks by indicating their impact on the condition of the Polish heating sector.
Keywords: heating industry, conditions of activity, local district heating companies, threats.
Category of the paper: Research paper.

1. Introduction

District heating companies operate in a changing environment, which, especially in recent years, has posed difficult challenges and significant risks to their operations. This is related to the stringent climate and energy policies consistently implemented in the European Union. It implies legal and environmental frameworks, efficiency measures, technological solutions and development trends. The main elements of this policy in the area of district heating are efficient use of energy, development of renewable energy sources (RES) and cogeneration,

reduction of greenhouse gas emissions and implementation of energy-saving technologies in buildings (European Commission, 2016). In continuation of this policy, the EU has adopted:

- in 2019 - European Green Deal action strategy (European Commission, 2019),
- in 2021 - European Climate Law and the "Fit for 55" Package.

Achieving the set climate goals by 2050 requires transitioning the energy sector, including district heating, to low-carbon technologies, reducing fossil fuel consumption in favor of renewable energy sources, and transforming existing district heating systems into efficient systems. It should be noted that these issues are particularly relevant in EU countries where district heating is most developed due to lower external temperatures. Currently, more than 77 million EU citizens receive heat from district heating systems (Euroheat and Power, 2024). The highest percentage of citizens using district heating (above 40%) is found in Denmark, Estonia, Lithuania, Latvia, Poland, Slovakia, Sweden and Finland (Euroheat and Power, 2024). Therefore, the transition of the district heating sector is important in the energy policies of these countries, including in Poland (Ministry of Climate and Environment, 2021). The most advanced solutions as well as studies in this area are conducted in Denmark, Sweden and Finland. They indicate that the directions of development and possible decarbonisation paths of the heating sector require the implementation of modern fourth and fifth generation district heating systems (4GDH and 5GDH). These are low-temperature district heating networks (LTDH) integrated into sustainable energy systems using renewable energy sources and heat storage (Lund et al., 2014; Bloess et al., 2018; Buffa et al., 2019; Kavvadias et al., 2019; Allen et al., 2020; Millar et al., 2021). Advantages of LTDH systems include reduced heat losses in the network (efficiency), reduced greenhouse gas emissions, flexibility to use multiple renewable heat sources (including consumers), increased use of heat storage units, improved power-to-heat ratio in CHP systems, and economic benefits (Olsthoorn et al., 2016; Werner, S., 2017; Mathiesen et al., 2019; Sorknæs et al., 2021).

A significant problem in decarbonising district heating and increasing the share of RES in the heat generation process is the fragmentation of heat markets (OECD/IEA, 2018). Indeed, urban district heating systems are mostly operated by locally based companies that are limited on the demand side by heat demand (population, climatic conditions, etc.). Local district heating companies operating under energy policy solutions at the national level must adopt a risk-sensitive development strategy and a business model focused on necessary technological changes (Lygnerud, Werner, 2018; Lygnerud, 2019; Vilén et al., 2024). Applying this to the Polish district heating sector, which currently still uses more than 66% of coal fuels, the highest in the EU (Euroheat and Power, 2024), the question must be asked:

Do local district heating companies in Poland identify current threats to their operations?

Awareness of existing threats and the ability to exploit opportunities are essential not only at the stage of creating a long-term development strategy, but also in ongoing operational activities. This is a prerequisite for the effective implementation of the transition process of the Polish district heating industry while ensuring the security of heat supply.

2. Operating conditions and directions of change in the Polish heating industry

The complexity of factors currently influencing the development and direction of changes in the heating sector companies is shown in Figure 1 (Wrzalik, 2021).

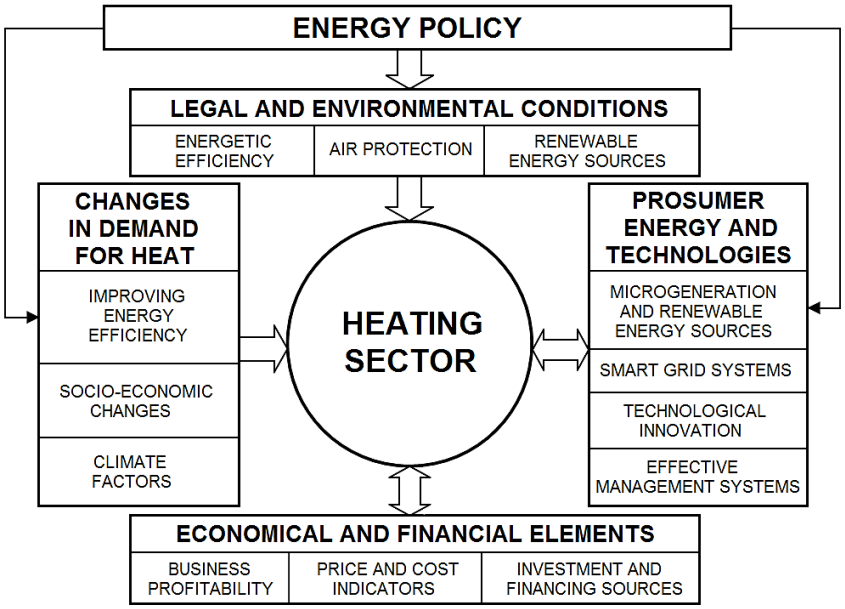


Figure 1. Factors influencing the directions of change in the heating sector.

Source: own study.

Detailed legal solutions and financial instruments resulting from the objectives of the energy policy, as well as current market and local conditions, create a specific framework for the operation of heating companies. Taking this into account with the complexity of impacts on the district heating sector (Figure 1), Table 1 presents the most important factors affecting the operation and development opportunities of district heating companies (Rak, 2018).

Table 1.

Factors affecting the operation and development opportunities of district heating companies

Internal factors	External factors
– economic and financial situation of the company – enterprise development strategy – implementation of technological and organizational innovations – heat generation technology – level of reserves in the heat source – technical condition of heat generation and transmission infrastructure – introduction of IT tools for monitoring and management of the district heating system – management commitment and ability to manage resources – skills, experience and competence of employees operating the heat infrastructure	– macroeconomic conditions – level of fuel prices (impact on costs and profitability of operations) – technical and environmental requirements resulting from legal regulations – programs and funds promoting energy efficiency growth and environmental protection – state financial support for innovative activities – development of energy-efficient construction technologies – development of prosumer energy and microgeneration with RES participation – current weather conditions – reliability of fuel and electricity supply

Source: own study.

Among external factors, technical and environmental requirements, the level of fuel prices, access to external sources of financing (aid funds) and energy-saving technologies (RES, low-energy construction) are of particular importance. Possibilities for the development of district heating companies should be considered in the context of the strategic goals of the state energy policy (EPP2040). They are aimed at, among other: decarbonizing the energy sector, implementing low-carbon technologies, reducing fossil fuel consumption in favor of renewable and alternative energy sources, increasing energy efficiency and reducing carbon emissions. In addition, the size of the city in which it operates (the level of heat demand, the company's potential) matters for a particular enterprise. The diversity of operating conditions and development prospects of district heating companies in Poland depending on the size of the city is illustrated in Table 2.

Table 2.
Determinants of operation and development of district heating companies in different cities

Category	Large cities	Medium cities	Small cities
Strategy	Conservative	Transformational	Adaptive
Demand for heat	Stable	Diversified	Decreases
Heat prices	Below average	Medium	Above average
Finance and technology	Satisfactory	Diversified	Weak
Access to capital	Easy	Diversified	Difficult
Business potential	High	Diversified	Moderate
Environmental requirements	Possible to meet	High challenge	High challenge
Perspective	Good	Diversified	Bad
Fuel	Coal/gas	Coal/gas/biomass	Gas/biomass
Innovative activities	Modernization of generating units and distribution networks taking into account realistic forecasts of heat demand - reducing emissions, heat losses and operating costs		

Source: based on Rączka, Rubczyński, 2017, p. 14; Mazur, 2017, pp. 21-22.

Achieving stable development under the conditions of the energy transition, while ensuring the security of heat supply, improving energy efficiency and environmental indicators, requires the adoption of a long-term strategy by district heating companies. As part of it, it is necessary to comprehensively modernize the existing infrastructure and implement innovative technological solutions (Wojdyga, Chorzelski, 2017; Rak, 2018; Chwieduk et al., 2020; Wrzalik, 2022; Talarek et al., 2023).

3. Threats to operations in the assessment of local heating companies

A detailed analysis of the threats to operations and their relevance was carried out using the desk research method, analyzing data contained in the activity reports for 2019 for the group of 158 (out of 250 companies) local district heating companies listed in Table 3, broken down by city size and type of business - licenses held (Wrzalik, 2022). The threat factors to operations

indicated by local district heating companies, according to the hierarchy of their importance, are shown in Figures 2 and 3.

Table 3.
Number of local district heating companies indicating threats to their operations in 2019 reports

Size of city	Number of local district heating companies indicating threats									
	WPIDO		WPID		W		PIDO		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Small < 20 thousand inhabitants	5	62.5	51	56	1	100	5	45.5	62	55.9
Medium 20-100 thousand inhabitants	11	73.3	60	69	2	100	6	40	79	66.4
Large < 20 thousand inhabitants	8	72.7	7	100	1	100	1	100	17	85
Total	24	70.6	118	63.8	4	100	12	44.4	158	63.2

WPIDO - companies that generate heat and purchase it from other generators, and then transmit and distribute it, WPID - companies that comprehensively serve customers by generating, transmitting and distributing heat to customers, W - heat producers that generate heat and sell to companies engaged in the transmission and distribution of heat to customers, PIDO - distribution companies that transfer and distribute heat purchased from producers.

Source: own research.

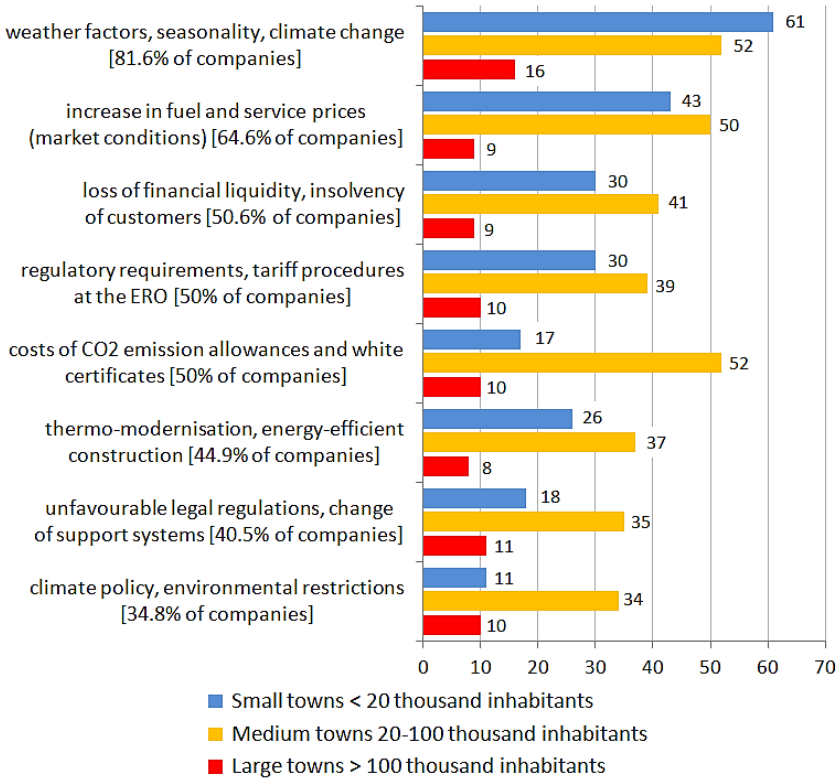


Figure 2. Threat factors to operations indicated by local district heating companies by city size, quantified (n = 158 of 250).

Source: own research.

The companies indicated (81.6%) weather factors (temperature, season length) and climate change as the most important threat, as they have a decisive impact on the volume of heat sales and, as a result, together with prices, on sales revenue.

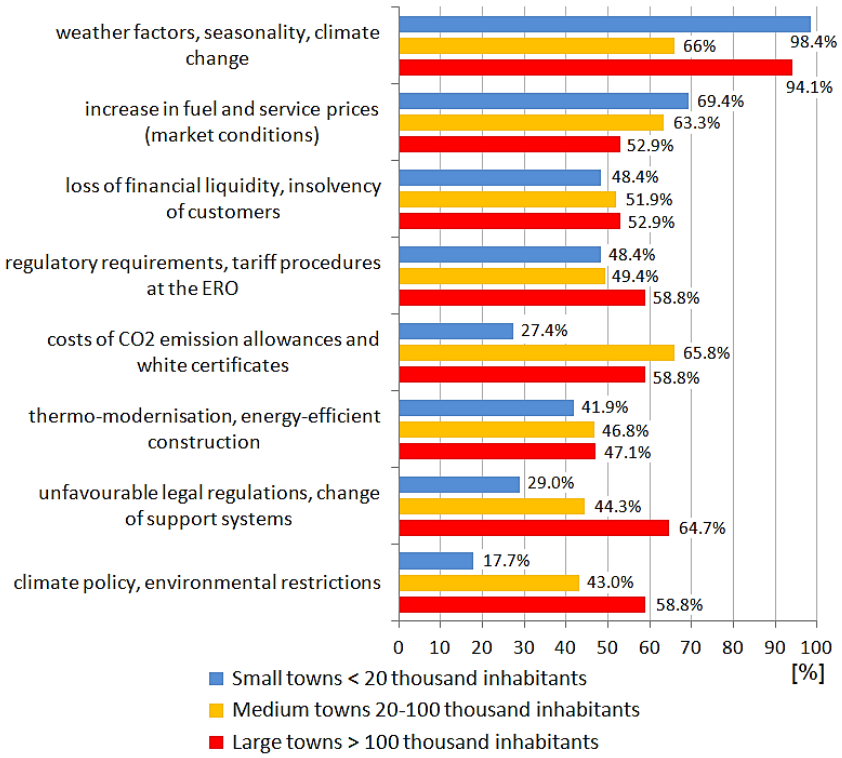


Figure 3. Threat factors to operations indicated by local district heating companies (n = 158 out of 250) by city size in percentage terms (percentage from sample of cities: 17 large, 79 medium and 62 small).

Source: own research.

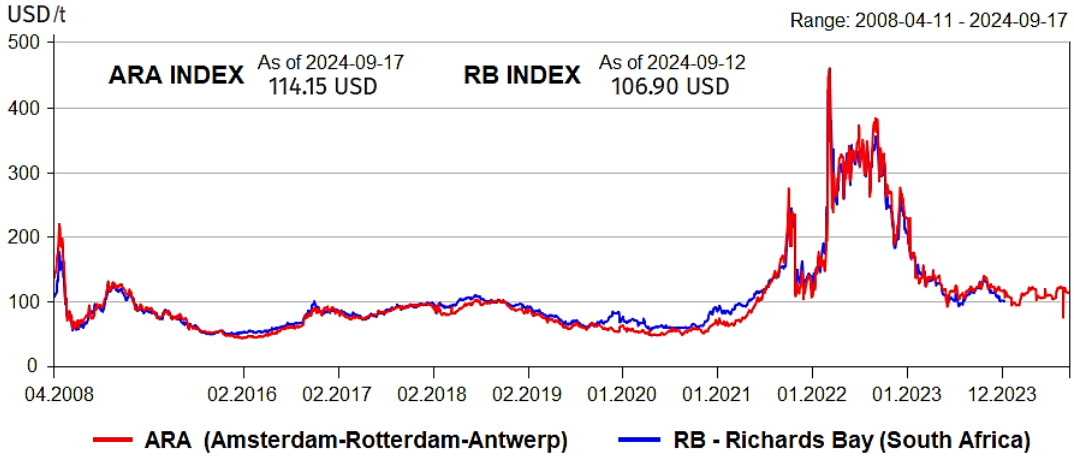


Figure 4. Quotations of coal prices on world markets in historical terms.

Source: based on https://www.wnp.pl/gornictwo/notowania/ceny_wegla/?zakres=5, 18.09.2024.

The second most important threat indicated is the increase in prices of fuels and services (64.6%), with the percentage of indications being highest for companies operating in small towns (69.4%). The accuracy of this assessment is confirmed by the changes in quotations of coal and gas prices on world markets, presented in Figures 4 and 5. Next, heating companies mention the threat of loss of financial liquidity (50.6%) due to the amount of operating costs and insolvency of customers, regulatory requirements, especially tariff procedures at the ERO (50%), and the increase in the cost of purchasing CO_2 emission allowances (50%).

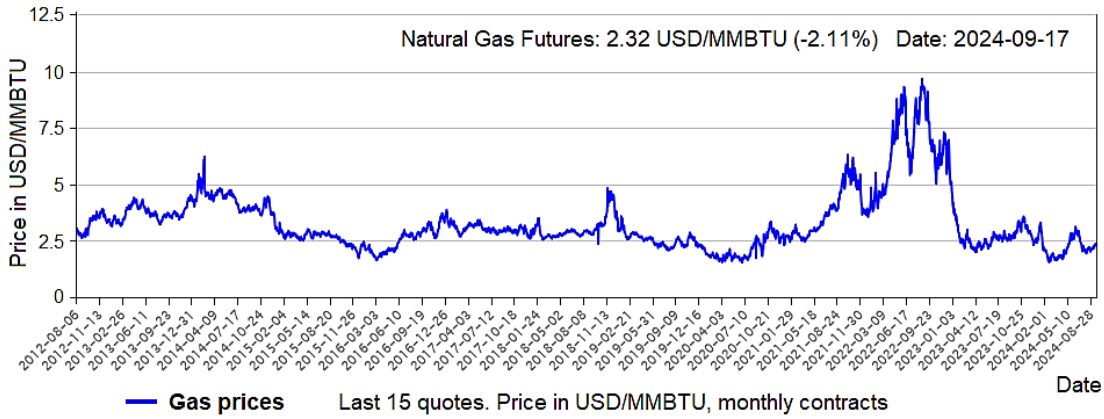


Figure 5. Quotations of gas prices on world markets in historical terms.

Source: based on https://www.wnp.pl/gazownictwo/notowania/ceny_gazu/?zakres=10000, 18.09.2024

The increase in the cost of emission allowances (due to the size of the capacity of sources above 20 MW_t, there is an obligation to participate in the EU ETS) primarily affects heat producers (W and WPID groups) and, due to the size of the heating company, those operating in medium-sized cities (65.8%). The scale of the problem is illustrated by the historical dynamics of CO_2 allowance prices shown in Figure 6, which exceeded EUR 80/tCO2 in December 2021 reaching a peak of more than EUR 105/tCO2 in March 2023.

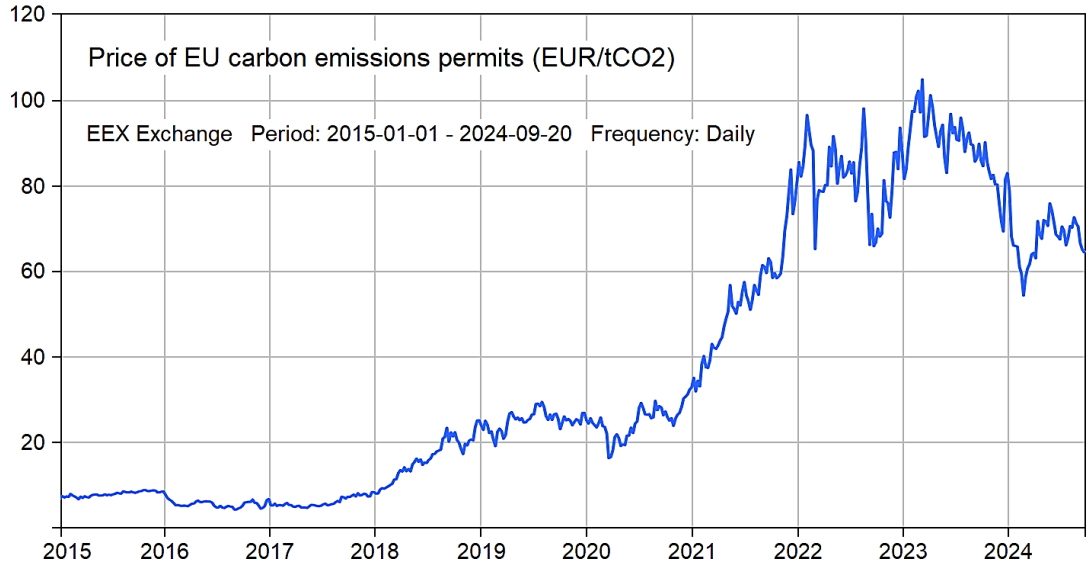


Figure 6. Price dynamics of CO_2 emission allowances in historical terms.

Source: https://tradingeconomics.com/commodity/carbon, 20.09.2024.

A noticeable price increase has been occurring since the beginning of 2018, i.e. since CO_2 allowances became a financial instrument (non-heat operators can purchase them). According to many companies, this is an unjustified increase of a speculative nature. It should be added that heating companies do not have the possibility to purchase allowances directly on the exchange and have to use intermediaries.

4. Impact of major threats on the condition of the Polish district heating sector

The most recent data available to the public on the heating sector in Poland (URE, 2023) indicate that rising operating costs for companies (including fuel, energy and CO2 emission allowance prices) have caused a significant decline in the profitability of the heating industry from 9.68% in 2016 to -22% in 2022 (Figure 7). Other financial indicators of the sector also deteriorated during the period - the level of total debt increased from 0.38 to 0.59 while liquidity decreased from 0.67 to 0.55 (URE, 2023, p. 22).

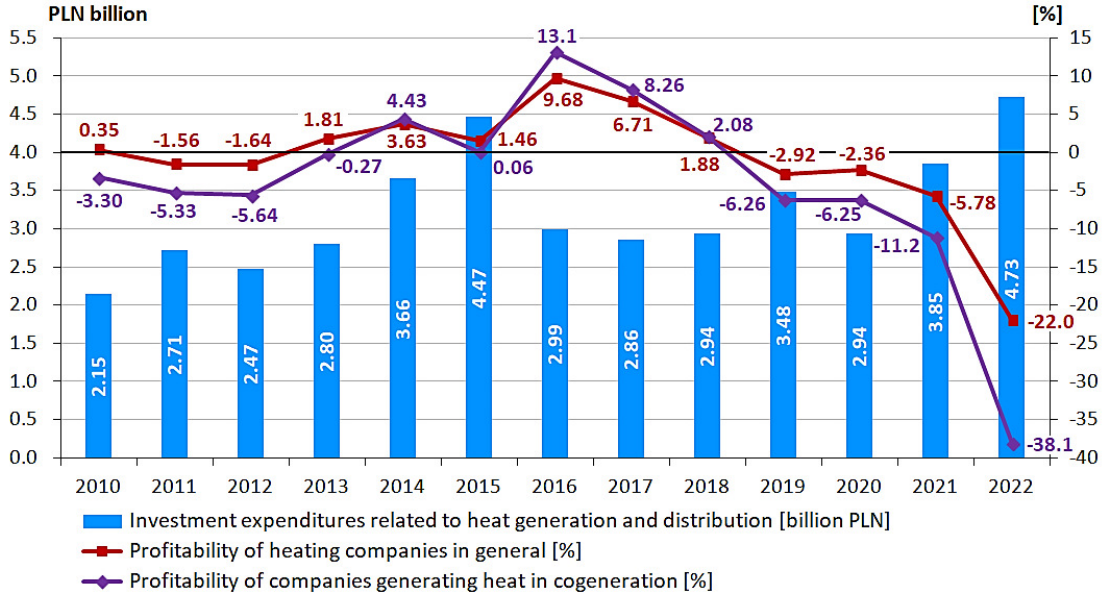


Figure 7. Investment expenditures and profitability of licensed heating companies in 2010-2022. Source: own study based on report URE, Energetyka cieplna w liczbach - 2022, pp. 18, 31.

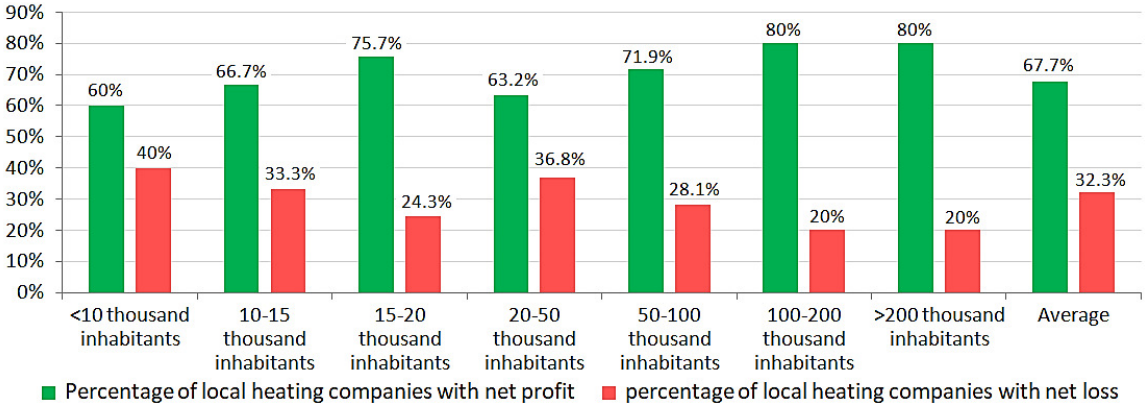


Figure 8. Distribution of financial results for 2019 of 248 local heating companies by city population. Source: own research.

Referring to the situation of individual local district heating companies, the research indicated (Wrzalik, 2022) that almost 1/3 of them made a net loss in 2019 (Figure 8). The relatively slightly better financial performance of district heating companies operating in

small cities (67.9% have a net profit) than in medium-sized cities (65.5%, respectively) is due to the fact that they generally do not have to buy CO_2 allowances.

The deterioration in the profitability of heating companies is influenced by the ERO's statutory regulation of heat prices (protecting the interests of heat consumers). The tariff requirement prevents companies from responding quickly and flexibly to dynamic changes in key cost components (CO_2 emission allowances, fuel and electricity prices), which do not feed through into current heat tariff prices and rates. This is especially true in the 2021-2023 period, when heat sales prices (Table 4) in 2021-2022 grew more slowly than the cost components (fuel and allowance prices, cf. Figures 4-6) while in 2023 the surge in heat prices was accompanied by radical reductions in coal and gas prices, almost to pre-2021 levels.

Table 4.
Average sales prices of heat generated in non-CHP units owned by licensed companies

Year	Average heat sales prices [in PLN/GJ] for generation units that are not CHP units				No. of Information of the President of the Energy Regulatory Office
	fired with coal fuels	fired with gas fuels	fired with heating oil	constituting renewable energy sources (RES)	
2014	42.48	75.66	161.23	46.99	10/2015
2015	41.52	75.24	109.60	46.44	17/2016
2016	40.23	71.47	88.96	44.13	21/2017
2017	39.65	66.87	84.87	43.11	25/2018
2018	41.89	63.55	80.71	44.20	21/2019
2019	46.67	71.94	94.29	44.85	18/2020
2020	50.38	72.43	113.30	46.46	18/2021
2021	51.91	72.02	75.66	46.12	17/2022
2022	74.67	94.91	82.72	65.31	18/2023
2023	119.37	173.96	165.23	103.09	16/2024

Source: based on https://www.ure.gov.pl/pl/cieplo/ceny-wskazniki/7904,Srednie-ceny-sprzedazy-ciepla-wytworzonego-w-nalezacych-do-przedsiebiorstw-posia.html, 25.09.2024.

The increase in the price of CO_2 emission allowances is now significantly affecting the costs of the district heating business and translating directly into the price of heat.

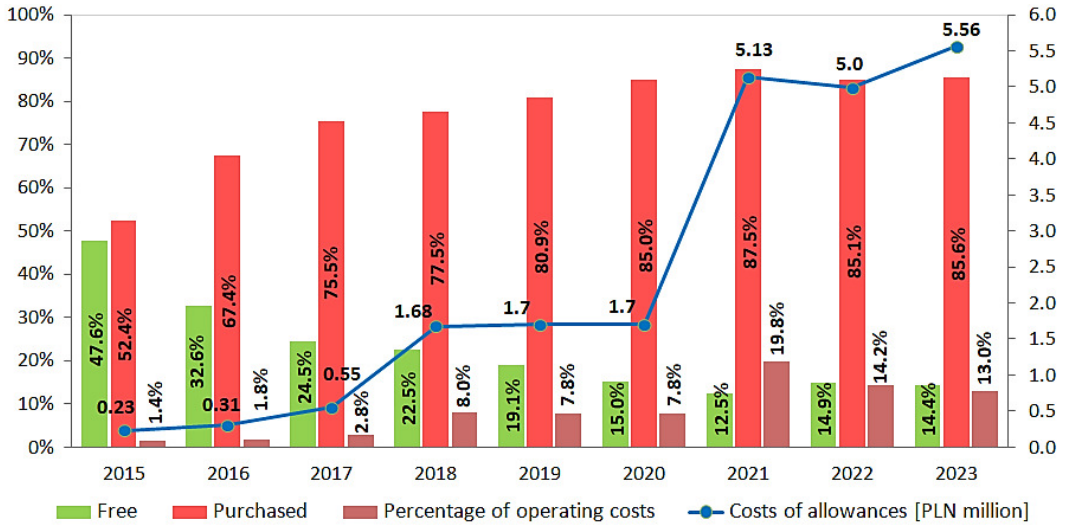
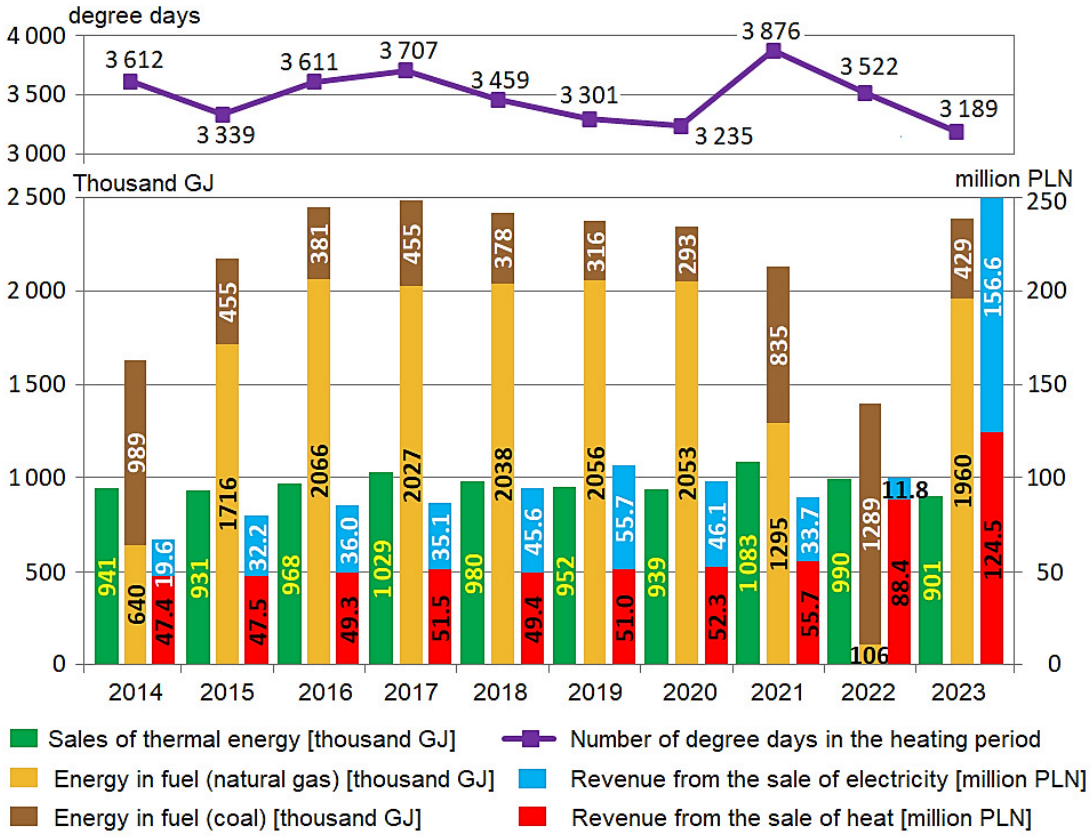


Figure 9. The structure and cost of CO_2 emission allowances in MEC Szczecinek from 2015 to 2023.
Source: own study based on the activity reports of MEC Szczecinek for 2019 and 2023.

Figure 9 shows, using the example of the selected company, the increase in the cost of purchasing emission allowances (a steady decline in free allowances) and the impact on the cost structure of district heating operations over the period 2015-2023 - an increase from 1.4% to almost 20% in 2021. As the price level of emission allowances remains high, as a result, allowance costs are often the second-highest component of thermal power generation costs (after fuel consumption costs).

Another unfavorable phenomenon that became apparent in 2021-2022 was the financial problems of cogeneration companies, for which heat tariffs are approved using the so-called simplified method based on the previous year's prices (ERO, 2023, p. 23). This is illustrated by the case of PEC Siedlce, for which selected data on heat production and sales are shown in Figure 10. The inability to change heat prices in the tariff with a sharp increase in gas prices forced the company to shut down its gas-fired CHP plants for 1.5 years and use only coal-fired sources for that period. The lost revenue from the sale of electricity and cogeneration premium caused the company to incur a net loss of PLN 5.87 million in 2022, but the following year, after gas prices were reduced and the CHP sources were put back into operation, it made a net profit of more than PLN 40.2 million (PEC Siedlce, 2024).



Electricity sales revenue does not include proceeds from cogeneration certificates of origin, cogeneration premium and participation in the Power Market, and heat sales revenue for 2023 does not include compensation for heat.

Figure 10. Selected figures for the production and sale of heat in PEC Siedlce in 2014-2023.

Source: own study based on the activity reports of PEC Siedlce for 2019 and 2023.

Regardless of the current threats to the district heating business, a key challenge is the need to continue with the transformation of the district heating market. It is estimated that in order to meet the requirements of the "Fit for 55" package in the area of decarbonization, it is necessary to spend between PLN 276 billion and PLN 418 billion on the transformation of the district heating sector in Poland, depending on the adopted investment scenario (PTEZ, 2023). At the current level of investment expenditures in the district heating sector (Figure 7), this would be a process that would take 60 to 90 years, so according to the ERO, external sources of financing are necessary (URE, 2023, p. 5).

5. Summary

The article attempts to determine whether local district heating companies operating in Poland are able to identify existing external threats to their operations, which is an essential element in formulating a business development strategy. The study was carried out by desk research method of analyzing found data from activity reports for 2019 for a group of 158 out of 250 local district heating companies, divided by city size.

The research showed that managers at licensed local heating companies can correctly identify existing threats to their operations. These are external threats over which the companies have no control. The results made it possible to systematize the operational threat factors mentioned by local heating companies according to the hierarchy of their importance. The largest number of companies pointed to weather factors, especially in winter (temperature), projecting the demand of customers for heat for heating purposes and determining the length of the heating season. This is measured by the number of degree days correlated with the volume of heat sales (see Figure 10), which, with the prices included in the tariff, determines the size of the company's revenues. Also important are the market risks affecting the cost side, i.e. increases in fuel prices (gas, coal, biomass), and, for several years now, the cost of CO_2 emission allowances related to the EU's stringent climate and energy policy. Difficulties in balancing the revenue and cost sides are created by the tariff procedures at the ERO, i.e. the heat sales prices in approved tariffs do not reflect the current costs incurred. This is especially true for companies generating heat from cogeneration sources, where simplified tariffs apply. With the occurrence of extraordinary events and unexpected dynamic increases in fuel prices in the markets, as was the case in 2021-2023, heat companies have incurred losses.

In my opinion, there are no comprehensive studies in the literature on the risks to the operations of companies in the Polish district heating sector of such scope (research method, research sample size, quantitative approach) and such a degree of detail, including verification of the impact of major risks on the performance of the entire sector, as well as selected individual

local companies. A study with a similar theme (Iwaszczuk, A., Iwaszczuk, N., 2022) is based on an analysis of the scientific literature and the macroeconomic environment, as well as interviews with employees from the heating industry. The presented results are a qualitative analysis of the impact of the identified risks for these companies, but the article does not provide information on the research sample (number of companies, their potential).

In summary, a long-term threat to the Polish heating sector is the EU's climate and energy policy, which calls for a shift away from fossil fuels and climate neutrality by 2050, in terms of carbon emissions. This is particularly challenging for the Polish district heating sector, which currently uses more than 66% carbon fuels (URE, 2023). Since municipalities are responsible for supplying heat under current regulations, it must be delivered to residents. It is therefore to be feared that the huge costs of the energy transition will be included in the price increase not only for heat, but also for electricity, i.e. they will be passed on to consumers of these energy carriers. Ultimately, the costs will be borne by society as a whole.

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MANAGEMENT OF OPERATIONAL SAFETY OF ELECTRICAL DEVICES AT CONSUMERS

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Purpose: The purpose of this article is to discuss issues related to the production and transmission of electricity and the safe operation of electrical devices. The article reviews concepts related to the effects of electric current and presents the principles of first aid in the event of electric shock.
Project/methodology/approach: Based on the literature study, the following research hypothesis was formulated: what are the methods of protection against accidents related to electric shock?
Findings: Two protection devices are practically used in households: a differential circuit breaker and an overcurrent circuit breaker.
Research limitations/implications: The discussion was limited to safe operation in households and did not address issues related to safety in high-voltage switchgears.
Practical implications: The need for education related to the safe use of electricity.
Social implications: Education and first aid in rescuing persons from electric shock.
Originality/merit: The article systematises safety and first aid concepts.
Keywords: Electricity production and transmission, protection of electrical devices, impact of electricity, fire protection.
Article category: Theoretical article.

1. Introduction

Management is the set and process of regulatory activities with the purpose of determining and selecting rational goals and objectives for an enterprise, as well as formulating and controlling the means of achieving these goals (Duraj, 2000). R.W. Griffin defines management as a set of activities (managing people) oriented at resources of the organisation (human, financial, material and organisational) and performed with the intention to achieve the goals of the organisation in an efficient and effective manner (Griffin, 2017).

Some authors define management as the process of planning, organising, leading and controlling the work of the members of an organisation and using all available resources of the organisation to achieve its goals (Stoner, 2011).

Occupational health and safety management should be based on three areas:

- leadership (vision, safety policy, strategy),
- organisation (resources, roles, use of the organisation's potential).

Processes and activities (communication, training and development, audits) (ww.sforo.pl).

These areas are particularly important in production plants, where electrical devices are used, as well as in offices.

2. Lines and voltages in the national electricity system

It is commonly believed that the electricity system is a set of devices intended for the generation, transmission, distribution and use of electricity, interconnected into a system enabling the supply of (Gawlak 2022).

The supply of alternating current electricity to various consumers is possible thanks to the proper functioning of an extensive energy transmission system. The entire electricity system consists of transformer stations and power lines of different voltages. To put it very simply, the whole process from generation to delivery of energy to the recipient is as follows:

- power stations of various types produce electricity, after which the voltage is increased at MV/EHV (medium voltage/extra high voltage) transformer stations to transmit it over long distances;
- EHV (extra high voltage) lines (domestic voltage: 220kV and 400 kV) transmit energy to local EHV/HV (extra high voltage/high voltage) transformer stations, where the voltage is reduced to 110 kV;
- HV (high voltage) lines, a voltage of 110 kV in the country, transmit energy over distances not exceeding several dozen kilometres to HV/MV (high voltage/medium voltage) stations;
- MV (medium voltage) lines (for AC electricity, in the country these are: 10kV, 15kV, 20kV or 30 kV) transmit energy to typical MV/LV (medium voltage/low voltage) pole-mounted transformers;
- low voltage lines (the lowest voltages in the country are 400V and 230V) transmit energy to final consumers (electricity points).

As there is no way to directly store AC electricity, the amount of energy generated at power plants must be equal to the energy consumed by recipients at all times. This forces the electricity system to maintain the ability to change the direction and amount of transmitted energy. This is possible thanks to the numerous connections between energy producers, power stations

and groups of energy consumers. The more extensive such a network is, the safer the system and the greater the stability and continuous supply of AC electricity to consumers.

3. Green electricity generation using renewable energy sources

The European Union's policy to stop the adverse climate change associated with carbon dioxide emissions has forced member states to, e.g., develop the renewable energy sector, and eco-energy solutions are a guarantee of zero CO2 emissions. Currently, the country is accelerating investment in renewable energy with a larger share of solar and wind energy generated both on land and at sea (Gawlak, 2022).

In the power industry, the "green energy" term is associated primarily with a reduction in the use of fossil fuels (hard coal, lignite, peat, oil, gas) and the use of low- and zero-emission sources of electricity called Renewable Energy Sources (Gawlak, 2022). Renewable Energy Sources or Renewable Non-Fossil Energy Sources include:

- wind energy,
- solar energy (solar radiation),
- hydropower,
- aerothermal, geothermal, hydrothermal energy,
- wave, current and tidal energy,
- biomass, biogas, agricultural biogas and bioliquid energy.

Wind energy and hydropower have been used for a millennium.

Individual Renewable Energy Sources can be characterised as follows:

- Wind energy is produced from wind using special turbines located on land, as well as on farms built on very large bodies of water such as seas and oceans. Wind energy is not only simple and cheap to obtain, it is also efficient. The above features of electricity generated in that way make wind energy, especially that produced using wind farms located in the seas and oceans, positively assessed by the public.
- Solar energy, i.e. the electricity and heat generated using solar radiation, is obtained through photovoltaic installations and heating collectors. The country's residents are eagerly choosing that solution and the number of prosumers (i.e. people who generate electricity for their individual consumption) exceeded one million in April 2022 and is steadily increasing.
- Hydropower is generated in special hydrotechnical structures with a built-in system of turbines that convert the force of flowing or falling water into kinetic and then electrical energy. However, it must be taken into account that hydropower, although renewable, has a significant impact on the natural environment and, under certain conditions,

can generate emissions comparable to fossil fuel-based energy, due to methane emissions from decomposing organic matter in the power plant reservoirs.

- Geothermal energy usually exists in the form of water resources beneath the Earth's surface. That water has a temperature of several dozen to one hundred degrees Celsius. Through specially drilled boreholes, it is brought to the surface and converted into different types of energy by means of appropriate technical installations.
- One of the sources of renewable electricity can be the energy associated with the water movements of the seas or oceans: waves (wind and seismic), sea currents (warm, cold and neutral) and tides (high and low tides). Wave energy is converted into electricity by wave energy converters. The waves set the converter in motion and thus electricity is generated. However, wave energy production is limited to areas near the coast. When the water is shallow, it can no longer circulate freely. Ocean currents are the primary driver of water circulation in the ocean. For the time being, however, their use is close to zero due to technical problems and the concern that even a small reduction in the energy of sea currents could fundamentally affect the climate and lead to unpredictable changes. Tidal energy is generated by the gravitational pull of the Earth, the Moon and the Sun. Tides cause the water level in the ocean to rise and fall regularly. The estuary of a river flowing into the sea and high banks enable the construction of a dam allowing seawater to flow into the river valley during high tide and its direction through electric water turbines at low tide. Tides are a source of energy with lower potential than sea currents, but they are safer and better understood. The power plants listed above do not require fuel, however, their construction is very expensive and technically complex. The advantage of such power plants is their independence from weather conditions. Whether the wind is blowing or the sun is shining, the sea tides are the same and generate the same power.
- Biomass energy is generated from biomass of animal or plant origin through highly advanced technological processes. Biomass is a solid or liquid biodegradable substance of plant or animal origin, which is produced from products, waste and residues from agricultural and forestry production, as well as industries processing their products, and sometimes from grain that does not meet quality requirements. Technical processes convert biomass into solid, liquid or gaseous fuels, which are then burned to produce heat to generate electricity. The basis is the use of existing waste, rather than using specially created bio-components for energy purposes. That kind of energy is gaining popularity in the country, especially in rural areas. By adding biocomponents obtained from biomass to traditional fuels, the role of renewable energy sources is also increasing in transport.

Storage of direct current energy, which is relatively often generated using Renewable Electricity Sources, makes it possible to store electricity, i.e. when its production is greater than current consumption. Such devices collect energy to make it available again for later use. Properly constructed electricity storage facilities allow for the use of almost all of the stored energy, and converters make it possible - by using the energy stored in the storage facility - to produce alternating current electricity with commonly used parameters. When such an electricity storage facility is installed close to the production area, the area can become independent of the electricity grid and, if the grid is used, also protected against power cuts or power grid failures.

Over the past few years, the amount of renewable energy produced in the country has increased enormously, primarily due to the use of solar panels and wind farms. On sunny and windy days, these meet the country's electricity needs. Sadly, due to technical limitations, traditional power plants (e.g. coal or gas-fired ones) are not able to flexibly reduce production below the minimum. Coal and gas-fired power plants are kept in operation at the expense of limiting the use of Renewable Energy Sources, which results in double the costs of electricity generation. The reason for restricting the production of solar and wind farms is the lack of flexibility in energy intake from such generators. During the hours when cheap energy from the sun or wind is widely available its use should be maximised by charging electric vehicles, heating water buffer tanks or buildings using heat pumps or heaters, as well as running energy-intensive industrial processes. With excess electricity in mind, the system is expanded by adding grid electricity storage facilities, electrode boilers - in district heating systems, and electrolysers for the production of eco-hydrogen. Their use not only reduces emissions but also enables significant savings on imports of energy carriers and the purchase of CO2 emission allowances. Obviously, if nuclear power plants are built in the country, they should support Renewable Energy Sources.

4. The national electricity system operator

In Poland, the role of the transmission system operator is performed by the State Treasury company Polskie Sieci Elektroenergetyczne S.A., which performs the tasks of the transmission system operator based on its EHV transmission network, which consists of (as of 31 December 2023) 306 lines with a total length of 16,133 km, including (https://www.pse.pl/obszary-dzialalnosci/krajowy-system-elektroenergetyczny/informacje-o-systemie):

- 135 lines with a voltage of 400 kV, a total length of 8950 km,
- 171 lines with a voltage of 220 kV, a total length of 7183 km,
- 109 extra-high voltage substations,

- undersea direct current connection between Poland and Sweden with a voltage of 450 kV, a total length of 254 km (of which 127 km belongs to Polskie Sieci Elektroenergetyczne S.A.).

Polskie Sieci Elektroenergetyczne S.A. has been implementing a nationwide programme for the modernisation and development of the National Electricity System for many years. A large part of the existing system was built in the middle of the 20th century and requires modernisation - all the more so as the electricity demand has increased over the years.

The paper (https://www.pse.pl/obszary-dzialalnosci/krajowy-system-elektroenergetyczny/plan-sieci-elektroenergetycznej-najwyzszych-napiec) presents the scheme of the national extra-high voltage (EHV) power grid, shown below:

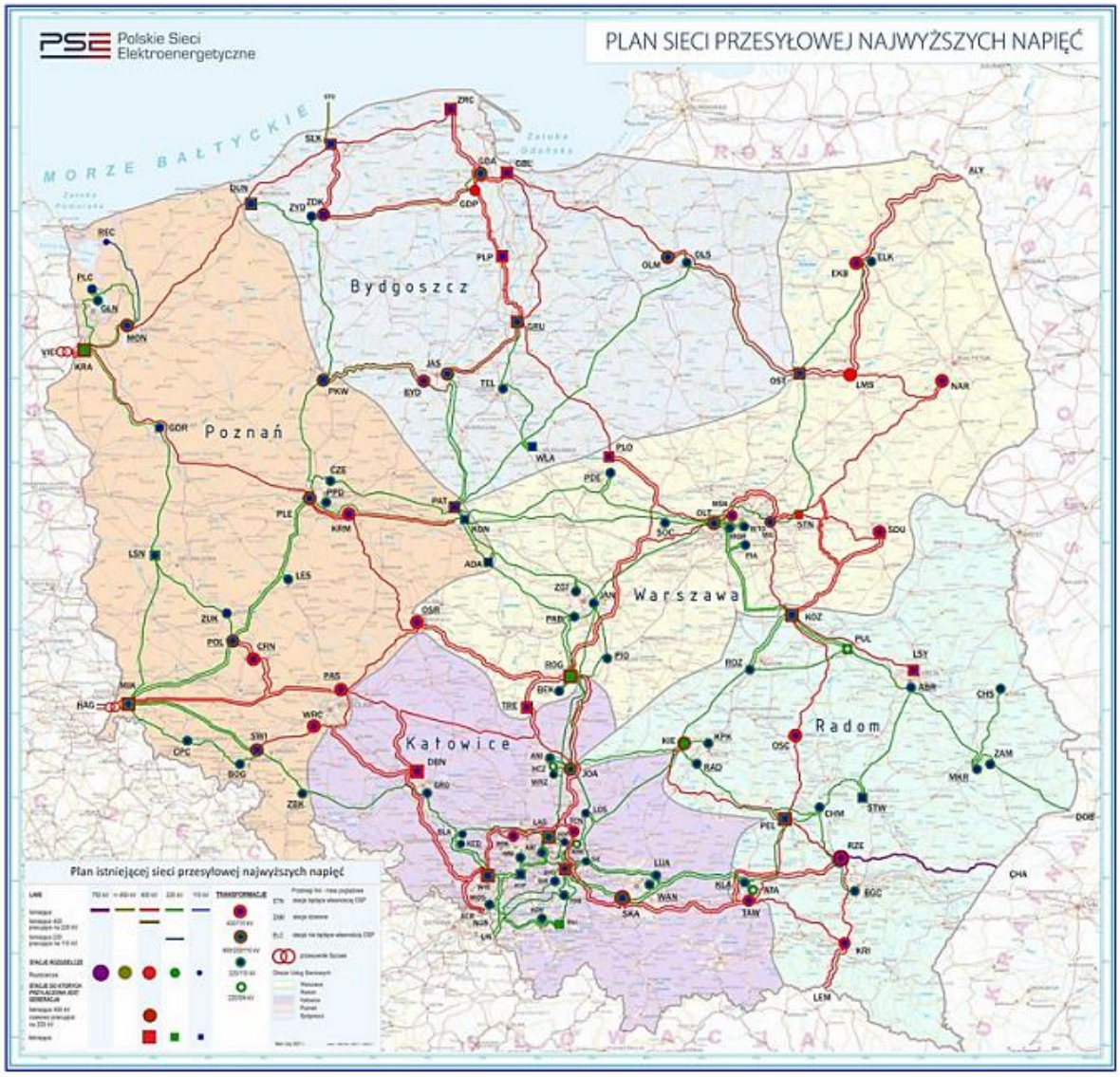

Figure 1. Scheme of the national extra-high voltage (EHV) power grid.

Source: Gawlak, 2022, p. 194.

5. Safe operation of electrical devices

Electricity plays an important role in human life. It is widely used in households and industry. The country's electricity is supplied to electrical devices via a current of 400/230 V and a frequency of 50 Hz. The transmission of energy with such parameters involves the risk of electric shock. Therefore, it is very important to ensure the safe use of electricity. Of particular importance is ensuring the safe work of employees responsible for the operation and maintenance of electrical machines or the maintenance and repair of the electrical network. Employees working with electrical voltage should receive training on the safe operation of electrical devices. Training courses preparing for the state exam are organised by the Association of Polish Electricians SEP. The courses include information on the operation, repair, maintenance and assembly of electrical equipment, inter alia. The course programme also covers issues related to the safe operation of electrical devices. The authorisations are divided into: G1 - authorisations for those involved in the operation and supervision of electrical equipment, G2 - for thermal equipment, G3 - for gas equipment. The training leading to obtaining the G1 authorisation, up to 1kV, is divided into: operations - work in the field of operation, renovation, maintenance, control, measurement, assembly (the E certificate is granted after passing the exam) and supervision - supervision, management of teams performing operational works (type D certificate is granted after passing the exam).

All groups of authorisations concern operation, assembly, repair, maintenance, inspection and measurement. Persons wishing to work in the field of electrical engineering and in possession of a diploma from a relevant school or a certificate from an employer confirming their work experience and length of service in that field may take part in the training and take the state exam (https://www.fachowyelektryk.pl/aktualnosci/2768-uprawnienia-elektryczne-g1 zakres-uprawnien-jak-przygotowac-sie-do-egzaminu-sep-e1-do-1kv.html, 5.01.2023).

6. Effects of electric current on the human body

The electric shock contributes to a number of changes in the human body. These depend on many factors:

- the type of current - direct current has a different effect on the human body than alternating current,
- current flow paths - e.g. hand - hand, hand - leg, etc.,
- current flow duration,
- current value,

- ambient temperature - the higher the temperature the better conductivity,
- contact surface of the body with the current source and the contact force.

In the case of direct current, the direction of current flow is also important, and in the case of alternating current - its frequency. The shorter the flow time and the lower the current value, the less significant the harmful effects on the human body. As far as current flow paths are concerned, the most dangerous are: hand-to-hand, hand-to-foot, as they lead through the heart and nerve centres. At the point of "entry" of the current, a skin burn may occur. In severe cases, it may result in tissue necrosis and charring. The effects of direct current are less dangerous for humans than that of alternating current of the same value, but this only applies to small current values (up to 20 mA). Current flow affects the respiratory, circulatory and nervous systems. The most dangerous for the human body is the alternating current with a frequency of 50-60 Hz.

The human body practically does not react to a prolonged flow of 50 Hz alternating current of 0.1-0,6 mA. Only a tingling sensation is felt, which is not dangerous. By increasing the current to 0.8-2 mA, a tickling and itching sensation appears or even a slight cramp in the hand. Subsequent increases in current cause more severe consequences for the body. The highest range, of 22÷50 mA, may contribute to cardiac arrhythmias and ventricular fibrillation or make it impossible for the person to breathe. The effects of the 50 Hz alternating current, depending on the current value, may cause different body reactions. These can be more or less noticeable and can sometimes lead to tragic consequences (Koradecka, 2008).

The permissible value of current flowing through the human body for a prolonged period is:

- 70 mA - direct current,
- 30 mA - alternating current.

The occurrence of cardiac fibrillation depends primarily on the time of current flow through the human body. With a current flow time of less than 0.2 s, it is rare. Cardiac ventricular fibrillation is a very dangerous process and unfortunately extremely difficult to reverse (Sroczan, 2019).

7. Protective measures against electric shock

Electric shock appears when a person touches two points of an electrical circuit simultaneously. Human electric shock can occur when a person touches a live part of an electrical circuit. This is known as direct contact. Electric shock may also occur through indirect contact. This happens when live conductive parts are touched as a result of a failure, which are not live during normal operation. Protection measures against electric shock are

divided into: basic protection (against direct contact), additional protection (against indirect contact), supplementary protection (Markiewicz, 2017).

7.1. Protection against direct contact (basic protection)

It is a direct contact protection that prevents people from touching a live electrical circuit. The basic element of such protection is to restrict or prevent access to that type of electrical equipment. Various types of measures are used for that purpose, such as isolation, obstacles, barriers, partitions, covers or housing (Markiewicz, 2006).

Working insulation of devices, made of solid insulating materials, is intended to create effective earth and phase-to-phase insulation of devices and to prevent accidental touching of live parts by a person, if these devices are installed in the space remaining in the so-called area within reach. When it is not possible to implement the measures of basic protection, electrical equipment is placed out of reach. Live parts are placed at a distance not accessible from a workstation.

7.2.Protection against indirect contact

Protection against indirect contact is intended to prevent people from touching conductive parts of a machine or device during normal operation, not under voltage.

7.2.1. Automatic shutdown of power supply

The use of an automatic shutdown of power supply is an additional protection measure, most popular. The protective device should automatically switch off the power to the protected device or circuit in the shortest possible time in the event of indirect contact, so that in the case of a short circuit between the live part and any conductive part, the touch voltage does not cause a dangerous flow of current when a person touches the conductive parts.

7.2.2. Workstation insulation

The purpose of workstation insulation is to prevent simultaneous contact of conductive parts with different potentials (voltages) as a result of damage to the basic insulation of the live parts. This is additional protection. Apart from basic protection, additional protection is also used. Its purpose is to prevent the persistence of a touch voltage, which is dangerous. One or more layers of poorly conductive materials. The material used for workstation insulation must have high wear resistance and permanent insulating properties (e.g. gravel, tar, felt, paving slabs, asphalt).

7.2.3. The use of class II protection equipment

The application of that protection measure is intended to prevent a dangerous touch voltage from appearing during the use of a factory-made electrical device. Insulation of live parts of class II equipment should be made in such a way that its damage to the extent that could cause a risk of electric shock is impossible or very unlikely.

7.2.4. Non-earthed local equipotential bonding

That protection is intended to prevent touching equipment that could be under dangerous voltage by damaging the basic insulation of the electrical device's conductive parts and other conductive parts. It is a combination of two protection measures: local equipotential bonding and workstation insulation (Rozporządzenie Ministra Gospodarki, 2019).

7.2.5. Electrical isolation

This is a protection method consisting of separating the supply circuit and the receiving circuit (separated) in a safe way, so that in the event of damage to the basic insulation of the separated circuit, there is no risk of electric shock. The separated circuit may be powered by: an isolation transformer or another source. The electrical isolation equipment is intended to show the existing voltage. However, if the indicator shows no voltage, it is not sufficient proof that it is not present. You must not go near or touch such a device.

7.3. Supplementary protection

Differential circuit breakers are the most commonly used means of supplementary protection. These are protective devices that operate independently of the mains voltage. They are placed in domestic installations, public facilities and factories. They protect people against an electric shock by indirect contact - preventing the emergence of long-lasting, life-threatening voltages on the housing and covers of electrical equipment. If the receiver and the installations behind the device are fully operational, the sum of the currents flowing through phase and neutral conductors is equal to zero and the device can be switched on and remain in the "on" position. In the event of a ground fault, posing a risk of electric shock, part of the current flows through the protective conductor directly to the ground, or through the human body, and does not return through the neutral conductor, so the sum of the currents flowing through the phase and neutral conductors, passing through the summing transformer, is different from zero and the circuit breaker disconnects the faulty circuit.

8. Fire protection of electrical devices

Faulty or improperly used electrical equipment may cause fires. The use of electrical devices is associated with the generation of losses, which cause an increase in temperature. In the event of overload or deterioration of cooling conditions, the temperature rise may exceed the temperatures permitted for the insulation. In the years 2000-2014, the average number of fires originating from the use of electrical equipment and installations in relation to the total number of fires in that period was 4.22% (Wiatr, 2015). If only building fires are taken into account, the percentage of fires caused by the use of electrical installations increases to 22%.

This means particularly high material losses due to fire. Therefore, the time at which the firefighting action starts is important, the earlier the material damage is prevented the more time remains for safe evacuation. Having a fire alarm system means that a fire can be quickly located and the fire brigade can be notified (Skiepko, 2010).

The most frequent causes of fires associated with the use of electrical installations are:

- improper selection of cable cross-section and protection - too small cable cross-sections lead to an excessive increase in insulation temperature and contribute to exceeding the permissible temperature. Incorrectly selected protection leads to overloading of the installation and damage to the insulation (Jaskółowski, 2015). Correct selection of cable cross-sections makes damage less likely. The value of the protection device current should be correlated with the load capacity of the selected cable cross-section.
- overload of the electrical installation - long-term overload causes a permanent increase in,
- temperature and gradual degradation of insulation. The causes of overloads in the case of motor power supply may be: the absence of one phase in the power supply, an increase in the load, a change in the supply voltage, deterioration of the cooling conditions, e.g. fan damage, which causes inadequate cooling and an increase in the temperature of the windings,
- poor installation or condition of the installation and equipment contacts - too little pressure in the contacts causes an increase in contact resistance and the release of an increased amount of heat,
- deterioration of cooling conditions and placing the electrical installation too close to flammable materials,
- poor condition of insulation - each type of insulation has a specific period of use. The insulation condition deteriorates over time, therefore it should be inspected on a regular basis (Laskowski, 2019).

In the event of a fire, devices should be disconnected from the power supply source. While doing so, it should be taken into account that power sources are also used by rescue teams. Static electricity and lightning also pose a fire risk. Static electricity can be a fire hazard, especially in premises where there is a highly concentrated explosive mixture. A spark jump can cause an explosion. Static electricity usually accumulates on plastics. To protect the surroundings against the accumulation of charges, it is advisable to dissipate any charges using earthing. Lightning protection can be external, which dissipates the current occurring when lightning strikes to ground, or internal, which protects people and electrical equipment inside a building. The flow of lightning current in the vicinity of flammable agents is particularly dangerous. If the lightning protection system wires run too close to electrical installation wires, a spark may damage the wire insulation and create a fire hazard (Niestępski, Parol, Pasternakiewicz, Wiśniewski, 2019).

9. Provision of first aid in the event of an electric shock

Electric shock may contribute to severe damage to organs in the human body and even death. First aid in the event of an electric shock is of great importance. It is important to separate the affected person from the current as soon as possible and provide first aid. The source of current should be pulled away preferably using tools made of non-conductive materials (e.g. dry wood, plastic) so that the rescuer does not get the electric shock as well. This increases the chance of saving life. The voltage must be switched off. If this may cause the affected person to fall, the person should be secured against falling. The fall may cause serious injuries, e.g. in the case of hitting the head on something hard.

Once the affected person is freed from the electric current and is in a safe place with the rescuer, first aid can be administered. The chances of saving the person after an electric shock decrease as time passes (Koradecka, 2008).

10.Conclusions

Electric current is a common medium for transmitting energy. The electricity system delivers power generated in power stations to electrical devices of many types, operating in different locations (railways, aviation, factories, craft workshops, homes).

Electrical devices are found practically everywhere, therefore it is important to use them safely. Electric shocks lead to many dangerous changes in the human body and may even cause death. It is important to know how to behave in a dangerous situation and provide first aid to a person after an electric shock and not to expose yourself to danger. Switching off the power, pulling the affected person away and administering first aid - this is the correct sequence for rescuing those affected by an electric shock. The use of appropriate protective measures significantly reduces the risk of getting an electric shock. A common means of protection against direct contact is insulation. Any electrical device must have basic insulation protection. The most frequently used means of additional protection are overcurrent circuit breakers and the means of supplementary protection are differential circuit breakers. Faulty or improperly used electrical appliances may cause a fire. If it happens, it is important to choose the appropriate fire-extinguishing equipment, suitable in a given situation. The fire of small electrical devices can be extinguished with a fire blanket and of larger ones - with a powder extinguisher. Using inappropriate fire-extinguishing equipment may be dangerous and cause even more fire-related damage. By ensuring a safe working environment and using protective measures properly, many accidents can be avoided. In power generation, it is equally important to raise awareness of the possible dangers at the workplace and to exercise special caution by the employees.

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FRAMEWORK FOR SELECTING QUALITY AND ENVIRONMENTAL ASPECTS IN THE QLCA METHOD SUPPORTING SUSTAINABLE PRODUCT DEVELOPMENT

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Purpose: The aim was to develop a framework for selecting quality and environmental aspects when improving products towards their sustainable development.
Design/methodology/approach: The framework was developed based on the results of previous studies, within which the Quality Life Cycle Assessment (QLCA) method was developed, dedicated to the sustainable development of products, taking into account the aspects of quality (customer satisfaction) and the environment (the impact of the product on the environment in the life cycle). During the development of the framework, a five-step methodology was used, i.e.: i) collecting data from previous studies, ii) computational simulation including verification of the proportions of the participation of aspects, iii) analysis and interpretation of results, and iv) development of a framework for the selection of aspects. The simulation was supported by the analysis of statistically significant differences in the Statistica 13.3 program with the ANOVA test.
Findings: If the quality indicator has a weight in the range of 0.70 to 0.35 and the environmental indicator of 0.30 to 0.65, then the quality and environmental aspects have a similar impact on the ranking. Then, it is possible to direct improvement activities to meet customer expectations regarding the quality of the product while limiting the negative impact on the environment of the product.
Research limitations/implications: The framework is primarily designed for use within the QLCA method. Additionally, it does not consider the proportion of other sustainability aspects, such as costs, which may affect product development decisions at later stages.
Practical implications: The framework is tailored to support designers' decisions in the early stages of product design and development. It can be used by manufacturing companies for sustainable product development as a tool to help predict product rankings depending on the adopted share of quality and environmental aspects.
Originality/value: To define new assumptions and concepts for product development in the form of a research framework that will support decision-making in guiding sustainable product development while taking into account quality (customer satisfaction) and environmental impact (LCA).

Keywords: QLCA, quality, life cycle assessment, customer expectations, production engineering, mechanical engineering.
Category of the paper: Research paper.

1. Introduction

Considering sustainability issues in process improvement and product development increasingly seems to be essential in successful enterprises (Berglund et al., 2020). One example of such action is the development and adaptation of current engineering practices and techniques to achieve effective ecodesign tools (Kobayashi et al., 2005). In this respect, quality management (QM) can provide significant benefits from the aforementioned integration, e.g. through continuous improvement and adaptation of products to customer requirements. As reported, e.g. (Gremyr et al., 2014), quality management is relatively well known, including integrated with management processes in most organisations, including often appropriately adapted to sustainable environmental activities.

Quality management can be understood as adapting a product to customer expectations, including ensuring their satisfaction with using the product, as in (Siwiec, Pacana, 2021; Pacana, Siwiec,2022b; Siwiec et al., 2023a). Quality management also involves minimising and eliminating product nonconformities as part of improving manufacturing processes, as in (Pacana, Siwiec, 2021, 2022a; Siwiec, Pacana, 2022). On the other hand, sustainable product development in its basic sense concerns achieving the quality of products that meet the expectations of society, including maintaining the principles of socially responsible products, limiting their negative impact and considering financial aspects (Bhasker, 2004; Siva et al., 2016a; Carvalho, 2017). Although these aspects are known and attempts have been made to integrate them, there is still a lack of principles and methods supporting the improvement of products towards their sustainable development.

In connection with this, a review of the literature on the subject in the field of sustainable product development was conducted, taking into account quality aspects. Among other things, the article (Arsic, 2016) analysed the possibility of presenting product quality in the form of actions carried out within the framework of sustainable development. The considerations and structure of the main quality aspects were analysed, including the synergy of the more important variables accompanying these undertakings. On the other hand, the authors of the study (Siva et al., 2016b) reviewed work in which quality management techniques were used together with other sustainable development initiatives. For example, integrated management systems, quality management within the implementation of management systems, integration of issues used in traditional work, or stakeholder management and customer orientation were selected. Similar studies were carried out by the authors of the work (Vandenbrande, 2021), in which a general framework was presented for small and medium-sized enterprises (SMEs)

implementing sustainable development through quality management methods. As a result, a framework is proposed to support a qualitative economic and social system. On the other hand, the authors of the work (Güdemann, Münnich 2023), verified qualitative issues in terms of subjective choices of complex indicators used to measure sustainable development. The implications of missing data are carried out, including the creation of a research project in the form of the construction of a complex indicator that supports sustainable development. In turn, in the article (Jasiulewicz-Kaczmarek, 2014) an analysis of the impact of introducing sustainable development on quality management was carried out. Initiatives based on the prediction of possible changes in the organisation and the market were verified. Subsequently, the authors of the work (Wang et al., 2021) proposed a comprehensive model of decision-making within the framework of sustainable environmental management in the macroecological approach. The model was created in a mathematical approach in order to quantitatively consider complex factors influencing the policy of ecological environment management with the promotion of sustainable and balanced development. The framework of the modern concept of quality costs was also developed, which was considered in relation to all stages of the product life cycle, by all stakeholders in the supply chain, as, e.g., in (Tomov, Velkoska, 2022). Other works concerned the introduction of methods supporting the sustainable development of products towards a closed loop, such as by (Pacana et al., 2023). Furthermore, studies were conducted, e.g. (Tung, 2021), which analyzed the positive effects within the framework of quality management and achieving environmental sustainability, including sustainable development of the quality of these products. The issues of quality in industry 4.0 are also important in this respect, which can facilitate the improvement of products, but should also take into account environmental aspects, including the concepts of sustainable development. For example, as indicated by the authors of the works, among others (Stawiarska et al., 2021; Wolniak, 2021; Avilés-Sacoto et al., 2024).

It has been observed that improving the quality of products and at the same time reducing their negative environmental impact is used within the framework of the sustainable development approach. So far, the possibilities of integrating quality management and sustainable development have been considered, but no method has been sought to weight the aspects of sustainable development aspects in the product improvement process. Therefore, the objective was to develop a framework to select quality and environmental aspects during the improvement of products toward their sustainable development. This framework was developed based on the results of previous studies, for example (Pacana, Siwiec, 2024; Siwiec, Pacana, 2024b, 2024a, 2024c), within which the Quality Life Cycle Assessment (QLCA) method dedicated to sustainable product development was developed, taking into account the aforementioned quality and environmental aspects.

The developed framework can be used in manufacturing companies to focus the product improvement process to meet product quality and limiting their negative impact on LCA. Designers can determine the proportions of quality and environmental aspects in the early

stages of product development so that they meet market expectations, as well as the individual requirements of the company using the indicated framework.

2. Problem and concept of research

The QLCA method is dedicated to designing and improving products as part of meeting customer expectations regarding product quality and at the same time ensuring their minimal negative impact on the environment in the life cycle (LCA). The QLCA method is based on the development of various product prototypes for which the voice of customers (VoC) is obtained (Shen et al., 2022). Based on customer requirements, the quality level of these prototypes is calculated, which is presented by the aforementioned quality indicator (Q). Subsequently, the environmental impact of prototypes is estimated according to the life cycle assessment method compliant with ISO 14040 (Finkbeiner et al., 2006). The results of the life-cycle assessment of prototypes are presented by the environmental indicator (LCA). These indicators are aggregated into one quality and environmental indicator (QLCA) according to which a ranking of prototypes is developed. On the basis of this ranking, product development decisions are made. The QLCA method is presented, e.g., in (Pacana, Siwiec 2024; Siwiec, Pacana, 2024b, 2024a, 2024c).

In the approach practised so far, the authors of the QLCA method assume that quality and environmental aspects are equivalent (equally important) to the decision maker, e.g. designer, manager, or experts in the field of quality management and environmental impact of products. This means that the quality of prototypes and their impact on the environment in the life cycle have the same share in the final decision regarding product development.

Based on previous studies in the field of quality and environmental improvement of products, e.g. (Pacana et al., 2023; Siwiec et al., 2023b) it was shown that manufacturing companies (mainly small and medium-sized enterprises, SMEs) (Lu et al., 2022) relatively often take into account qualitative aspects to a greater extent than environmental aspects when improving products. Therefore, it was considered reasonable to define a framework to select the proportion of the share of qualitative aspects in relation to environmental aspects in the QLCA method. This framework will be useful for entrepreneurs in the improvement activities they undertake, depending on market needs, but also being consistent with the idea of sustainable product development.

The research method was based on the development of a framework for the selection of quality and environmental aspects during the sustainable development of products according to the QLCA (Quality Life Cycle Assessment) method. The method was based mainly on computational simulation and sensitivity analysis carried out on the basis of a quality indicator (customer satisfaction with the use of the product) and an environmental indicator (product

impact on the environment in the life cycle), which were developed according to the QLCA method presented, e.g., in (Pacana et al., 2023a). The adopted research scheme is presented in Figure 1.

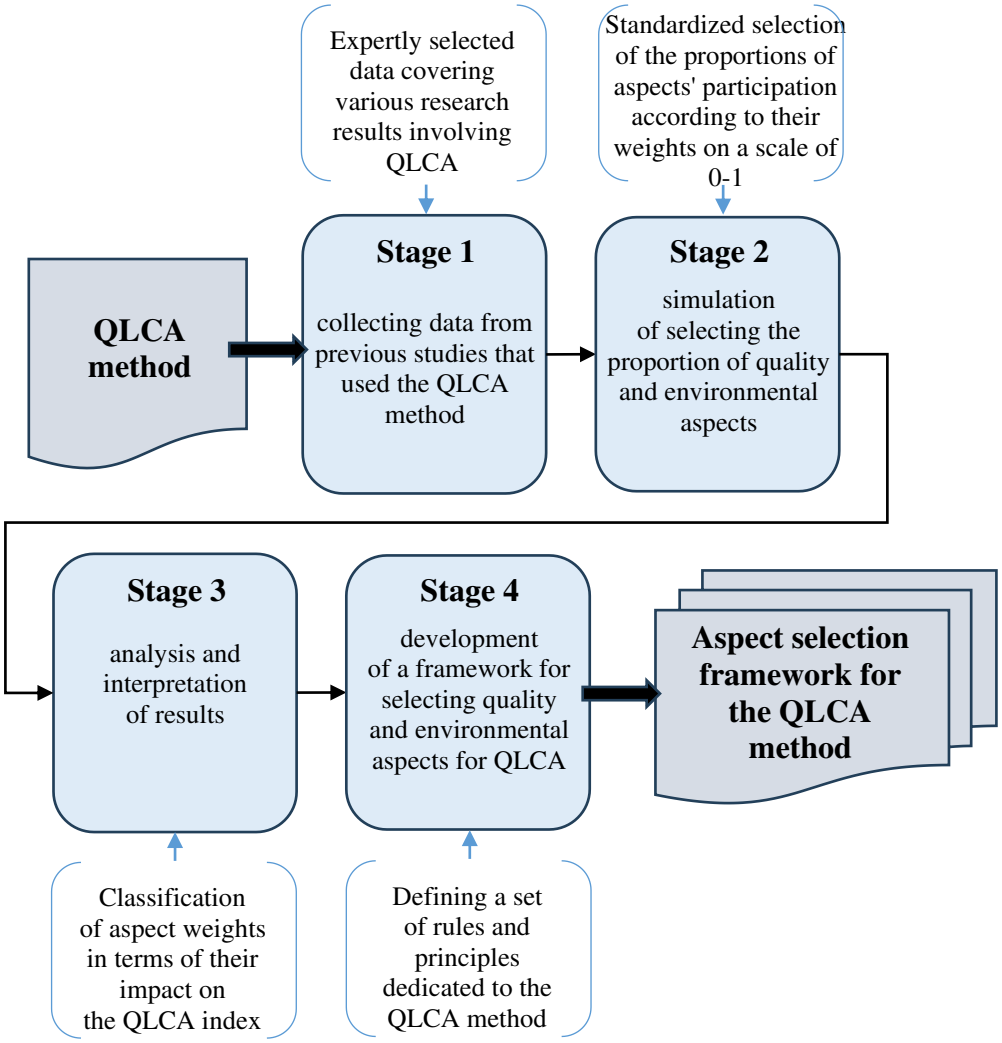

Figure 1. Scheme for developing a framework for selecting the proportions of quality and environmental aspects in the QLCA method.

Source: Own elaboration.

Therefore, the research method was developed in the following stages: i) collection of data from previous studies, ii) computational simulation based on the prediction of the selection of the proportions of the share of qualitative and environmental aspects, iii) analysis and interpretation of the results, and iv) development of a framework for the selection of aspects.

Obtaining data from previous studies refers to defining the data obtained during the use of the QLCA method. These data should include the values of the main indicators of the QLCA method, i.e. the Q indicator – qualitative and LCA – environmental. The indicators' values can be presented in any value (depending on the techniques used to support the implementation of the QLCA method, it is possible to obtain values from 0 to 1 or above 1). In the case of values

above 1, these data should be normalized according to formula (1) (Pacana, Siwiec, 2024; Siwiec, Pacana, 2024a):

$$\begin{cases} \text{for } Q > 1: \dfrac{Q_{ij} - \min Q}{\max Q - \min Q} \\ \text{for } LCA > 1: \dfrac{\max LCA - LCA_{ij}}{\max LCA - \min LCA} \end{cases} \quad (1)$$

where:
Q – i-th value of the qualitative aspect,
LCA – i-th value of the environmental aspect,
j – product or prototype.

In turn, the computational simulation consists of assigning weights to these aspects on a scale (0-1), where these weights were changed by 0.05, which is justified by statistical assumptions about the detectability of statistically significant differences (Andrade, 2019). The weighted quality-environmental index was estimated as the arithmetic mean of the simulated weight and the value of the product of a given indicator, as presented in formula (2):

$$E_{ij} = \frac{w_{ij} \times Q_{ij} + w_{ij} \times LCA_{ij}}{2} \quad (2)$$

where:
w – i-th aspect weight (importance),
Q – value of the qualitative aspect,
LCA – value of the environmental aspect,
j – product or prototype.

During the simulation, weights equal to 0 and 1 are omitted. This results from the assumption of the QLCA method, where it is assumed that qualitative and environmental aspects are taken into account simultaneously without omitting any of them in the final result of the method.

Based on the simulation results, a comparative analysis is performed, and the results are interpreted. In this process, it is crucial to observe the change in the product prototype rankings (created according to the weighted quality or environmental indicator) in relation to the change in the proportion of indicators. On the basis of these observations, it is possible to develop a framework for the selection of quality and environmental aspects, the result of which is presented in the next chapter of the study.

3. Results

The framework for selecting qualitative and environmental aspects was based on data from previous studies by the authors, in which the QLCA method was used. It was based on data from a publication, i.e. (Siwiec, Pacana, 2024a), in which the QLCA method was applied to the sustainable development of photovoltaic panels. This product was modelled qualitatively and environmental way for thirteen prototypes. Based on customer requirements, a quality indicator was determined for the prototypes of this product, where the entropy method was used for this purpose. However, the life cycle assessment was carried out using the Ecoinvent database in the OpenLCA programme. Data on the values of the main indicators, i.e. Q – qualitative (customer satisfaction with the quality of the product) and LCA – environmental (impact on the natural environment of the product in its life cycle), developed as part of the research presented in (Siwiec, Pacana, 2024a), are presented in Table 1.

Table 1.
Results from the QLCA method presenting an equal proportion of quality and environmental indicators

Indicator	**Pa**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
Q	0.00	0.62	0.31	0.93	0.30	0.60	0.15	0.51
LCA	0.43	0.46	0.34	0.70	0.42	0.56	0.00	0.95
QLCA	0.22	0.54	0.33	0.82	0.36	0.58	0.08	0.73
Indicator	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	
Q	0.84	1.00	0.70	0.87	0.54	0.62	0.37	
LCA	1.00	0.60	0.34	0.39	0.51	0.39	0.25	
QLCA	0.92	0.80	0.52	0.63	0.53	0.51	0.31	

where: Q – quality indicator, LCA – environmental indicator, QLCA – quality-environmental indicator, Pa – current product, P1-P9 – prototypes.

Source: Own elaboration based on (Siwiec, Pacana, 2024a).

The data were expressed in the range of values from 0 to 1, therefore their normalization was omitted. Next, a simulation of the selection of the proportion of the share of qualitative and environmental aspects (expressed by the Q and LCA indicators) in the total quality-environmental index QLCA was performed. Formula (2) was used for this purpose. As a result, 19 simulations of the change in the weights of the aspects were performed, including taking into account the equivalent proportion of their share. The results are presented in Table 2.

Table 2.
Values of the simulated weighted quality index (Q) and weighted environmental index (LCA)

Q	LCA	Prototypes														
Proportion		Pa	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
0.95	0.05	0.01	0.31	0.16	0.46	0.15	0.30	0.07	0.27	0.42	0.49	0.34	0.42	0.27	0.30	0.18
0.90	0.10	0.02	0.30	0.16	0.45	0.16	0.30	0.07	0.28	0.43	0.48	0.33	0.41	0.27	0.30	0.18
0.85	0.15	0.03	0.30	0.16	0.45	0.16	0.30	0.06	0.29	0.43	0.47	0.32	0.40	0.27	0.29	0.18
0.80	0.20	0.04	0.29	0.16	0.44	0.16	0.30	0.06	0.30	0.44	0.46	0.31	0.39	0.27	0.29	0.17
0.75	0.25	0.05	0.29	0.16	0.44	0.17	0.30	0.06	0.31	0.44	0.45	0.31	0.38	0.27	0.28	0.17
0.70	0.30	0.06	0.29	0.16	0.43	0.17	0.29	0.05	0.32	0.44	0.44	0.30	0.36	0.27	0.28	0.17
0.65	0.35	0.08	0.28	0.16	0.42	0.17	0.29	0.05	0.33	0.45	0.43	0.29	0.35	0.26	0.27	0.16
0.60	0.40	0.09	0.28	0.16	0.42	0.17	0.29	0.05	0.34	0.45	0.42	0.28	0.34	0.26	0.26	0.16
0.55	0.45	0.10	0.27	0.16	0.41	0.18	0.29	0.04	0.35	0.46	0.41	0.27	0.33	0.26	0.26	0.16
0.50	0.50	0.11	0.27	0.16	0.41	0.18	0.29	0.04	0.37	0.46	0.40	0.26	0.32	0.26	0.25	0.16
0.45	0.55	0.12	0.27	0.16	0.40	0.18	0.29	0.03	0.38	0.46	0.39	0.25	0.30	0.26	0.25	0.15
0.40	0.60	0.13	0.26	0.16	0.40	0.19	0.29	0.03	0.39	0.47	0.38	0.24	0.29	0.26	0.24	0.15
0.35	0.65	0.14	0.26	0.16	0.39	0.19	0.29	0.03	0.40	0.47	0.37	0.23	0.28	0.26	0.24	0.15
0.30	0.70	0.15	0.25	0.17	0.38	0.19	0.29	0.02	0.41	0.48	0.36	0.22	0.27	0.26	0.23	0.14
0.25	0.75	0.16	0.25	0.17	0.38	0.20	0.29	0.02	0.42	0.48	0.35	0.22	0.26	0.26	0.22	0.14
0.20	0.80	0.17	0.25	0.17	0.37	0.20	0.28	0.02	0.43	0.48	0.34	0.21	0.24	0.26	0.22	0.14
0.15	0.85	0.18	0.24	0.17	0.37	0.20	0.28	0.01	0.44	0.49	0.33	0.20	0.23	0.26	0.21	0.13
0.10	0.90	0.19	0.24	0.17	0.36	0.20	0.28	0.01	0.45	0.49	0.32	0.19	0.22	0.26	0.21	0.13
0.05	0.95	0.20	0.23	0.17	0.36	0.21	0.28	0.00	0.46	0.50	0.31	0.18	0.21	0.26	0.20	0.13

Source: Own elaboration.

The ANOVA analysis was performed in Statistica 13.3. The aim was to check whether the obtained values of the weighted quality-environmental index differ statistically significantly between individual prototypes. This determines the validity of their further analysis. A test for factorial systems was used, i.e., independent variables, which were the values of the weighted quality-environmental index. As part of the analysis, a confidence interval of 0.95 and a significance level of 0.05 were established. The results of the analysis are presented in Table 3.

Table 3.
ANOVA test results

Test	Value	F	Df effect	Df error	P-value
Wilksa	0.231	60	1	18	0.000

Source: Own elaboration.

It was shown that there are statistically significant differences between the values of the weighted quality-environmental index obtained for product prototypes. This determines the validity of their further analysis. Therefore, the values obtained from the weighted quality-environmental index were compiled into prototype rankings. This is presented in Figure 2.

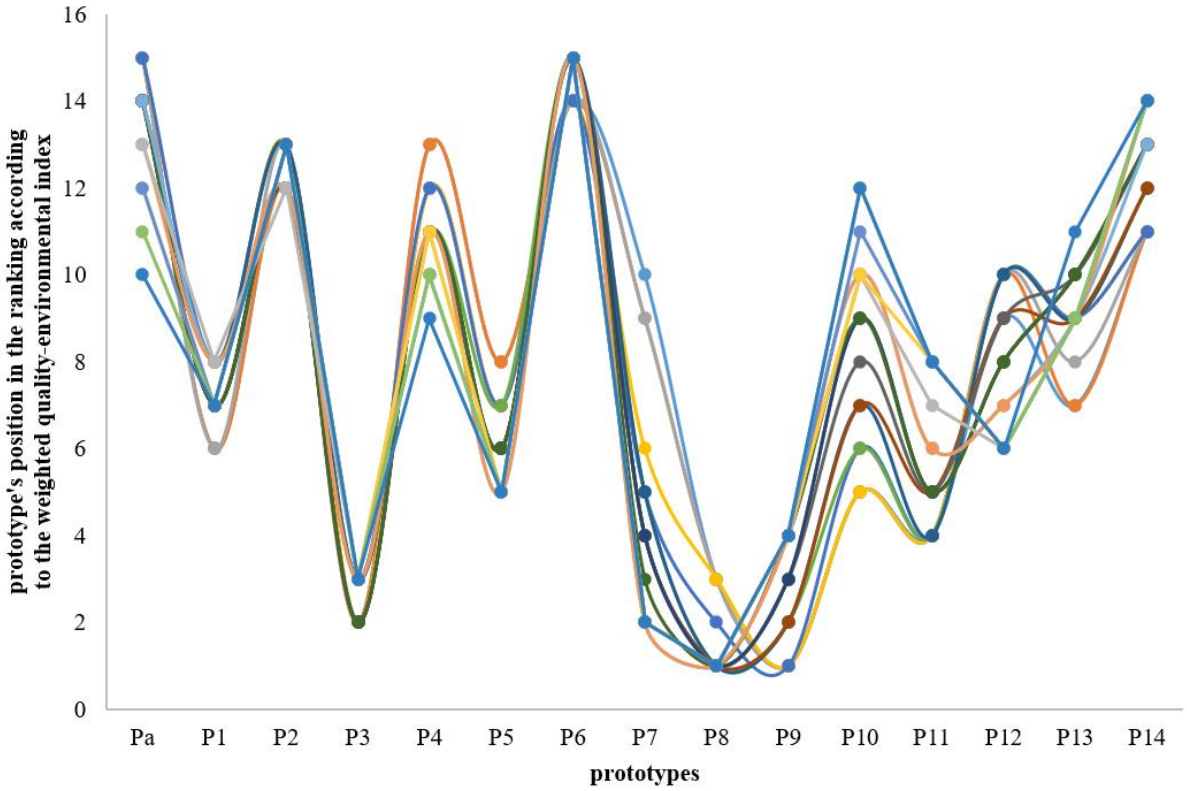

Figure 2. Changes in the prototype ranking according to changes in the proportion of quality and environmental aspects.

Source: Own elaboration.

It was observed that the importance of qualitative and environmental aspects generates changes in the position of prototypes in their final ranking, which is created according to the weighted qualitative and environmental index. Additionally, it was observed that:

- the higher the value of the quality indicator and the higher the weight of this indicator, the higher its position in the ranking;
- the low value of the qualitative and environmental indicators means that changes in the weights of these indicators do not significantly affect the prototype rankings;
- significantly high value of the quality indicator means that even if it is given a low weight, its position in the ranking changes relatively little;
- the higher the value of the environmental indicator and the higher the weight of this indicator, the higher its position in the ranking, only if the value of the quality indicator is relatively high compared to the others;
- if the value of the environmental indicator is low and its weight is high, including the value of the quality indicator being low or relatively unremarkable compared to the others, the prototype occupies a low position in the ranking.

The observations made it possible to demonstrate that the QLCA method is sensitive to prototype ranking taking into account the importance of quality and environmental aspects.

Table 4.
Framework for selecting the proportion of the share of quality and environmental indicators dedicated to the QLCA method within the framework of sustainable product development

Observation	The proportion of the indicator weights	Conclusion	Application
No change in ranking when: • the weighted value of the quality and environmental indicator is very low; • the weighted value of the quality indicator is very high and the environmental indicator is very low; Observed changes in ranking when: • the weighted value of the quality indicator is at an average level, and the environment indicator is very low.	$Q \in \langle 0.95; 0.75 \rangle$ $LCA \in \langle 0.05; 0.25 \rangle$	The quality index value generates a prototype ranking, while the environment index value has little influence on the ranking	Focusing improvement activities on meeting customer expectations regarding product quality, taking into account the basic aspects of impact on the natural environment
No change in ranking when: • the weighted value of the quality indicator is very low; • the weighted value of the environmental indicator is very high; Observed changes in ranking when: • the weighted value of the quality and environment indicator is relatively similar.	$Q \in \langle 0.70; 0.35 \rangle$ $LCA \in \langle 0.30; 0.65 \rangle$	The quality and environment index values have a similar impact on the ranking	Focusing improvement activities on meeting customer expectations regarding product quality while limiting the negative impact of the product on the environment
No change in ranking when: • the weighted value of the quality indicator is very low; • the weighted value of the environmental indicator is very high; Observed changes in ranking when: • the weighted value of the quality indicator is low and at the same time the weighted value of the environment indicator is at an average level.	$Q \in \langle 0.30; 0.05 \rangle$ $LCA \in \langle 0.70; 0.95 \rangle$	The value of the environment index generates the prototype ranking, while the value of the quality index has little influence on the ranking	Focusing improvement activities on reducing the negative environmental impact of the product, taking into account the basic customer expectations regarding product quality

Source: Own elaboration.

The proposed proportions of the share of the quality and environmental indicator are dedicated to sustainable product development in accordance with the QLCA method. Their selection may result from the specificity of the company's activity, including the concept of product development and market requirements.

4. Discussion and Summary

Enterprises take into account various criteria when making development decisions about products, services, technologies, or market position (Graham et al., 2005; Relich, 2023). In turn, promoting activities for sustainable development, it is necessary to take into account other key aspects, such as risk, time, or costs (Gonçalves et al., 2022; Ključnikov et al., 2022). Additionally, increased climate change generates the need to reduce the negative environmental impact of enterprise activities (Solaun, Cerdá, 2019; Serra et al., 2022). In the case of products that are an integral element ensuring the survival of manufacturing companies, including being a link between profits and customer satisfaction, it is necessary to assess their life cycle (LCA) (Schellscheidt et al., 2019; Lai et al., 2022). Therefore, it is necessary to search for methodological solutions that will support product development decisions, taking into account various aspects of sustainable development. In this study, the analysis focused on two selected aspects of product sustainability, which are key in the traditional approach to product improvement and maintaining environmental balance. These aspects are the quality of the product and its environmental impact on the environment in the life cycle (Garvin, 1984; Park et al., 2007; Gawlik et al., 2024). Therefore, the objective was to develop a framework for selecting quality and environmental aspects when improving products towards their sustainable development. This framework was developed based on the results of previous studies, for example (Pacana, Siwiec, 2024; Siwiec, Pacana, 2024b, 2024a, 2024c), within which the Quality Life Cycle Assessment (QLCA) method dedicated to sustainable product development was developed, taking into account the aforementioned quality and environmental aspects.

The framework supports the creation of product rankings taking into account the ratio of the share of meeting customer expectations and producing environmentally friendly products throughout their life cycle. Other, main benefits of the developed framework for selecting the proportion of the share of qualitative and environmental indicators include:

- improving the process of selecting quality and environmental aspects depending on the chosen product development direction,
- ensuring the appropriate dynamics of the participation of quality and environmental aspects in the product improvement process,
- verification of undertaken improvement actions in terms of quality and environment as part of the created product prototype rankings,
- support the decision-making process when predicting the direction of product development.

However, some limitations concern the omission of other important aspects of sustainable development, such as the costs of purchasing products. This may result in obtaining design solutions, including prototype rankings, which may change at later stages of development, e.g. due to the available budget. Additionally, the product selection framework is dedicated,

in particular, within the QLCA method. This results from the adopted methodology, based on which the assumptions for creating the framework for selecting the proportions between the verified quality and environmental aspects were outlined.

Therefore, further research will include the extension of the QLCA method to other aspects of sustainable development. Then, it is planned to develop a framework for selecting the proportions of other aspects, e.g. cost. Another intention is to define a framework for selecting the proportions of sustainable development aspects that are general, which can be used not only within the QLCA method, but also within different approaches during the design and improvement of products.

Therefore, the developed framework for selecting quality and environmental aspects can be used by designers and experts during the development of sustainable products. Mainly, when using the QLCA method. The results will be useful when making development decisions, where it is crucial to direct actions towards achieving customer satisfaction with the quality of products and reducing their negative impact on the natural environment in the life cycle.

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THE IMPACT OF ADVANCED TECHNOLOGIES ON THE DEVELOPMENT OF THE CASHLESS PAYMENTS MARKET IN POLAND

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Purpose: the purpose of the article is to analyze the impact of modern technologies on the development of cashless payments and to assess the trend of changes in the Polish payment instruments market.
Design/methodology/approach: general scientific and empirical methods and tools of economic science, methods of analysis and synthesis, comparison, summary and grouping were used in the study. GRETL programming was used to find out the impact of the cashless payment market on the economic development of the country. The method of summarizing the results was used to draw conclusions regarding the trends of the cashless payment market in Poland.
Findings: the article analyzes the quantitative and qualitative changes in the market of payment instruments in Poland, the main place of which belongs to bank payment cards in conditions where the digitalization of the economy determines the main development trends not only of the financial sector but of all aspects of human life. The dynamics of the main quantitative parameters of the functioning of the payment card market in Poland over the past eight years have been analyzed, which indicates its active qualitative development and the presence of stable growth trends.
Research limitations/implications: modeling the relationship between GDP and the development of cashless payments is limited to selected indicators characterizing the development of the contactless payment market in Poland. Quarterly data for the period of 2012-2022 were used for this purpose.
Practical implications: the study confirms the need for the banking sector to implement a set of measures to develop the cashless payment market in Poland. Expanding the use of payment cards will not only contribute to the technological development of banks and strengthen their competitive position, but will also have a positive impact on the digital transformation of the economy in general.
Social implications: the development of cashless payments contributes to the accessibility, convenience, and speed of their implementation for users. The further use of innovative payment instruments by customers requires, first and foremost, improving the quality of their service and ensuring the security of cashless payments.
Originality/value: the study confirms a direct link between the number of payment card transactions and online payments and the country's economic development.
Keywords: cashless payments, payment cards, advanced technologies.
Category of the paper: Research paper.

1. Introduction

The rapid development of digital technologies has promoted the emergence of new tools for providing services in the financial market, the growing popularity of mobile applications, innovative IT technologies, neobanking, cryptocurrencies, etc. Innovations in the banking sector are changing the approaches and attitudes of customers to the use of financial services. First and foremost, they seek convenience, speed and security in managing their own funds and performing the required transactions. Automation of business processes, introduction of online banking, installation of self-service banking terminals, and use of artificial intelligence to analyze and monitor financial transactions benefit both financial services consumers and financial institutions.

Technological changes in the organization of banking institutions also affect the approaches to the implementation of their functions. Some researchers (Dziubliuk et al., 2022) point out that the organization of payment turnover as a key function of the banking system can no longer be considered separately from the emergence in recent decades of the latest digital products and technologies related to electronic transactions, bank cards, modern cash flow instruments, and virtualization of bank-customer interaction in general, which in fact fundamentally changes the entire banking activity, adding to it the dynamism that meets the needs of the new, digital economic order, especially in terms of payments. The spread of Internet banking, virtual wallets, contactless payment technologies and other innovations in banking is essentially an adequate response of the digital economy to the demands of the times to reduce the turnover costs associated with the movement of funds between market participants. The payment card market is the key link in this process, and it actually meets these needs in practice. Payment cards are becoming a key tool for implementing the complex task of reducing the share of cash payments in the overall structure of cash turnover as an important means of reducing overall turnover costs and increasing the efficiency of economic development in general.

A significant number of research papers have been devoted to the issues of cashless payments and their impact on economic development. The following research papers are particularly remarkable in this regard Galbraith & Tkacz (2007; 2009; 2015), Ching & Hayashi (2010), Hasan et al. (2012), Mieseigha & Ogbodo (2013), Guptha & Rao (2018), Przenajkowska & Polasik (2018), Aladangady et al., (2019), Sahi et al. (2021), Karjaluoto et al. (2021), Świecka et al. (2021), Kotkowski & Polasik (2021), Zandi & Singh (2021), Di Iorio & Rocco (2022), Carbo-Valverde et al. (2023), Niankara & Traoret (2023), Tut (2023), Stoika (2024).

However, despite a large number of thorough researches, it should be noted that a significant number of issues related to the impact of innovations on the development of the cashless payment market remain understudied.

The purpose of this publication is to analyze the impact of modern technologies on the development of cashless payments and to assess the trend of changes in the Polish payment instrument market.

2. Methods

General scientific and empirical methods and tools of economic science, methods of analysis and synthesis, comparison, summary and grouping were used in the study. GRETL programming was used to find out the impact of the cashless payment market on the economic development of the country. The method of summarizing the results was used to draw conclusions regarding the trends of the cashless payment market in Poland. Statistical data of the National Bank of Poland (NBP), the European Central Bank and the Polish Bank Association were used to analyse the development of the payment instrument market in Poland.

3. Literature review

In recent years, researchers have been increasingly focused on the impact of cashless payments on various processes in the economy. In particular, the article by Das et al., 2023, is devoted to the study of the impact of the Indian demonetization policy on tax compliance. The authors conclude that the use of e-payments has likely strengthened the ability of tax authorities to monitor tax liabilities and ensure compliance.

Rahman et al., 2022 note that the introduction of cashless payment systems by businesses in Malaysia can reduce the costs associated with handling huge amounts of cash in the market and increase the speed of transactions. At the same time, the key factors affecting the introduction of cashless payments by businesses are not their size, but the support of management, pressure by competitors, and the intensity of information.

The other researchers (Luan et al., 2023) note that the use of cashless payments increases the income of public tourist companies in Vietnam.

Lv, J. et al., 2024, investigate the impact of the digital economy on the informal economy in China. The researchers conclude that the development of digital finance has a negative impact on the informal economy. This is because digitalization provides many more benefits in terms of addressing the informality problem, such as transparency of payments, easing credit constraints, increasing overall income, and helping governments reach out to the population and businesses.

Some researchers (Aladangady et al., 2019; Baker, 2018; Galbraith, Tkacz, 2007) notes, that the use of electronic payments, including mobile banking and other FinTech platforms, is an important determinant of the cyclical position of the economy and is an indicator of economic growth Electronic payments represent a unique source of information for short-term economic forecasting (Aprigliano et al., 2019). Existent research denotes a link between the development of non-cash payment system and economic growth (Alvarez, Lippi, 2009; Mieseigha, Ogbodo, 2013; Aliha et al., 2020). The existing literature has determined that electronic card transactions are a real-time indicator of the economy's cyclical position (Galbraith, Tkacz, 2009, 2015).

Zandi & Singh (2021) have conducted a comprehensive analysis of the macroeconomic benefits of payment cards in terms of their distribution in individual countries and their impact on economic growth. Their findings show that the transition from physical cash to payment cards serves as an impetus for the development of the entire global economy and thus determines the need for public policy that encourages and accelerates such a transition.

Humphrey et al. (2006) found that the development in the use of electronic payment systems, mainly electronic retail payment instruments, is related to notable improvements in banking performance. In fact, as documented in Humphrey et al. (2006), between 1987 and 1999, European countries may have saved $32 billion by shifting from paper-based to electronic payment systems that is the 0.38% of the aggregate GDP in 1999. Furthermore, they document that if a country shifts from an all paper-based to a fully electronic-based payment system and substitutes branch offices with ATMs, the annual savings may be around 1% of GDP.

In 2019, the largest U.S. banks paid out $35 billion in rewards (Sumit et al., 2023). For cardholders, credit card rewards are an opportunity to earn money or perks with the use of their credit cards. For banks, credit card rewards are an incentive scheme to induce consumers to adopt and increase the usage of the banks' credit card products (Sumit et al., 2010; Ching, Hayashi, 2010).

Kotkowski R. & Polasik M. (2021) notes, however, the COVID-19 pandemic (henceforth "the pandemic"), and the measures imposed by governments to contain it, appear to have had a considerable impact on consumer payment behaviour. This is most evident in the rapid increase in the adoption of cashless payments.

Tut D. (2023) shows the effects of the coronavirus disease 2019 (COVID-19) pandemic on financial institutions and on consumers' adoption of Financial Technology (FinTech) for payments. Carbo-Valverde et al. (2023) examines the impact of the Covid-19 mobility restrictions on the payment choices at brick-and-mortar establishments. Niankara I. & Traoret R.I. (2023) shows, how the digital payment-financial inclusion nexus fostered demand-driven payment system innovation and diffusion within the global open economy during the COVID-19 crisis.

Driven by the worldwide increase in consumers' preferences for real time payments, especially since the onset of the global COVID-19 crisis (Vargo et al., 2021), the global demand

for digital payment transactions, has been reportedly fuelled by the increasing adoption of contactless payment solutions, including digital wallets (Singh et al., 2020), mobile payment, online banking (Karjaluoto et al., 2021) and point of sale (Sahi et al., 2021).

By drawing on the data from various national payment systems, Kraenzlin et al. (2020), Ardizzi et al. (2020) shows that the volume of cashless payments increased in Switzerland, Italy and France during the pandemic, despite an overall decline in consumption expenditure.

The innovation in the payment system and instruments have caused a change in the choice of payment method among the consumers. Consumers are expected to benefit from the convenient payment instruments, both in terms of timing and costs. Therefore, cashless payment is expected to facilitate consumption, thereby increasing economic growth. Payment cards as a key tool for remote access to bank accounts are the main driver of the development of cashless payment operations and the promotion of the institutional foundations of money circulation in the direction of the increasing growth of its cashless component.

4. Results and Discussion

Information technology is one of the main factors affecting the possibility of banking services access. During 2015-2021, the share of Internet users in the European Union (EU) and Poland increased from 76% to 87% and from 68% to 85%, respectively (Fig. 1). Increasing penetration of the Internet and mobile telephony in the EU and in Poland has contributed to the change of consumers' habits and preferences. They increasingly use social interaction via digital media to share information about themselves, interact with administrative authorities, make online purchases, or gain access to new services, including 24/7 financial services (Peterson, 2018).

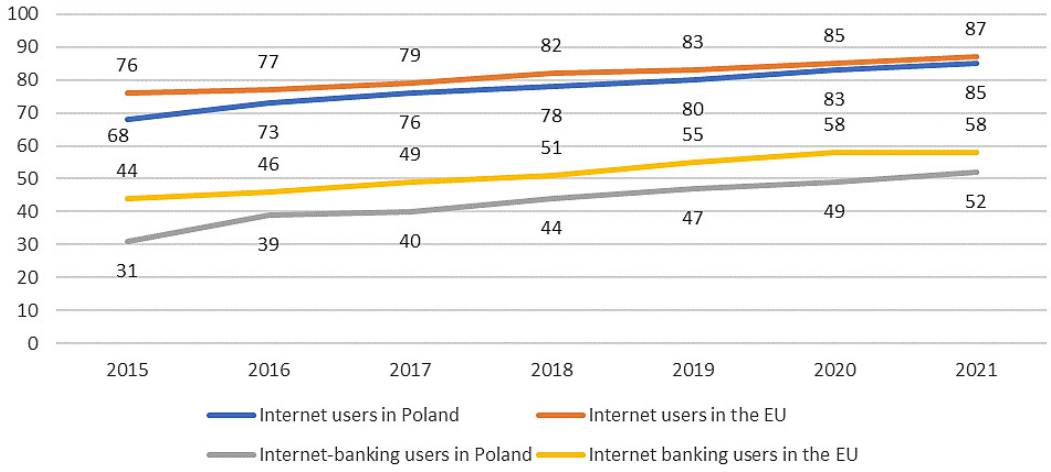

Figure 1. Internet and internet banking users in the EU and Poland in 2015-2021 (% of population).
Source: The author' own research on the basis of Eurostat.

Against the background of increased access to Internet technologies, there is an increase in the share of people using Internet banking. During 2015-2021, it increased from 44% to 58% among the EU population, and from 31% to 52% in Poland. Among the EU Member States, internet banking is most common in Denmark (95% of users in 2021), Norway (96%), Iceland (95%), Finland (93%) and the Netherlands (91%). The fewest internet banking users in 2021 were in Bulgaria (15%) and Romania (15%) (Eurostat 2023). The high level of e-banking use is primarily due to the active development of digital innovations and information technology. In particular, this is confirmed by the data of the Digital Economy and Society Index (DESI). In 2021, the leaders according to the DESI index were Denmark, Finland and Sweden. Poland was in 24th place among EU countries, ahead of Greece, Bulgaria and Romania (DESI, 2021).

During 2015-2022, the number of individual accounts of customers with access permission agreements to online banking in Poland increase from 30 million to 42 million. Moreover, only half of customers are active users of Internet banking, of which about 10% are small and medium-sized enterprises (SME) (Fig. 2):

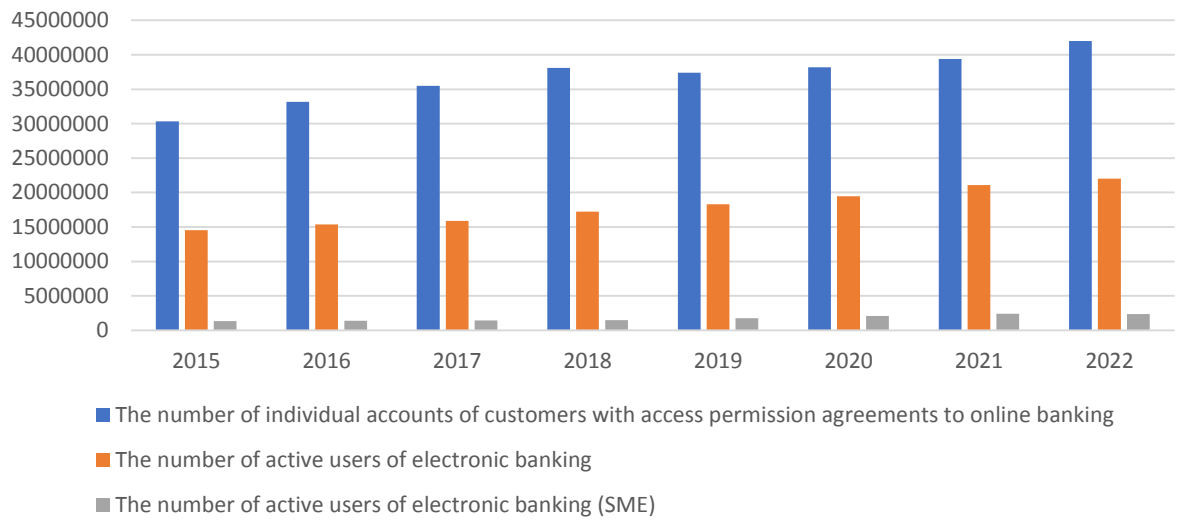

Figure 2. Number of e-banking users in Poland in 2015-2022, persons.

Source: The author's own research on the basis of Polish Bank Association.

The number of Poles who actively use their bank account via the Internet is increasing (from 46% in 2009 to 80% in 2021). At the same time, the relationship between the age of a bank client and the use of an Internet account is obvious. In younger age groups up to 44 years, up to 96% of customers use the Internet to access their accounts. In the group of 45-54-year-olds – 86%, among 55-64-year-olds 67% use the possibility of servicing accounts via the Internet, and among the oldest customers (over 64 years old) – 44%. Most often, Internet accounts are used to check transaction history and make payments. At the same time, there is an increase in the number of people who often pay bills or make money transfers using the Internet (by the end of 2021, their share was 99%). Instead, other transactions, in particular, opening a deposit, buying shares in an investment fund, are less popular. The percentage of Poles who say that they "definitely more often" use remote bank account management instead

of visiting a branch increased from 46% in 2009 to 73% in 2021. Moreover, only 5% of people who have access to an account via the Internet more often choose a personal visit to a bank branch (Maison, 2021).

In Poland, payment cards were first introduced to the market in the 1990s. This payment instrument is becoming more popular and, against the background of the other cashless instruments, its use is growing annually by about 30%, while in the EU market this growth is about 10% (Niedzwiedzka, 2018). Over the past eight years, the number of payment cards in Poland has increased by almost 10 million (Table 1):

Table 1.
Number of payment cards in Poland in 2015-2022 (pcs.)

Years	Cards, total	Cards for individual customers		Cards for business customers		Contactless cards	
		number	share, %	number	share, %	number	share, %
2015	35,209,043	32,217,141	91.50	2,991,902	8.50	27,018,902	76.74
2016	36,874,489	33,324,415	90.40	3,550,074	9.60	28,494,784	77.30
2017	39,095,880	35,059,278	89.68	4,036,602	10.32	31,138,220	79.65
2018	41,237,320	36,829,538	89.31	4,407,782	10.69	34,675,149	84.09
2019	42,989,876	38,277,841	89.04	4,712,035	10.96	37,281,629	86.72
2020	43,675,231	38,742,597	88.71	4,932,634	11.29	38,361,247	87.83
2021	43,261,902	38,303,241	88.54	4,958,661	11.46	40,174,309	92.86
2022	44,523,137	39,825,523	89.45	4,697,614	10.55	41,637,837	93.52

Source: The author' own research on the basis of NBP.

Cards for individual customers significantly prevail (89.45% in 2022), but the share of cards for business customers is also on the rise (10.55% in 2022). The number and share of contactless payment cards is also growing. Between 2015 and 2022, their volume increased by more than 14 million cards, and their share – from 76.74% to 93.52%. Besides contactless cards, there are also the other media on the Polish market that allow for contactless payments. These include cards installed in phones, watches, bracelets, and so-called stickers. According to the NBP, the number of all contactless payment instruments based on payment cards amounted to 49 million at the end of 2022. The gradual rise in popularity of contactless payment cards containing more advanced information security technologies is an indicator of the further digitalization of payment mechanisms and their coverage of an increasing number of economic agents in the payment environment.

Debit cards significantly prevail among the issued payment instruments in terms of the payment method. Between 2015 and 2022, their share increased from 76.43% to 84.20%, while the share of credit cards decreased from 16.49% to 11.00%. The feature of debit cards is that they allow paying for purchases or withdrawing cash within the amount of funds available on your bank account. Unlike bank deposits, payment cards show better liquidity and thus reliability for storing funds, and therefore enjoy a higher level of public trust.

The number of payment card transactions almost tripled between 2015 and 2022, from 3,307,005,565 to 9,097,719,555 (Fig. 3). At the same time, the number of cashless payment card transactions also increased significantly, from 2,556,223,180 to 8,566,775,212, and their share – from 77.3% to 94.2% during the period under review.

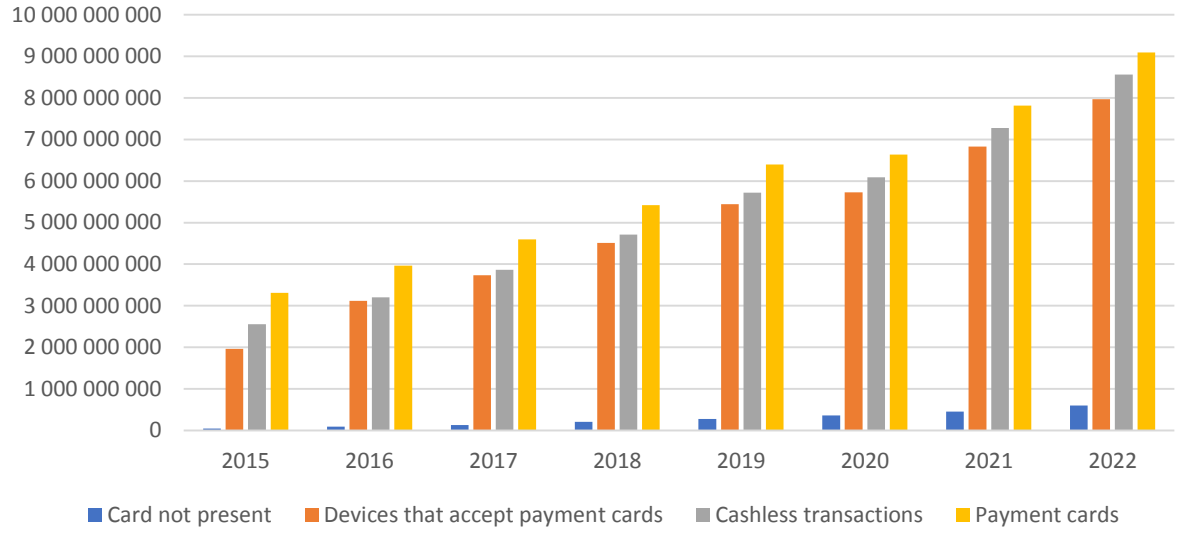

Figure 3. Number of transactions with payment cards and devices that accept payment card, as well as cashless transactions in Poland in 2015-2022**.**

Source: The author's own research on the basis of NBP.

It should be noted that during 2015-2022, the number of transactions using CNP cards grew significantly, from 44,577,242 to 596,718,881. Card not present (CNP) is a type of payment card transaction in which the cardholder is not physically present with their card at the time and place of payment. These trends indicate that Polish market participants are almost completely ready to use payment cards as a means of paying for goods and services in the course of cashless payments, rather than as a tool for withdrawing cash at a bank's cash desk or ATM.

The spread of cashless payments in Poland is facilitated not only by innovative card instruments, but also by payment systems. In particular, when making online purchases, 70% of customers usually choose a quick transfer through a payment service (e.g. PayU, DotPay, przelewy24), 48% - mobile payments (e.g. BLIK), and 42% - conventional transfers. At the same time, 76% of people make online purchases using a smartphone. In the youngest group of customers (15-24 years old), this figure was 92% (E-commerce w Polsce, 2021).

Another factor influencing the increase in the number of e-banking users using mobile phones is the popularity of the BLIK mobile payment system. This system serves to carry out various transactions using the phone within the banking mobile application. BLIK is an entirely Polish "invention" and was developed in February 2015. By the end of 2015, less than a million transactions were carried out using BLIK, but since 2018, there has been an intensive increase in transaction data. By the end of 2022, the number of BLIK transactions was 1.235 billion (fig.4), and the number of active users of this system was about 13 million people.

What is more, 49% of users of banking mobile applications choose it most often as a form of payment. Such popularity of BLIK among Poles is explained by its convenience, safety and ease of use (Polski Standard Płatności, 2023).

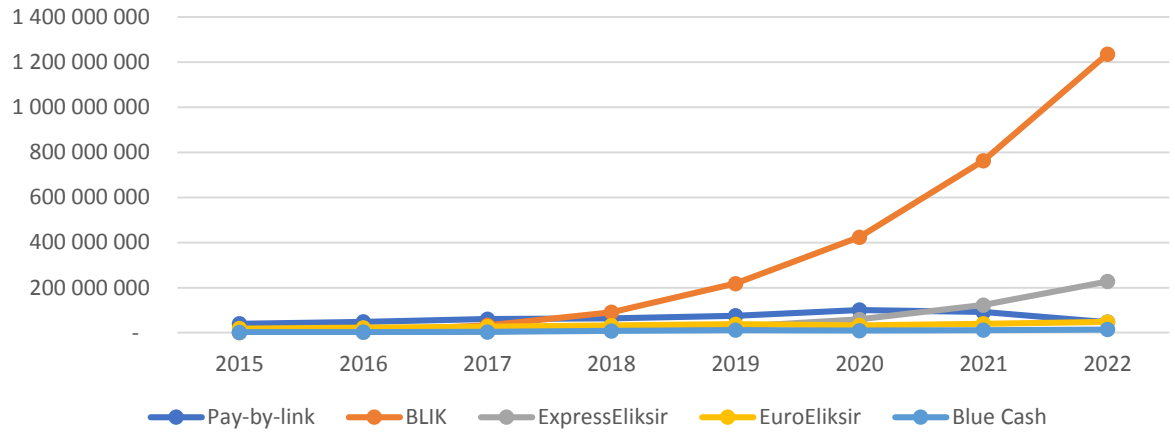

Figure 4. Number of transactions in terms of some payment systems in Poland in 2015-2022.
Source: The author's own research on the basis of NBP.

Given the customers' focus on cashless payments, there are changes in the payment card market infrastructure to ensure their implementation (Table 2):

Table 2.
Payment card market infrastructure in Poland in 2015-2022 (number, pcs.)

Parameters	2015	2016	2017	2018	2019	2020	2021	2022
Acceptors	196,758	225,196	276,288	367,959	417,861	492,755	553,518	618,531
Branches of retail and service networks	364,186	424,016	489,511	609,743	694,136	785,861	876,740	959,874
POS terminals	465,457	563,236	632,955	786,845	906,564	1,027,490	1,123,060	1,220,597
ATMs	22,143	23,443	23,230	22,879	22,704	21,829	21,396	21,310

Source: The author's own research on the basis of NBP.

During 2015-2022, the number of acceptors and branches of retail and service networks accepting payment cards, as well as POS terminals increased almost threefold. It should be noted that the growth in the number of POS terminals in Poland is largely due to the launch of the Poland Cashless program, which aims to eliminate the cost for entrepreneurs to install a payment terminal and the cost of using the same during the first twelve months after its installation. Instead, the number of ATMs decreased by about 1000 pcs. This trend is typical not only for Poland but also for the entire Europe. Banking institutions are interested in reducing the number of ATMs in order to cut their own costs and create conditions to encourage card users to further abandon cash and to maximize the use of cashless payments.

In 2015-2021, Poland ranked first among the 27 EU countries in terms of the number of payment service branches. Poland's high position in this ranking is mainly due to the fact that conventional l institutions offering payment services (banks, credit unions, Poczta Polska, etc.)

also include a new group of entities that have been eligible for the benefits of such services since the entry into force of the Payment Services Directive in 2009. In our country, these are mainly companies where customers deposit cash into bank accounts to make monthly payments (e.g., energy, gas, telephone, rent). According to NBP, excluding branches of payment service institutions and payment service points, this figure be 472 branches per million population in 2021, i.e. above the EU average (393), and Poland would have ranked 11th among the 27 EU countries.

In terms of the ratio between GDP per capita (in EUR) and the number of payment instrument transactions per capita in 2021, there is a clear difference between the so-called "old" EU member states and the "new" EU member states, i.e., countries that acceded to the EU on or after May 1, 2004. The "new" member states have both lower income levels and fewer cashless transactions per capita. In 2021, GDP per capita in Poland amounted to EUR 15.1 thousand. The number of transactions per capita in Poland in 2021 was 300.9 (2020: 253.3), while the average GDP per capita in the Union in 2021 was EUR 32.3 thousand and the average number of cashless transactions was 318.2.

In terms of the country's share in the total number of card payments in the EU, which amounted to 9.8% in 2021, Poland ranked fourth after France (21.5%), Germany (11.1%), and Spain (10.2%) (Fig. 5):

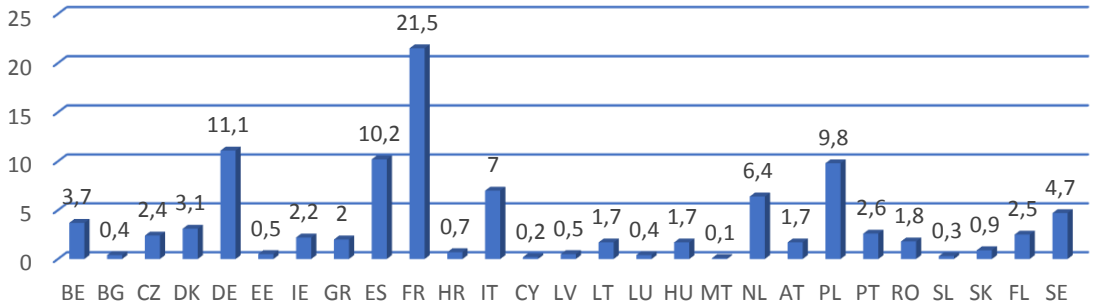

Figure 5. Country's share in the total EU number of card payments in 2021 (as a percentage; total for the period).

Source: The author's own research on the basis of European Central Bank.

In terms of the country's share in the total value of EU card payments in 2021, Poland ranked eighth after France (24.6%), Germany (14.6%), Italy (10.0%), Spain (9.5%), the Netherlands (5.0%), Belgium (4.4%), and Sweden (4%) (Fig. 6):

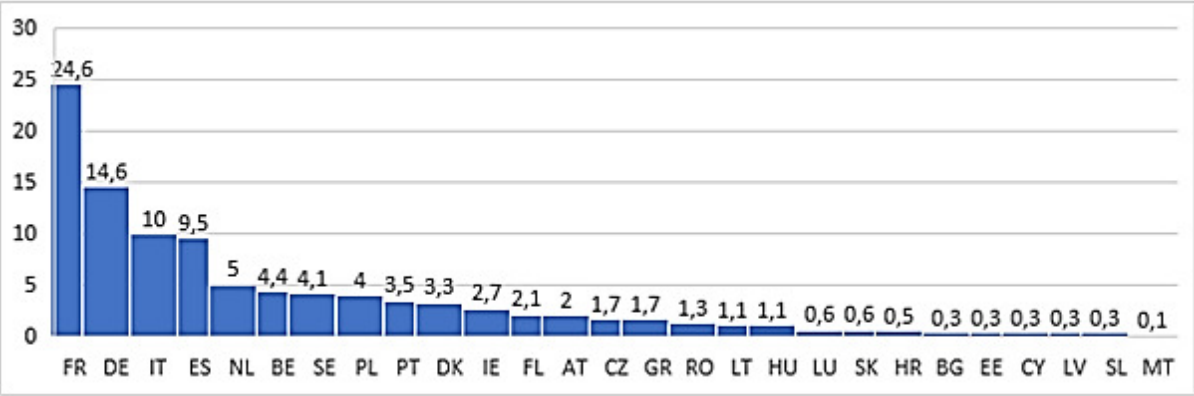

Figure 6. Country's share in the total EU value of card payments in the EU in 2021 (as a percentage; total for the period).

Source: The author's own research on the basis of European Central Bank.

To determine the relationship between a country's GDP and the cashless payment market, a linear model is built to explain its dependence on the following indicators that reflect the quantitative characteristics of the development of the payment card market and its infrastructure in the country:

- number of individual customers having access to e-banking, persons;
- number of ATMs, pcs.;
- number of POS terminals, pcs.;
- number of payment card acceptors, pcs.;
- number of online payment branches, pcs.;
- number of payment card transactions on the Internet, pcs.;
- cost of payment card transactions on the Internet, PLN;
- number of payment cards, pcs.;
- share of cashless payment card transactions, %;
- number of payment card transactions, pcs.

The calculations produced a model that reflects a linear relationship between a country's GDP and some indicators of the cashless payments development in the country.

To build the model, quarterly statistical data for the 2012-2022 period from the following databases were used: the Main Statistics Office, the National Bank of Poland and the Polish Bank Association. GRETL programming was used for the research and the classical least squares method was applied. As a result of calculations, a model was obtained that reflects the linear relationship between the country's GDP and some indicators of the payment card market:

$$GDP = a_0 + a_1POSt + a_2PCTinternet + a_3PCTnumber$$

where:

POSt - number of POS terminals, pcs.;

PCTinternet - number of payment card transactions on the Internet, pcs.;

PCTnumber - number of payment card transactions, pcs.

Table 3 shows the model evaluation results.

Table 3.
Model evaluation results: OLS estimation, using observations 2012:4-2022:4 (number of periods - 41). Dependent variable: GDP

Variables	***Coefficient***	***Std. Error***	***t-ratio***	***p-value***	***Notes***
const	465060	44792,7	10,38	<0,0001	***
POSt	−0,509913	0,151393	−3,368	0,0018	***
PCTinternet	0,00937317	0,00225546	4,156	0,0002	***
PCTnumber	0,000177345	5,39824e-05	3,285	0,0022	***
Basic statistics for variables					
Mean dependent var		535103,7	S.D. dependent var		115980,6
Sum squared resid		4,52e+10	S.E. of regression		34962,49
R-squared		0,915943	Adjusted R-squared		0,909127
F(3, 37)		134,3919	P-value (F)		6,04e-20
Log-likelihood		−485,0153	Akaike criterion		978,0307
Schwarz criterion		984,8850	Hannan-Quinn		980,5266
rho		−0,050343	Durbin-Watson		1,786693

Notes:
***The variable is statistically significant at a significance level of 0.01.
** The variable is statistically significant at a significance level of 0.05.
* The variable is statistically significant at a significance level of 0.1.

Source: The author's own calculations based on GRETL programming.

Additional model reliability testing confirmed the linear relationship between the dependent and independent variables, as well as the absence of heteroscedasticity and autocorrelation.

The model evaluation results show that it explains 91% of the variability of the dependent variable, and all variables of this model are statistically significant. The number of POS terminals in the country demonstrates the strongest relationship with the dependent variable (i.e. GDP), although it is inverse to GDP. A direct relationship between the country's GDP and the number of payment card transactions and payment card transactions on the Internet has also been confirmed. There is no relationship between the other indicators and the dependent variable. This situation may be due to the still weaker development of certain indicators of cashless payments in Poland (e.g., the number of individual customers having access to e-banking, the number of payment cards, the share of cashless transactions using payment cards) and, consequently, their insignificant impact on the country's GDP.

Conclusion

The development of modern technologies has determined the direction of changes in the payments sector. Digitalization is a recognised mechanism of economic growth due to the ability of technology to positively influence the efficiency, effectiveness, cost and quality of economic, public and personal activities. Modern banking can no longer be considered separately from the emergence of the latest digital products and technologies and the

virtualisation of interaction between banks and customers in general. Internet access, the use of smartphones, and the development of e-commerce have led to remote payment servicing. Modern customers choose convenience, ease, speed and security of payments. Banks are trying to adapt to the needs of the population and provide access to advanced payment instruments.

Poland is characterised by an increase in the number of individual customer accounts with access permission agreements to online banking, but in fact only about half of them are active users. The share of customers of small and medium-sized enterprises is also insignificant.

The main payment instrument in Poland is contactless payment cards, the number of which is growing rapidly. Further to that, CNP cards, which do not require the presence of their holder to make a payment, are gaining popularity. The emergence of the BLIK payment system in 2015, which allows for various transactions using a mobile banking application, also contributed to the spread of cashless payments in Poland.

These changes in customers' approach to payment methods have promoted the development of the payment infrastructure. Between 2015 and 2022, the number of acceptors and branches of retail and service networks that accept payment cards, as well as POS terminals, almost tripled. In 2015-2021, Poland ranked first among the 27 EU countries in terms of the number of payment service outlets. These trends indicate that Polish market players are almost completely ready to use payment cards as a means of paying for goods and services in the course of making cashless payments, rather than as a tool for withdrawing cash at a bank's cash desk or ATM.

The model of GDP dependence on certain indicators of cashless payments development built by the author of this paper has confirmed the direct connection between the number of payment card transactions and Internet payments and the country's economic development.

The further development of the payment card and cashless payments market should become a strategic direction for the Polish financial system in the digital age. This requires expanding innovative services for payment cards, improving the quality of their service, further developing payment infrastructure tools, and ensuring security of cashless payments. Thus, it would be useful to learn from the foreign countries’ experience of arranging cashless payments in order to develop recommendations for their improvement in Poland.

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DETERMINANTS OF DISCRIMINATION AGAINST WOMEN IN THE LABOUR MARKET AND STEREOTYPES IN THE PERCEPTION OF THEIR SOCIAL ROLES

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Purpose: This article aims to verify the areas affected by discrimination against women in labour market and, at a later stage, also to assess whether these areas are correlated with each other.
Design/methodology/approach: The first part of the article refers to the theoretical assumptions of discrimination. In turn, the empirical part presents the results of a preliminary survey conducted in early 2024. In this respect, an attempt was made to build a logit model based on the ordinary least squares (OLS) method. Only the responses given by women, who accounted for 64.19% of the total respondents, were used for the analysis.
Findings: Based on the research conducted, it was proven that there is a significant relationship between the explained variable and the explanatory variables. According to the respondents, women who are discriminated against in such areas as employment conditions, salary and access to high-level positions, as well as because of their choice to have and raise children, simultaneously believe that they are discriminated against because of their choice of jobs. Further, according to the same respondents, there should be no work-life balance in women's lives. It was also found that employers do not take any measures to encourage women to return to the workforce, which reinforces feelings of discrimination.
Research limitations/implications: Based on the results of the analysis conducted, it was assumed that further research would assess the solutions promoted by employers to encourage women to return to the labour market. The limitations of the research conducted were taken to be its concentration on one region only.
Social implications: The results of the research carried out prove the need for solutions to eliminate it completely. Dissemination of good practices in this area may significantly contribute to the professional development of women while positively influencing their willingness to return to the labour market and, consequently, changing social attitudes and suppressing stereotypes.
Originality/value: The article presents new original empirical research that confirms the existence of discrimination against women in the labour market. These considerations are primarily directed at women remaining in or re-entering the labour market, as well as employers.
Keywords: Discrimination, discrimination of women in the labour market, ordinary least squares method (OLS).
Category of the paper: Research paper.

1. Introduction

According to the definition in the Public Information Bulletin of the Commissioner for Human Rights, discrimination occurs when persons — due to their gender, nationality, religion, belief or disability — are treated worse than they would be if they did not stand out from others in terms of the aforementioned characteristics (Public Information Bulletin of the ROP, 2014).

The obligation of equal treatment of citizens by public authorities, including with particular emphasis on gender equality, is regulated by the Polish Constitution (Constitution of the Republic of Poland, Art. 32., Art. 33. Chapter II. The Freedoms, Rights and Obligations of Persons and Citizens. General Principles, 2009). Notably, additional provisions have been established to guarantee that these standards will be respected, including: the Act of 3 December 2010 on the implementation of some regulations of the European Union regarding equal treatment (Labour Code, Art. 112–113., Art. 183c., 2023).

Regardless of the area it concerns, discrimination is recognised as a widespread problem, present at many levels of socio-economic life. Generally, this phenomenon is the subject of numerous scientific considerations, with one of the most frequently addressed being the issue of discrimination against women in the labour market.

In this regard, discrimination is the inferior treatment of women in relation to men, even though — from a work-oriented standpoint — these individuals do not differ in terms of social, demographic or economic characteristics (Niedziński, 2022). The unequal treatment of women results from using different criteria to verify the work of individuals, which, in practice, creates unequal conditions for their individual development. At this point, it is worth mentioning the prevailing social patterns according to which a woman is obliged to take care of children. It must be noted that motherhood negatively affects women's professional development and their ability to generate income (Yopo Díaz, 2022). Labour market discrimination occurs in spite of the fact that women and men are characterised by similar competencies, comparable experience and the same productivity (Dziuk, 2020; Fernandes et al., 2023).

The main forms of discrimination include direct (intentional) discrimination (Aislinn Bohren et al., 2023) and indirect discrimination, i.e. in the area of wage policy (Lindholm et al., 2022). The former occurs when the inferior treatment of employees is due to their gender. The latter, on the other hand, stems from forcing a particular group of employees to meet demands that they are unable to cope with. This results in a disparity between positions in the labour market (Dziuk, 2020; Niedziński, 2022; Wilk, 2018).

Another, more detailed, classification of discrimination considers the relationship that exists between a person and the labour market. This classification is included in Table 1.

Table 1.
Discrimination according to the relationship between the employee and the labour market

Discrimination by relationship between the individual and the labour market	Pre-employment discrimination, including: – employment-related (when an employer selects an employee based on the characteristics of a particular group of people) – competencies- and occupation-related (related to the existence of top-down educational restrictions, e.g. assumptions that women should not work in certain professions) – human capital (related to the inhibition of certain groups of people who seek to increase their work efficiency, e.g. access to training) – self-discrimination (involves fighting each other to defeat an "opponent" instead of fostering cooperation and mutual assistance)
	Work-related discrimination
	Wage discrimination (occurs when wage disparities are due to arguments other than labour productivity indicators)

Source: own elaboration based on (Kalinowska-Nawrotek, 2004; Dziuk, 2020).

D. Witkowska notes that, despite successive efforts to eliminate gender inequalities in the labour market, gender-based disparities and resulting discrimination against women are still observed. In this regard, she draws attention to discrimination against women, which can take such forms as (Witkowska et al., 2019):

- discrimination in terms of choosing specific fields of education,
- discrimination in terms of the salary received,
- discrimination with regard to terms and conditions of employment,
- forcing women into low-paid industries and professions, indicating low social standing,
- limited opportunities for promotion and enhancement of competencies to achieve a better professional position.

The first of the above types of discrimination is indirectly linked to the labour market and concerns people who are at the "pre-entry" stage. In contrast, the next four types are directly linked to it (Witkowska et al., 2019)

The literature contains scientific studies focused on the search for the causes of discrimination against women in the labour market (Wilk, 2018). In this respect, it is often noted that women are less committed and lack proper skills towards negotiating a higher salary or have a low tolerance for risk, among other things. The considerations undertaken in this area generally involve assessing the level of discrimination against women in the labour market in statistical terms, while taking into account prevailing stereotypes. It is worth noting that such an approach conceals the real conditions that directly influence the unequal treatment of women and men in the labour market. These factors include things like background, ascribed social status and any prejudices or stereotypes acquired during the socialisation process, etc. (Adamus, 2015).

Citing E. Lisowska's research, D. Witkowska notes that what lies at the root of women's discrimination in the labour market is their historical legacy, and more specifically, the barriers that existed in the past in terms of access to education, which contributed to the lowering of women's standing. Women's discrimination in the labour market is observed as early as the recruitment process, which is sometimes expanded to include questions regarding marital status

and future plans (Lisowska, 2009). It is worth mentioning that women have always been viewed as kind-hearted and highly committed to the community, whereas men have always been perceived as decisive and characterised by a high level of commitment but without a sense of community (Manzi et al., 2024). Accordingly, the entry of women into the workforce was treated as the arrival of cheaper labour, while the work they performed was considered less demanding than that performed by men. It is vital to emphasise that there is still a belief in society regarding the division of occupations into "typical for women and characteristic for men" (Witkowska et al., 2019).

In practice, the influence of stereotypes on women's labour market situation is noticeable, including in terms of employment conditions, salary levels and the acquisition of new competencies. Still, the approach of women themselves to their professional development cannot be overlooked either. Due to the desire to balance their professional and private lives, they often lose their determination and decide to work in jobs requiring much less commitment and, therefore, accountability, resulting in a lower salary. In EU countries, discrimination against women in the labour market is most often associated with (Witkowska et al., 2019):

- earning lower wages than men working the same job,
- inhibiting the development of competencies and the pursuit of career advancement,
- limiting access to high-level positions,
- women's achievements being appropriated by men.

Recently, many attempts have been made to eliminate these stereotypes from society. These include:

- legislation to eliminate discriminatory practices affecting women's professional development,
- promoting women's employment in managerial positions, which translates into faster economic growth.

It is worth mentioning that the percentage of women occupying high-level positions is at an all-time low (28% in EU countries) (Maheshwari, Lenka, 2022). It is assumed that this is mainly due to society's beliefs about women's commonly accepted social roles, which are overwhelmingly reduced to childbearing and childrearing.

The so-called glass barriers preventing women from achieving leadership positions are particularly highlighted in the literature. They are described in Table 2.

Table 2.
Barriers hindering women's professional development

Glass ceiling	It is regarded as an invisible barrier that hinders women's professional development in terms of taking up high-level positions, which is the case in both politics and business (Babic, Hansez, 2021; Espinosa, Ferreira, 2022; Maheshwari, Lenka, 2022). Notably, this also applies to professions commonly dominated by women (Góral, 2021). The glass ceiling phenomenon refers to persons with tertiary education and extensive white-collar competencies (Witkowska et al., 2019). According to researchers, women occupy inferior positions to men in the area of management (Czajka, 2016). Glass ceilings are also referred to as glass doors (Kräft, 2022).
Glass wall	It occurs when women in managerial positions are not fully accepted by their colleagues (Góral, 2021; Shatilova et al., 2021).
Glass cliff	It involves appointing a woman to a managerial position with the presumption that she will not be able to handle the undertaking to which this promotion relates. In such cases, women-led projects are doomed to fail (Góral, 2021). This approach is intended to show that women do not perform well in management positions, especially in "no-win" situations. The term "glass cliff" also refers to constantly judging and criticising women in high-level positions (Witkowska et al., 2019). Often, it also refers to appointing a woman to a position of power when the company is about to collapse (Grangeiro et al., 2022; Yang et al., 2022).
Glass escalator	Refers to cases where men obtain managerial positions in jobs typically held by women, while limiting women's opportunities for advancement (Dziuk, 2020).

Source: Own elaboration.

With respect to the above barriers, the following notions should be mentioned as well:

- sticky floor — refers to hindering the professional development of employees with lower education and qualifications, who are employed in low social status "pink collar" positions (Ciminelli et al., 2021; Dziuk, 2020; Witkowska et al., 2019);
- Matilda effect — relates to the continued ignoring of women in the context of their research and scientific activities and the appropriation of their successes by men (Song et al., 2024; (Witkowska et al., 2019);
- velvet ghetto — refers to the continued dissemination of stereotypes according to which a woman's place is at home and her role is reduced to caring for the home and family. In practice, this approach generates difficulties for women's employment and inhibits their further professional development (Dziuk, 2020; Zeler, Bridgen, 2024);
- Leaky pipeline effect — implies a gradual reduction in the share of women at subsequent career levels. This phenomenon is observed within different specialisations, particularly affecting women working in STEM, as well as those holding judicial or managerial positions (Witkowska et al., 2019; Witteveen, Attewell, 2020).
- Queen Bee — occurs when, despite male dominance, a woman gains access to a managerial position while at the same time inhibiting the professional development of other women (Grangeiro et al., 2022).

As the literature shows, women's discrimination in the labour market is a broad problem, manifested through such things as barriers that prevent women from pursuing their professional development. Regardless of social expectations regarding women's place in the labour market, a question arises whether these expectations coincide with commonly held views, often dictated by stereotypes, which in effect generate prejudice and, at a later stage, discriminatory behaviour. The analysis of the literature presented above proves the relevance of the

considerations undertaken. The issue of discrimination against women in the labour market is a widespread problem, which in practice can negatively affect socio-economic development. Discriminatory behaviour against women demotivates them to self-development, return to the labour market and also discourages family enlargement. In accordance with the above, the purpose of this article was to analyse the areas in which discrimination against women in the labour market is observed, and at a further stage also to assess whether there is a relationship between these areas. In this regard, the following research questions were posed:

- Do women feel discriminated against in the labour market, and if so, what do they think this discrimination is about?
- Are there solutions that can reduce women's feelings toward their discrimination in the labour market?

The research conducted in the next section is current and new, moreover, it confirms the existence of the problem in question in society. They should be considered an important contribution to further scientific analysis, including both the assessment of the determinants of the occurrence of discriminatory behavior and measures aimed at eliminating it.

2. Methods

To answer the above questions, this section of the paper attempts to verify the relationship between the selected variables. In this regard, the results of a preliminary survey, which was conducted in early 2024 on a group of 310 respondents, were used. It must be noted that its purpose was to assess the public's views on the roles women play in different areas of the socio-economic environment, with particular emphasis on the labour market and private life.

The survey was a pilot study, and the responses obtained were intended to show whether society considers the phenomenon under analysis to be a problem and whether it should be explored further. As part of the research, only responses from women, who accounted for 64.19% of all respondents (199 people), were analysed. Table 3 presents their breakdown by age.

Table 3.
Share of female respondents by age (%)

Age (years)	<18	18-25	26-35	36-45	46-55	56-65	>65
Share of women of a specific age in the total structure of female respondents (%)	8.54	5.53	24.62	20.60	19.10	13.07	8.04

Source: Own elaboration.

The data in Table 3 shows that most of the women interviewed were aged 26-35 (24.62%), 36-45 (20.60%), 46-55 years (19.10%) and 56-65 years (13.07%), which accounted for 77.39% of the analysed group of respondents. Based on the responses of the female respondents, an attempt was made at a later stage to build a logit model, which made it possible to verify the relationships between the explained variable and the explanatory variables. It was assumed that the variables would be the responses given by respondents to specific survey questions, which were captured on a 5-point Likert scale (strongly disagree: 1, somewhat disagree: 2, no opinion: 3, somewhat agree: 4, strongly agree: 5). Accordingly, the dependent variable was the responses of the female respondents to the following topic:

- Do you think women are discriminated against when it comes to their choice of jobs? (A).

In turn, the results for the following questions were selected as independent variables:

- Do you think that women are discriminated against when it comes to the terms and conditions of employment (e.g. working time standards, annual leave, applicable notice period, etc.)? (B).
- Do you think that women are discriminated against when it comes to their remuneration for work? (C).
- Do you think women are discriminated against when it comes to access to high-level positions? (D).
- Do you think that employers encourage women to return to the labour market, e.g. after a long-term illness or after childbirth and childrearing period? (G).
- Do you think that women are discriminated against in the labour market with regard to their choice of giving birth to and bringing up children? (I).
- Do you think there should be a work-life balance in women's lives? (L).
- Do you think that a partnership-based family model should be promoted, i.e. one with a fair division of household chores between partners? (M).

The parameters of an ordered logit model were defined at a further stage using the variables indicated above and the Ordinary Least Squares method. The Gretl econometric package (Kufel, 2013; Adkins, 2018; Cotrell, 2021) was used for this purpose. The results obtained in this respect are included in the next section of the paper.

3. Results

Table 4 shows the parameters of the ordered logit model for the dependent variable A.

Table 4.
Model: OLS, using observations 1-199. Dependent variable: A

	Coefficient	***Std. error***	***t-ratio***	***p-value***	
const.	0.173219	0.302470	0.5727	0.5675	
B	0.380940	0.0641216	5.941	<0.0001	***
C	0.193381	0.0698595	2.768	0.0062	***
D	0.301752	0.0643409	4.690	<0.0001	***
G	-0.0988430	0.0538864	-1.834	0.0682	*
I	0.112976	0.0589960	1.915	0.0570	*
L	-0.114042	0.0668172	-1.707	0.0895	*
M	0.164088	0.0650919	2.521	0.0125	**

Mean dependent var.	2.989950	S.D. dependent var.	1.477064
Sum squared resid.	128.1358	S.E. of regression	0.819065
R-squared	0.703376	Adjusted R-squared	0.692505
F(7, 191)	64.70170	P-value(F)	4.64e-47
Log-likelihood	-238.5674	Akaike criterion	493.1349
Schwarz criterion	519.4813	Hannan-Quinn	503.7980

Source: Own elaboration.

The data in Table 4 proves the significant relationship between the dependent variable and the independent variables. As indicated by the p-value, the explanatory variables' significance levels range from $p<0.1$ (variables: G, I, L) to $p<0.05$ (variable M) up to $p<0.01$ (variables: B, C, D). The signs of the individual parameters show that variables: B, C, D, I and M are stimulants, while variables G and L are destimulants. At this point, it is worth mentioning that an increase in the value of stimulant variables determines an increase in the dependent variable's value, while a decrease in the value of stimulants results in a decrease in the explained variable's value. The situation is different for the destimulants, where a decrease in their value contributes to an increase in the value of the complex phenomenon, while an increase in the value of this type of variable affects the decrease in the value of the dependent variable. The analysis of the parameters of the logit model in question shows that respondents (women), who expressly confirm that women are discriminated against in such areas as:

- terms and conditions of employment,
- remuneration for work,
- access to management positions, and
- individual choices regarding childbirth and childrearing,
- also believe that they are discriminated against when it comes to their choice of jobs.

In contrast, respondents who believe that women are not discriminated against in these areas disagree with the statement that they are discriminated against in relation to their choice of jobs. On the other hand, interpreting the destimulants allows us to conclude that the more respondents disagree that:

- employers encourage women to return to the workforce and
- there should be a work-life balance in women's lives,
- the more they agree with the view that women are discriminated against in their choice of jobs.

Coupled with an increase in the values of the destimulants, construed as the respondents' positive attitude to women being encouraged to return to the workforce by employers and approval for work-life balance, this shows that discrimination against women in terms of their choice of jobs does not occur. On this basis, it can be concluded that the involvement of employers in women's return to the workforce and their work-life balance can condition a positive perception of women's place and role in the labour market, effectively conditioning the absence of discrimination. The analysis of the R-squared value demonstrates a satisfactory fit of the variables to the model, with the variation of the explanatory variables explaining nearly 70% of the variation of the explained variable. Equally important, the p-value for the F-test was <0.01, which indicates that the variables used in the model are significant.

4. Discussion

The issues outlined in this article indicate that discrimination against women in the labour market is still present and is a widespread problem. This is evidenced both by theoretical considerations, in which particular attention is focused on definitions and barriers limiting women's professional development, and by the results of the early 2024 survey. Significant importance in this regard is attributed to stereotypes, which largely shape society's opinions regarding the perception of women's role in the socio-economic environment.

Limiting the survey results to women's responses was intended to show the investigated problem only from their perspective; it is also worth emphasizing that about 80% of them were of working-age, and as such, were active in the labour market. Based on the parameters of the ordered logit model, it can be seen that women who are discriminated against because of their choice of jobs simultaneously feel discriminated against with regard to their employment conditions, remuneration for work, access to high-level positions or because of their choice to give birth to and raise a child. Those same women believe that a partnership-based family model should be promoted, i.e. one in which there is a fair division of domestic chores between partners; however, this does not mean that there should be a work-life balance in women's lives. According to respondents, women who are discriminated against in the areas indicated above are not encouraged by employers to return to the workforce. It is not difficult to see that women's discrimination in the labour market in a particular area is linked to their simultaneous discrimination in other respects, meaning that women are discriminated against for different reasons at the same time. Moreover, it can be assumed that the lower the involvement of their

employers in encouraging a return to the workforce, the more discriminated against the women feel in terms of their choice of jobs. By encouraging women to return to the labour market, employers may in turn reduce their impressions of discrimination. This conclusion highlights the need to implement new solutions to eliminate discriminatory behaviour against women, among which are, for example, the possibility of working from home or additional paid childcare days.

Based on the above considerations, it should be pointed out that the previously posed research questions have been answered, so that the purpose of the article has been fulfilled. Discrimination against women in the labour market can relate to many areas at the same time, i.e. ranging from the type of work to remuneration to discrimination based on the desire to start or expand one's family. Discrimination against women in the labour market is a widespread issue that is successively analysed in research. Its determinants include the stereotypes and prejudices held by society, especially in terms of the perception of women's roles in the social and economic environment. Notably, nearly half of the respondents (44%) believe that women are discriminated against in the labour market because of their choice of jobs, which is a substantial percentage and confirms the importance of the problem in question.

The conclusions obtained from the above research show, it seems necessary to implement measures that would make it possible to eliminate discriminatory practices used against women in the labour market. Despite the relevant legal regulations in force, including those introduced by the European Union, changing existing social prejudices and eliminating stereotypes in this context plays a key role here. Also noteworthy is the issue of employers encouraging women to return to the workforce. According to the research conducted, the dissemination of activities in this area determines the feelings of respondents concerning the lack of discrimination. As a result, this may contribute to increasing women's motivation to return to the labour market, as well as their striving for career development challenges. As a consequence, this will have a significant impact on broader social development and the dynamics of economic growth. Therefore, it is assumed that subsequent surveys will focus on the analysis of solutions encouraging women to return to the labour market, including as perceived by both employers and employees.

At this point, it should also be mentioned that the study was a pilot, and its purpose was to verify the occurrence of the adopted research problem. The justification for its occurrence implies the expansion of the research to include additional aspects. As part of the weaknesses of the implemented research, it was pointed out first of all that it was limited to one region.

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IMPACT OF INSTITUTIONAL INVESTORS ON THE FINANCIAL PERFORMANCE OF PORTFOLIO COMPANIES – SELECTED ASPECTS

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Purpose: The aim of the work is to examine the impact of selected institutional investors on the financial performance of portfolio companies. The research included one of the most important groups of institutional investors in Poland, i.e. pension funds.
Design/methodology/approach: The research covered the largest pension funds in Poland, which actively participate in general meetings of shareholders. The pilot studies included 72 non-financial companies listed on the Warsaw Stock Exchange for at least six years, i.e. in the years 2016-2021. Tobin's Q index was the chosen measure of financial performance. The research was conducted on three panels of companies, diversified in terms of the total participation of pension funds in general meetings of shareholders.
Findings: The influence of the institutional investors surveyed (i.e. the largest pension funds) on the financial performance of portfolio companies is of a varied nature. The positive influence of pension funds on the level of Tobin's Q occurs within a certain range, i.e. when pension funds hold between approximately 7.2% and 12.3% of the total number of votes at the general meeting of shareholders. However, below and above this range, negative effects of the presence of pension funds are observed.
Research limitations/implications: The conducted research is of a pilot nature. Further research should include a larger number of portfolio companies and more control variables.
Practical implications: The results of the research may be relevant to the academic debate on the effectiveness of corporate governance as exercised by institutional investors, especially pension funds. The results of the research are important for corporate governance researchers, pension fund managers and the management and supervisory boards of portfolio companies.
Originality/value: The added value of the study is that it undertakes research on the impact of pension funds on the financial performance of portfolio companies. An important element of novelty is the study of the participation of pension funds in the general meeting of shareholders. This is an important corporate governance mechanism that is relevant to the relationships studied.
Keywords: institutional investors, pension funds, corporate governance, corporate finance.
Category of the paper: Research paper.

1. Introduction

Companies with share capital are increasingly becoming owned by institutional investors, especially investment funds, pension funds and insurance companies. The process of institutionalisation of corporate ownership (Jeżak, 2010) is evident both in developed capital markets in different part of the world and in numerous European markets. The average share of institutional investors in global capital markets exceeds 41% of market capitalization. The greatest degree of institutionalisation of corporate equity occurs in the United States (72% of market capitalization). The average share of institutional investors in the market capitalization of companies listed on European capital markets is 38%, with countries such as the United Kingdom and Iceland markedly in the lead (more than 60%). Poland is also in the group of countries with a relatively high share of institutional investors (33%) (De La Cruz et al., 2019).

Due to the progressive institutionalisation of shareholding in listed companies in Poland, the identification of the economic consequences of the process is becoming a pertinent issue. The investment strategies pursued by institutional investors along with the associated criteria of selection of companies for the investment portfolio have an impact on the financial performance of the companies. It becomes especially important for the management boards to reckon with the perspectives held by institutional investors, who have enormous capital resources at their disposal. The above translates into a direction shift in the corporate decision-making processes towards value creation for shareholders and multiplication of the capital invested by them.

In the specific circumstances of Poland's capital market, the most important group of institutional investors are pension funds, whose share in the market capitalization is significantly higher than that of investment funds. The share held by pension funds in the capitalization of the Warsaw Stock Exchange is 20.6%, whereas for investment funds this is as low as 4.3%. With regard to free float in those markets, this is 41.8% for pension funds compared to 9% for investment funds (NBP, 2022; Szewc-Rogalska, Wąsacz, 2024). The above gives rise to the necessity of research to study the predominant role of pension funds in the market capitalization of companies listed by the Warsaw Stock Exchange.

It should be noted that previous research on the capital market in Poland has primarily focused on assessing the importance of institutional investors in corporate governance. Institutional investors have been included collectively as a homogeneous group, or studies have focus only at investment funds (Bojańczyk, 2007; Szewc-Rogalska, 2011, 2017; Adamska, Urbanek, 2014; Miziołek, Trzebiński, 2018; Bosek-Rak, 2019; Błoch et al., 2020; Kaldoński et al., 2020; Aluchna, Kuszewski, 2021). Furthermore, the results of these studies are inconclusive, and no separate analyses have been conducted for pension funds as a specific group of institutional investors. Therefore, this paper attempts to fill this research gap.

The main purpose of this study is to examine the impact of selected institutional investors on the financial performance of portfolio companies. The research includes one of the most important groups of institutional investors in Poland, i.e. pension funds. The impact of the process of institutionalization of the ownership of listed companies on their financial condition takes place through various corporate governance mechanisms, among which the participation of investors in the general meeting of shareholders is noteworthy.

The added value of this work is that it undertakes research on the impact of pension funds on the financial health of portfolio companies. An important element of novelty is the study of pension funds' participation in the general meeting of shareholders. This is an important corporate governance mechanism that is relevant to the relationships studied.

The structure of the following sections of the paper is as follows. The second part of the paper presents a literature review and an analysis of previous research. The third section contains the research methodology. The fourth section, on the other hand, discusses the results of the empirical research and their discussion is carried out in the fifth section. The final section presents a summary and directions for further research.

2. Literature review

Pension funds are – along with mutual funds and insurance companies – an important group of institutional (financial) investors. Financial investors make large investments in the capital market and expect to maximise the value of their portfolio companies (Rappaport, 1986; Copeland et al., 1990). The main function of pension funds is to provide a special type of service, which includes financing pensions, medical treatment and compensation for accidents (Sopoćko, 2005). The funds accumulated by pension funds are often used for long-term investments. Pension funds are among the investors who prefer high dividends paid by portfolio companies. Pension funds have less pressure for high short-term returns than investment funds (Szewc-Rogalska, 2012).

Pension funds – due to the fiduciary nature of their activities – have a rationale for corporate governance of portfolio companies. In addition to their financial motivations, they also have the suitable qualifications and skills to influence the managements of their portfolio companies. Opportunities for real influence on these companies – through corporate governance mechanisms – exist primarily where investors hold significant stakes. However, many institutional investors hold small stakes in individual companies in their investment portfolios. This results in significant limitations on the ability of these investors to obtain and process the information necessary to monitor portfolio companies (Gillan, Starks, 2000; Almazan et al., 2005; Chen et al., 2007).

The activity of pension funds and other institutional investors and their involvement corporate governance depends on a number of factors. The most important among those factors are: investment strategy, time horizon of the investment, structure and concentration of the investment portfolio, social goals pursued, and the level of development achieved by a given capital market (Celik, Isaksson, 2013). Long-term investors with significant shareholdings are the best positioned to become involved in corporate governance (Bushee, 2001). Foreign institutional investors display higher monitoring activity compared to domestic investors with regard to their portfolio companies (Ferreira, Matos, 2008). Moreover, independent institutional investors are more active compared to investors having business ties to local companies and loyalties to their management (Ferreira, Matos, 2008; Almazan et al., 2005; Chen et al., 2007; Sahut, Gharbi, 2010).

The results of existing studies into the impact of institutional investors on the financial performance of their portfolio companies are highly diversified. One can distinguish three types of relationships, viz. positive impact, negative impact, and lack of any significant impact on the part of the institutional investors. These results are dependent on multiple factors, such as the development level of the capital market, the type of institutional investors and their specific characteristics.

Studies in European markets show that there is a positive relationship between the size of the shareholding of the dominant institutional investor and the M/B ratio (the ratio of the market value of the shares to their book value). This relationship is strongest in the UK market, which stands out for having the largest share of institutional investors in market capitalisation (Thomsen, Pedersen, 2000). In contrast, Elyasiani, Jia (2010) found that there is a positive relationship between the performance of listed companies (industry-adjusted return on investment) and the stability of institutional ownership. A positive effect of institutional ownership on financial performance (including Tobin's Q ratio and ROA) was also found by Yuan et al. (2008) and Lin and Fu (2017).

In contrast, Rose (2007) found that there is no significant relationship between the presence of institutional investors in the shareholding structure of non-financial companies and the level of Tobin's Q ratio. On the other hand, the presence of the two largest institutional investors has a statistically significant negative effect on the level of Tobin's Q ratio. As remarked by Rose, the significance of the impact may be due to the nature of the Danish capital market. That market is characterized by a significant concentration of ownership and low participation level of institutional investors. Sahut and Gharbi (2010) found that in the French market there is a negative relationship between the share of institutional investors and the level of the Tobin's Q ratio. However, their subsequent research showed that this relationship can be described in more detail using a second-degree polynomial function. On this basis, they found that the impact of institutional owners on the development of the Tobin's Q ratio changes from negative to positive with increase in their shareholding. The return point is 56.3%.

The results of the research may vary depending on the type of institutional investor. The origin of the investor (Ferreira, Matos, 2008), the size of the shareholding held by institutional investors, the degree of independence of the investors and the degree of their sensitivity to pressure from the business environment can be important (Sahut, Gharbi, 2010; Elyasiani, Jia, 2010). Independent institutional investors that are not sensitive to pressure from the business environment include mutual funds and pension funds. Banks and insurance companies, on the other hand, have business relationships that limit their ability to exercise effective corporate governance over their portfolio companies. In view of this, they are treated as so-called pressure-sensitive institutional investors.

Ferreira and Matos (2008) determined that foreign institutional ownership has a positive impact on Tobin's Q. They found none such with regard to domestic institutional shareholding. The majority of studies show insensitive institutional investors to have a positive impact on the financial performance of the companies studied (Ferreira, Matos, 2008; Elyasiani, Jia, 2010; Lin, Fu, 2017). The impact of banks and insurance companies, on the other hand, may be diverse, i.e. there may be a lack of significant impact (Ferreira, Matos, 2008) or a positive impact (Elyasiani, Jia, 2010; Lin, Fu, 2017). Studies (Elyasiani, Jia, 2010) also show that so-called insensitive institutional investors have a higher positive impact on the ROI than sensitive institutional investors do. The comparison of the impacts of insensitive versus sensitive investors also takes into account other criteria such as the size of the institutional investors' shareholding within the shareholder structure, and the origin of such investors. Lin and Fu (2017) found large insensitive foreign investors to have a greater positive impact on the performance of the studied companies compared to small sensitive domestic investors.

Sahut and Gharbi (2010) determined that insensitive institutional investors in the French market have a negative impact on Tobin's Q, albeit with a change to the positive above 32.8% shareholding. For sensitive institutional investors, the change point falls at 35.5%. Moreover, investors simultaneously meeting three criteria: long-term, with significant shareholdings (above 5%) and insensitive to pressure have a positive impact on company value only when the shareholding exceeds 17%.

Among the studies on institutional investors, those that focus exclusively on one group of these investors, namely pension funds, deserve special attention. The scope, methodology and results of these studies are diverse, as indicated by studies by, among others: Woidtke (2002) and Jiao and Ye (2013). Woidtke (2002) found that the value of companies (as measured by Tobin's Q) is positively correlated with private pension fund ownership and negatively correlated with public pension fund ownership. In the case of private pension funds, managers' remuneration schemes were strongly correlated with the performance and market value of portfolio companies. In contrast, for public pension funds, political and social factors may play a large role.

Jiao and Ye (2013) studied the relationship between public pension funds' equity ownership of portfolio companies and the future performance of these companies. This performance was measured by stock return and operating performance. The authors found that the relationship studied is in the shape of an inverted U. This means that as the ownership of public pension funds increases, the performance of portfolio companies first increases and then decreases. The relationship between public pension fund ownership and future stock returns turns from positive to negative when the level of public pension fund ownership reaches around 3.5%. The results obtained suggest that the presence of public pension funds is conducive to shareholder value maximisation when they have a moderate influence on the management of portfolio companies. In contrast, excessively large public pension fund holdings may make it easier for the managers of these funds to pursue political interests and result in the destruction of shareholder value.

In the case of the capital market in Poland, theoretical considerations and empirical studies on institutional investors are undertaken, but usually these studies do not take into account the specifics of pension funds. Publications on pension funds are scarce in number (Słomka-Gołębiowska, 2014; Sołdek, 2016; 2022a, 2022b, 2023; Szewc-Rogalska, 2012; Szewc-Rogalska, Wąsacz, 2024), and they focus on the role of pension funds in various corporate governance mechanisms. In contrast, they do not undertake research on the impact of pension funds on the financial performance of portfolio companies.

Various financial ratios are taken into account in studies carried out on the example of the capital market in Poland, e.g. Tobin's Q, ROE, ROA, operating profitability ratio, P/BV, TSR, return on shares, MVA index (market value added index). The results of these studies vary depending on the financial indicator adopted and the research period. Some studies indicate that there is no statistically significant relationship between the participation of institutional investors and the level of ROA and ROE (Jeżak et al., 2010; Bohdanowicz, 2016). In contrast, the authors of other studies (Adamska, Urbanek, 2014) found that higher investment fund involvement tends to occur in companies with higher ROE levels. In contrast, the relationship between the involvement of investment funds and the development of stock returns is not so clear-cut. Oleksy and Zyguła (2018) found that the presence of institutional investors in the shareholding structure increases the probability that a company will achieve a positive market value added index (MVA index) and a positive TSR value. On the other hand, research by Bohdanowicz (2016) shows that there is a positive and statistically significant relationship between the participation of institutional investors in ownership structures and the level of Tobin's Q index.

Some studies, conducted on the capital market in Poland, have identified the existence of a non-linear relationship (Aluchna, 2007; Szewc-Rogalska, 2012; Bosek-Rak, 2019). Aluchna (2007) found that the relationship between the share of institutional investors and the level of ROE and operating profitability is positive, but – above the cut-off point – it changes to a negative relationship. The cut-off point is approximately 35% participation of institutional

investors in the shareholder structure. Bosek-Rak (2019), in turn, determined that the shareholding of institutional investors above 27% has a negative impact on the P/BV ratio. Szewc-Rogalska (2012), on the other hand, found that a positive impact of institutional investors on the level of Tobin's Q ratio occurs in the range of 16-39%, while a negative impact occurs in the range of 5-16% and above 39%

The analysis of the research done to date reveals the results of empirical studies in different capital market to lack unequivocality. It should be noted that studies on the capital market in Poland are scarce in number. Moreover, they usually concern institutional investors in general, without taking into account the specifics of pension funds. After another reform of the pension market in Poland (Ustawa z dnia 6 grudnia 2013…, 2013), the importance of pension funds has increased among institutional investors purchasing shares of listed companies in Poland. For the above reason, this paper attempts to study this particular group of institutional investors.

3. Research methods

The research covered selected institutional investors, i.e. pension funds. Particular attention was paid to the largest open pension funds in Poland. The two largest pension funds in Poland are: Nationale-Nederlanden OFE and Aviva OFE Aviva Santander. In 2021, their combined share of the pension fund market was almost 48%. Nationale-Nederlanden OFE's investment portfolio included 38.8% of companies listed on the Warsaw Stock Exchange. In turn, Aviva OFE Aviva Santander held shares in 27.2% of companies listed on the Warsaw Stock Exchange (Szewc-Rogalska, Wąsacz, 2024).

The research covered non-financial companies in which the largest pension funds, i.e. Nationale-Nederlanden OFE and Aviva OFE Aviva Santander (as at 2021), participated in the general meeting of shareholders. Companies listed on the Warsaw Stock Exchange for at least six years, i.e. between 2016 and 2021, were selected for the study. 72 companies met the criteria listed. It should be noted that the selected companies represented 33.3% of the total number of listed companies in which all OFEs operating in Poland held shares. The collected panel data included 364 observations, i.e. cases (company/year) in which pension funds participated in a given year at the general meeting of shareholders of the examined company. Cases with incomplete or unavailable data were excluded.

An arduous study followed, requiring the researchers to trace the communications from the AGMs. Those are available on finance websites such as bankier.pl and money.pl. Financial statements were sourced from the database of Emerging Markets Information Service Polska (EMIS Polska).

The study was conducted in three panels:

1) Panel A – all companies surveyed.
2) Panel B – companies where the total share of pension funds at the general meeting of shareholders is less than the median.
3) Panel C – companies where the total share of pension funds at the general meeting of shareholders is greater than the median.

The impact of pension funds on the financial performance of portfolio companies can be studied using both linear and non-linear models. For non-linear, those are usually second-degree polynomials (Sahut, Ghandi, 2010; Jiao, Ye, 2013) or third-degree ones (Szewc-Rogalska, 2012). Accordingly, the following models were proposed:

Model 1: $PERF$ = function (PF, control variables).

Model 2: $PERF$ = function (PF, PF^2, control variables).

Model 3: $PERF$ = function (PF, PF^2, PF^3, control variables).

where:

$PERF$ – a measure of the financial performance of portfolio companies,

PF – a measure of pension fund participation at the general meeting of shareholders of portfolio companies.

Tobin's Q ratio was used as a measure of financial performance of portfolio companies (similarly to Minquez-Vera, Martin-Ugedo, 2007; Ferreira, Matos, 2008; Sahut, Gharbi, 2010; Lin, Fu, 2017). This ratio was calculated as the sum of the market value of total shares and the book value of total liabilities, divided by the book value of total assets. The shareholding of pension funds was measured for all pension funds participating in general shareholder meetings together. Their percentage share of the total number of votes in the surveyed companies was determined. This method of measuring shareholder participation is particularly justified in the capital market in Poland (Szewc-Rogalska, 2012), which is characterised by a more concentrated control structure than ownership structure (cf. Adamska, 2013).

The models included the following control variables:

- ROA (Mishra, Modi, 2013; Kałdoński et al., 2020), determined as net financial result divided by total assets;
- leverage ratio (LEV) determined as total debt divided by total assets (Huang et al., 2007; Elyasiani, Jia, 2010; Kałdoński et al., 2020). Both asset profitability and debt level are important factors affecting the financial condition of enterprises and their ability to multiply the capital contributed by the shareholders (Fura, Szewc-Rogalska, 2018);
- SIZE measured as a natural logarithm of total assets (Sahut, Gharbi, 2010; Mishra, Modi, 2013; Lin, Fu, 2017). The size of a company may have a negative impact on its condition because of greater bureaucracy (Xu, Wang, 1999) and higher agency costs (Sun, Tong, 2003). Furthermore, large enterprises are less capable of responding flexibly to the changing market circumstances. However, larger companies may benefit

from the economies of scale, which is conducive to better financial performance. The impact of size on financial performance of companies is thus not equivocal (Lin, Fu, 2017).

To identify the outliers among the observations – before the estimation of the model – so-called Mahalanois distance was used (Kufel, 2013). Several cases were rejected because of Tobin's Q and ROA. Following rejection of the outliers, a total of 356 observations remained on the table. Basic statistics such as the average, median, standard deviation, coefficient of variation, minimum value and maximum value were calculated for each panel.

Next, the appropriate form of panel model was chosen. The following models were taken into account (Kufel, 2013; Verbeek, 2017):

- panel model (no separate identification of individual effects) estimated with the classical least squares method;
- fixed-effects panel model (FEM);
- random-effects panel model (REM).

In order to select the appropriate form of the panel model, the following statistical tests were applied: the Chow F-test, the Breusch-Pagan test, the Hausman test (Maddala, 2006; Kufel, 2013; Antczak, 2012). On this basis, it was determined that a panel model with fixed effects should be used for all panels (A, B, C). In addition, the Wald's heteroscedasticity test was performed (Maddala, 2006). Based on this, it was determined that there was heteroscedasticity of the random component in the models, which was corrected with robust HAC.

4. Results

Table 1 collates the basic statistics for the studied companies. Pension funds' share in the total number of votes in the firms ranged from 2.21% to 66.35%. One should explain that listed companies publish lists of shareholders with at least 5% of the vote in the AGM. There may exist cases in which a shareholder has more than 5% of the vote in the AGM but the shareholder's share in the total number of votes in the relevant company is less than 5%.

The average participation of pension funds (the PF variable) in the AGMs in the studied companies was around 16.9%. The median, on the other hand, was around 14.6%. On the basis of the median, two groups of companies were selected – those with less than 14.6% PF (Panel B) and those with more than 14.6% PF (Panel C). The average share in the former group was 8.9%, and in the latter group it was 24.8%.

Table 1.
Basic statistics for companies with pension-fund shareholders

Variables	Average	Median	Standard deviation	Coefficient of variability	Minimum value	Maximum value
Panel A: companies total (n = 356)						
Tobin's Q	1.33	1.05	0.91	0.68	0.41	9.07
PF	16.86	14.55	11.00	0.65	2.21	66.35
ROA	4.89	5.30	7.74	1.58	-32.88	44.30
LEV	48.72	49.22	18.00	0.37	2.65	91.05
SIZE	13.80	13.65	1.49	0.11	10.48	18.49
Panel B: companies with below-median participation of pension funds (n = 178)						
Tobin's Q	1.45	1.07	1.14	0.79	0.53	9.07
PF	8.91	9.22	2.87	0.32	2.21	14.45
ROA	4.48	5.24	9.26	2.07	-32.88	44.30
LEV	48.16	49.85	19.34	0.40	2.71	91.05
SIZE	13.52	13.37	1.51	0.11	10.48	17.69
Group C: companies with above-median participation of pension funds (n = 178)						
Tobin's Q	1.22	1.03	0.56	0.46	0.41	3.68
PF	24.80	21.70	10.38	0.42	14.64	66.35
ROA	5.29	5.35	5.83	1.10	-23.37	22.80
LEV	49.28	48.55	16.58	0.34	2.65	87.95
SIZE	14.08	13.84	1.42	0.10	11.57	18.49

Source: original studies.

In accordance with the methodology introduced in the previous section, the choice was made to use the fixed-effects panel model. The estimation was done both for linear and non-linear models (second-degree and third-degree polynomials). Subsequently, for each panel the best-fitting model was selected to describe the impact of pension funds on Tobin's Q (Table 2).

Table 2.
Fixed-effects panel models for Tobin's Q in companies with pension funds among the shareholders

Distinction	Panel A: companies total	Panel B: companies with below-median participation of pension funds	Panel C: companies with above-median participation of pension funds
Const	11.7941*** (4.865)	17.4141*** (4.394)	9.0940*** (3.540)
PF	-0.0049 (-1.145)	-1.6949* (-1.979)	-0.0121** (-2.217)
PF^2	X	0.1870* (1.965)	X
PF^3	X	-0.0064* (-1.924)	X
ROA	0.0202** (2.095)	0.0163** (2.555)	0.0400** (2.247)
LEV	0.0076* (1.683)	0.0040 (0.7947)	0.0112 (1.444)
SIZE	-0.7862*** (-4.376)	-0.8538*** (-2.895)	-0.5924*** (-3.134)
Number of observations	356	178	178
LSDV R-square	0.8733	0.9399	0.7485
Within R-square	0.2686	0.4643	0.2718
F statistic (p – value)	6.7987 (0.000)	5.9951 (0.000)	3.9322 (0.008)

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Source: original studies.

In Panel A, the regression coefficient for PF is negative, suggesting that increased participation of pension funds in the total number of the votes has a negative impact on Tobin's Q. However, the coefficient is not statistically significant. Accordingly, an attempt was made to explain these relationships through more detailed studies covering Panel B and Panel C.

In companies with a lower participation of pension funds (Panel B), the studied relationships can be described with the use of a third-degree polynomial. It should be recalled that in this group PF ranges from 2.21% to 14.55% (cf. Table 1). Thus, the impact of pension funds on Tobin's Q was found to be positive in the 7.17% to 12.31% band. A negative impact, on the other hand, occurs when the participation of pension funds is less than 7.17% or greater than 12.31%.

In companies with a greater participation of pension funds (Panel C), the studied relationships can be described with the use of a linear function. Increased participation of pension funds in the total number of the votes was found to have a negative and statistically significant impact on Tobin's Q.

It should be noted that in the studied companies with pension funds among the shareholders (Panels A, B and C), ROA has a positive and statistically significant impact on Tobin's Q. The impact of SIZE on Tobin's Q is also statistically significant, albeit negative.

The studies show that for small participation of open pension funds in the AGM (from approx. 2.2% to nearly 7.2% of the vote), there are negative effects of the presence of pension funds (no positive effects). This may be the consequence of the investors' small shareholdings and thus limited ability to influence AGM decision-making. By contrast, holding 7.2% to 12.3% of the vote provides pension funds with more opportunity for realistic impact on AGM decision-making. With a greater participation level of open pension funds in the AGM (exceeding 12.3% of the vote), there is a negative impact of open pension funds on Tobin's Q. The presence of a larger number of open pension funds in the AGM can have the effect of compounding the difficulty of the achievement of a consensus and with it the exercise of effective corporate governance.

It should be emphasized that a pension fund is usually a minority shareholder. Accordingly, it is exposed to an agency conflict in relations both with the management and with the dominant shareholder. From the minority shareholder's position, there is a problem of information asymmetry increasing the difficulty level of the making investment decisions and the exercise of corporate governance (oversight). Agency conflicts often lead to tunnelling, which is detrimental to the well-being of minority shareholders.

The studies demonstrate that in companies having pension funds among their shareholders asset profitability has a positive and statistically significant impact on Tobin's Q. Such a correlation was found in all three panels. This means that in companies having pension funds as shareholders increased asset profitability is conducive to the achievement of a better market valuation as measured by Tobin's Q. On the other hand, it should be noted that the studied companies belong to the investment portfolio of the largest pension funds in Poland.

Those have invested enormous cash in the purchase of the shares of such companies, and their investment decision-making has to be attentive to the safety of the funds needed for future pension payouts. Due to their fiduciary nature, those funds carefully select the companies for the investment portfolio, paying attention to financial performance and development perspectives.

The investment portfolios of pension funds usually include a large number of listed companies. Pension funds have increasingly been adopting an active stance, participating in the AGMs of their portfolio companies. However, due to the large numbers of such companies and small shareholdings in each, there may be difficulties with access to direct corporate governance.

5. Discussions

The studies revealed that a non-linear relationship exists between pension funds' presence in the AGMs in the portfolio companies and the latter's financial results. The existence of a non-linear relationship is also confirmed by other studies (Aluchna 2007; Sahut, Gharbi 2010; Szewc-Rogalska, 2012; Jiao, Ye, 2013; Bosek-Rak, 2019). However, it must be emphasized that our studies were focused on one specific group of institutional investors, those being pension funds. The cited studies, by contrast, analysed the cumulative participation of institutional investors. Moreover, different measures of financial performance were used.

The studies show that a positive impact of pension funds on financial performance exists within a certain band, while both above and below that band negative effects of the presence of pension funds in the equity structures are observed. The results to a certain extent coincide with those of other studies into Poland's capital market (Aluchna, 2007; Szewc-Rogalska, 2012; Jiao, Ye, 2013; Bosek-Rak, 2019). The similarity of the results consists in showing that after a certain change point is crossed, the nature of the relationship between institutional investors and financial performance of portfolio companies changes. With the crossing of that point, a positive relationship turns into a negative relationship.

Original studies have demonstrated that the change point falls lower than in the case of other studies dealing with Poland's capital market. It should be explained that this is primarily the consequence of the method of study of institutional investors' participation. Existing studies (Aluchna, 2007; Szewc-Rogalska, 2012; Bosek-Rak, 2019) have dealt with the participation of investment funds, pension funds, insurance companies and other institutional investors jointly. Our original studies, by contrast, focused solely on pension funds, which currently hold the greatest share in market capitalization compared to other institutional investors. Moreover, existing studies have analysed the formal shares held by institutional investors in the ownership structures. Our studies, by contrast, analysed pension funds taking an active participation in

corporate governance and participating in AGMs. When comparing the results, one must also consider that the respective studies were pursued in different circumstances of functioning of Poland's capital market. The important factors include different chronological periods, different structure of institutional investors, legislative changes affecting the functioning of pension funds, and significant changes to the structures of pension funds' investment portfolios.

Pension funds and investment funds are reckoned among the group of institutional investors characterized by independence and ability to resist pressure. Most of existing studies dealing with different capital markets show insensitive investors to have a positive impact on the financial performance of companies (Ferreira, Matos, 2008; Elyasiani, Jia, 2010; Lin, Fu, 2017). Studies dealing with the French market (Sahut, Gharbi, 2010), in turn, reveal a negative impact of such investors on Tobin's Q, which, however, changes into positive impact after reaching the change point. Our original studies show that a positive impact of pension funds on Tobin's Q exists only within a specific band. When confronting the results of our studies with those of other authors', attention should be paid to several important factors. The nature of the individual capital markets may have a significant impact on the results. A considerable impact may belong to the development level of the capital market in question, the share held by institutional investors, the level of ownership concentration, the characteristics of the most important institutional investors, and the effectiveness of corporate governance.

6. Conclusions

This study endeavoured to determine the impact of selected institutional investors on the financial performance of portfolio companies in Poland in years 2016-2021. The research focused on pension funds, which are a very important subset of institutional investors in Poland. Pension funds currently hold approximately a 4.7 times greater share in the market capitalization at Warsaw Stock Exchange compared to investment funds. A key role is played by two largest open pension funds, viz. Nationale-Nederlanden OFE and Aviva OFE Aviva Santander. The studies concentrated on active pension funds, i.e. those participating in the company's AGM. The average share held by pension funds in the total number of votes in the studied companies was approximately 16.9%, and the maximum share was 66.4%.

Evaluation of the impact of institutional investors and especially pension funds on the financial performance of portfolio companies presents a considerable research challenge. This is a consequence of the complexity of the corporate governance mechanisms and difficulty with the unequivocal measurement of the studied relationships. Accordingly, this article proposed different research approaches, i.e. panels of companies with different levels of pension-fund participation in the AGM, as well as estimation of linear and non-linear models (especially third-degree polynomial).

The studies demonstrate that there exists a non-linear relationship between the participation of pension funds in the AGMs and the Tobin's Q of the studied companies. A positive impact of pension funds on this ratio exists when pension funds hold an approximately 7.2% to 12.3% share in the total number of votes. Both below and above this band, by contrast, one can observe the negative effects of the presence of pension funds in the AGMs. A negative impact can be seen primarily in companies with a relatively high cumulative shareholding by pension funds. There is a possibility that the presence of a large number of pension funds with smaller individual shareholdings makes effective corporate governance more difficult to achieve. In such ownership structures, a significant role is played by insiders, especially the managers of the portfolio companies. The intensification of agency conflicts may have a negative impact on the financial performance of such companies and value creation for shareholders, especially for the minority shareholders.

It is necessary to continue research on the impact of institutional investors, especially pension funds, on the financial performance of portfolio companies. The research conducted is of a pilot nature. Further research would need to include a larger number of portfolio companies and more control variables. To achieve more and better knowledge of the mechanisms of this impact, the studies should also consider the impact of other factors such as the ownership-concentration level, insider share in ownership structures, level of divergence between formal and effective control wielded by pension funds in AGMs, participation of other institutional investors in the ownership structures, the situation in the capital market, as well as the characteristics of the industry or sector in which the studied companies operate.

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THE ASSESSMENT OF COMPLIANCE WITH LEGAL REQUIREMENTS IN FOOD SAFETY MANAGEMENT SYSTEM

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Purpose: The purpose of this article is to present the requirements of the ISO 22000:2018 standard relating to food law and the methods that organisations with an implemented food safety management system (FSMS) can use to assess compliance with legal requirements.
Design/methodology/approach: To achieve the aim of the work, an analysis of the requirements of the ISO 22000:2018 standard was used, as well as a review of the literature on FSMSs and the assessment of their effectiveness.
Findings: The lack of inclusion of requirements in the ISO 22000:2018 standard that would explicitly oblige organisations to periodically assess compliance with legal requirements may be a factor that reduces the effectiveness of FSMSs. However, despite the absence of such requirements, organisations should implement system solutions that provide them with information on the results achieved in the area of compliance. Only then will FSMSs be an effective tool to support organisations in the production of safe food that meets the requirements of food law.
Research limitations/implications: The criteria and measures of assessment of compliance with food law and the criteria of self-assessment of the maturity of the process of ensuring compliance with legal requirements proposed in the paper are of a very general nature and do not take into account the different circumstances of the organisation in food chain, which may limit their applicability.
Practical implications: The results can be applied by organisations with an FSMS in place to design and implement methods and tools to support their regulatory compliance assessment activities. They can also be an inspiration for organisations with other standardized management systems, which, like FSMSs, oblige organisations to ensure compliance with the law and periodically assess this compliance.
Originality/value: The originality of the obtained results lies in proposing tools, in the form of criteria and metrics for assessing compliance with food law, as well as criteria for self-assessing the maturity of the compliance process, which can be used by organisations to identify needs for improving the systemic solutions in place for compliance.
Keywords: ISO 22000, compliance assessment, legal requirement, food safety management system.
Category of the paper: Research paper.

1. Introduction

The food choices of today's consumers are increasingly conditioned by a growing awareness of the links between the quality and safety of the food they eat and their health (Kwiatek, Patyra, 2021; Antonio et al., 2020). For consumers, it is important that the food they consume is free from contaminants that pose a risk to their health. In order to ensure an adequate level of protection for consumers, as well as to increase their confidence in the safety of food products on the market, food safety issues are regulated by law (Stoyanowa, 2019). Compliance of food with legal requirements is a prerequisite for it to be considered safe and to be legally marketed (Regulation, 2002).

A key role in shaping food quality and safety play organisations in food chain that are responsible for the process of designing and manufacturing products that not only meet the requirements of applicable law, but also satisfy consumers in terms of nutritional value, sensory value and availability (Zimon, Madzik, Domingues, 2020). Declining consumer confidence in food safety, caused by food crises, is forcing organisations to look for opportunities to improve the solutions they use to reduce the risk of hazards in food that can cause adverse health effects (Silva, Fonseca, Sousa 2016; Kotsanopoulos, Arvanitoyannis, 2017).

The ISO 22000:2018 compliant food safety management system (FSMS) is a tool that can support organisations in the production of safe food taking into account the applicable legal requirements. This system can be a key determinant of an organisation's competitiveness, increasing consumer confidence in the safety of its products (Monge-Mora et al., 2020). Indeed, the system model described in the standard sets out requirements that oblige organisations to ensure that the products they produce comply with food law (Rosiak, 2020, Stoyanowa, 2019). When implementing a system, organisations define responsibility and authority, and formalise the activities involved in identifying the legal requirements applicable to the organisation's activities and its products, ensuring that personnel have access to these requirements, and implementing them in practice (International Organization for Standarization, 2022; Zimon, Madzik, Domingues 2020). As a result of the implementation of the FSMS, staff knowledge of the applicable legal requirements increases, and an organisational culture is formed, a key pillar of which is the commitment of staff at every level of the organisational structure to legal compliance, which organisations see as one of the main benefits of maintaining the system (Cierpioł, Wąsikiewicz-Rusnak, 2021). Compliance with the ISO 22000:2018 standard not only minimises the risk of non-compliance with food law, but also reduces the consequences of non-compliance, such as the need to compensate consumers for damage to their health caused by non-compliant food, the cost of withdrawing the product from the market or disposing of it, administrative fines imposed on organisations by the official food control authority, decisions by the authority to temporarily suspend production or ban activities, loss of reputation and damage to image (Szkiel, 2021).

Ineffective system solutions related to ensuring compliance with the legal requirements may be a source of non-compliance in the FSMS and the reason for the lack of effectiveness of the system in ensuring food safety. Therefore, an integral part of the periodic assessment of the effectiveness of the FSMS, both internally by organisations and externally by certification bodies, should be an evaluation of the activities carried out in the system to ensure compliance with the legal requirements and an assessment of how the organisation checks its compliance with these requirements.

The purpose of this article is to present the requirements of the ISO 22000:2018 standard relating to food law and the methods that organisations in food chain with an implemented FSMS can use to assess compliance with legal requirements. It has been hypothesised that the limitation of the FSMS model described in the standard, which results from its failure to include requirements relating to the assessment of compliance with legal requirements, is a factor reducing the effectiveness of the systems.

The paper poses the following research problems:

- what criteria and metrics for assessing compliance with legal requirements organisations can use within the FSMS,
- what criteria for self-assessment of the maturity of the compliance process can be used to assess the maturity of the process,
- what risks associated with the process of assessing compliance with legal requirements may affect the reliability of the assessment results, and thus the possibility of using them to improve the FSMS.

The issue of evaluating ISO 22000 compliant food safety management systems has been the subject of many studies. For example, there are publications devoted to the factors determining the effectiveness of systems (Monge-Mora et al., 2020; Purvanto, Hutagalung, Yanthy, 2020), as well as the assessment of their effectiveness (Psomas, Kafetzopoulo, 2015; Kiriezieva et al., 2013) and maturity (Glykas, 2024). The work also presents methods that organisations can use to assess and improve the effectiveness of the system, such as internal and external audit (Kotsanopoulos, Arvanitoyannis, 2017; Król, Chmiel, Brodziak, 2022) and management review (Lesiów, Orzechowska-Przybyła, Niewelt, 2014; Dzwolak, 2009). Research was also conducted on assessing the convergence of the results of external audits conducted by certification bodies in organisations with a certified FSMS with the results of inspections conducted in organisations by official food control authorities (Turku, Lepistö, Lundén, 2018; Powell et al., 2013; Psomas, Kafetzopoulo, 2015; Piira et al., 2021). However, in the area of assessment of FSMSs compliant with the ISO 22000:2018 standard, a research gap has been identified – no research has been conducted so far aimed at analyzing the role of conformity assessment with legal requirements in maintaining an effective FSMS and presenting methods supporting the conformity assessment process.

The originality of the paper results from two issues. Firstly, the issues of assessing compliance with food law as an integral element of FSMS are discussed to a negligible extent in the literature on the subject. Secondly, there is a lack of publications on the methods that organisations in food chain can use within the implemented FSMS to assess compliance with legal requirements. In turn, the originality of the obtained results lies in proposing tools, in the form of criteria and metrics for assessing compliance with food law, as well as criteria for self-assessing the maturity of the compliance process, which can be used by organisations in food chain to identify needs for improving the systemic solutions in place for compliance.

2. Research methodology

The research method used for achieving the aim of the paper was a review of literature on the comprehensive approach to food safety management. The review covered publications concerning the analysis of the requirements of the ISO 22000:2018 standard, as well as papers presenting the results of studies devoted to the evaluation of the effectiveness of FSMSs, including methods supporting the evaluation process, such as the internal and external audit, management review and self-assessment.

Another research method used in the study was an analysis of standards used by organisations to support the comprehensive approach to ensuring the safety of produced food. The analysis covered the ISO 22000:2018 standard describing requirements for the FSMS model, with particular emphasis on requirements related to ensuring compliance with food law. Apart from that, standards describing guidelines for auditing FSMS and for conducting self-assessments of standardised management systems were analysed.

3. Results

3.1. The requirements of the ISO 22000:2918 standard relating to food law

The FSMS model described in the ISO 22000:2018 standard has been designed to enable organisations in food chain to mitigate the risk of non-compliance with food law and demonstrate that they have exercised due diligence to ensure such compliance (Dzwolak, 2018a; International Organization for Standarization, 2020). The FSMS also helps organisations to flexibly adapt to the applicable legal requirements to ensure food safety, which is recognised by organisations as one of the main factors motivating them to implement the system and seen as a benefit of its implementation (Paunescu, Ruxandra, Miruna, 2018; Stoyanowa et al., 2022; Gonçalves et al., 2020; Granja et al., 2021). Meeting the applicable

legal requirements, in addition to meeting the requirements of the ISO 22000:2018 standard, is a condition for the organisation to obtain a certificate for the system.

Needs and expectations relating to an organisation's compliance with legal requirements may be formulated by different interested parties (table 1).

Table 1.
Examples of interested parties requirements relating to the organization's compliance with legal requirements

Interested party	Examples of requirements for organizations
Clients / Consumers	– ensuring conformity of products with the legal requirements – effective communication of information concerning the characteristics of the product and appropriate handling of the product in accordance with legal requirements – effective reporting of non-conforming products – effective response in the event of crisis situations related to non-compliance of products with the legal requirements
Suppliers	– effective communication of legal requirements for purchased products – effective notification of non-conformity of supplied products with the legal requirements
Employees	– effective communication of, and access to, legal requirements applicable to the organisation's activities and to the manufactured products – provision of legal equirements training – communicating the results of internal and external evaluations on compliance with legal requirements
Official food control authority	– compliance with the legal requirements applicable to the organisation's activities and the manufactured products – effective communication in the framework of ongoing compliance assessment inspections – provision of evidence of compliance with the legal requirements during inspections – effective implementation of actions in response to inspection results – effective reporting of and response to product non-conformity crises
Certification body	– communicating to the audit team, prior to the audit, the legal requirements applicable to the organisation's activities and the manufactured products – compliance with the legal requirements applicable to the organisation's activities and the manufactured products – providing evidence during audits of compliance with legal requirements

Source: own elaboration.

The requirements for ensuring that an organisation's operations and manufactured products comply with food law are addressed at many clauses in the ISO 22000:018 standard (table 2).

Table 2.
The requirements of the ISO 22000:2918 standard relating to food law

Clause of ISO 22000:2018	Requirement
4.1.	Determination of issues from the legal environment of the organisation that are relevant to its purpose and affect its ability to achieve the intended FSMS results
4.2.	Consistent provide of products that meet legal requirements
5.1.	Demonstrating FSMS leadership by communicating the importance of compliance with the legal requirements
5.2.1.	Including, in the food safety policy, a commitment to satisfy the legal requirements
6.2.	Taking into account the legal requirements for FSMS objectives
7.4.2.	Establish and implement effective communication with statutory and regulatory authorities
7.4.3.	Keeping the food safety team informed of applicable legal requirements

Cont. table 2.

7.5.1.	Inclusion in FSMS documentation of information required by legislative bodies
8.2.3.	Identifying legal requirements when selecting and establishing prerequisite programmes
8.3.	Identifying legal requirements when establishing and implementing a traceability system
8.4.2.	Identifying emergency response legal requirements
8.5.1.	Identifying the legal requirements necessary to carry out a risk analysis
8.5.1.2.	Identifying legal requirements for raw materials, ingredients and product contact materials
8.5.1.3.	Identifying legal requirements for the end products
8.5.2.2.1.	Consideration of legal requirements when identifying food safety hazards

Source: own elaboration based on ISO 22000:2018 *Food safety management systems. Requirements for any organization in the food chain*.

The analysis of the ISO 22000:2018 standard shows that its requirements are aimed at indicating activities within the FSMS that should be implemented taking into account legal provisions. The legal requirements are one of the factors that form the context of an organisation that can affect the achievement of its food safety objectives (Stoyanova, 2019). Therefore, the organisation should ensure that it knows the legislation applicable to its operations and products, understands it properly and implements it in practice. However, the standard does not specify requirements that explicitly obliged organisations to periodically assess compliance with food law and document its results. It also does not indicate the methods and tools that should be used by organisations in the conformity assessment process. Failure to take into account the requirements in this regard in the FSMS model may result in the assessment not being carried out or being ineffective. Although the organisation is not obliged to formalise its food law compliance assessment activities, drawing up a documented procedure describing how to proceed in this area is reasonable, as it can contribute to the organisation's ability to operate in accordance with the applicable legal requirements and to adapt flexibly to changes in these requirements. Formalisation of activities also enables an organisation to gather evidence, in the form of records, that it knows the full picture of the applicable legal requirements, monitors changes to those requirements, takes them into account when updating the system and monitors the status of its compliance.

3.2. Methods for assessing compliance with legal requirements within the FSMS

As mentioned, the FSMS model described in the ISO 22000:2018 standard does not explicitly specify the methods that should be used by organisations to periodically assess compliance with legal requirements. However, this assessment can be carried out during periodic FSMS audits - both internal and external (Kotsanopoulos, Arvanitoyannis, 2017; Chen et al., 2020; Monge-Mora et al., 2020). In addition to the requirements of the standard relating to food law (table 2), the criteria for which auditors compare the evidence collected as a result of audit tests may be the legal provisions applicable to the activities and products of the organisation (ISO 19011, 2018).

The FSMS internal audit is a fundamental management tool that verifies the system's compliance with the requirements of the ISO 22000:2018 standard and its effectiveness, and ensures that actions are implemented to mitigate the risks associated with the business, including those associated with non-compliance with legislation (Król, Chmiel, Brodziak, 2022). Audit testing should be focused on confirming the ability of the FSMS to support the organisation in meeting regulatory requirements. For this purpose, auditors should check, among others:

- whether persons responsible for identifying applicable legal requirements and monitoring changes to those requirements have been appointed,
- what are the competences of the persons responsible for ensuring compliance with the legal requirements and what actions does the organisation take to increase these competences,
- whether the organisation maintains and updates the list of applicable legal requirements,
- how access to legal requirements is provided to personnel,
- how often and how the assessment of the organisation's compliance with legal requirements is carried out and how the results are documented.

Compliance with food legislation is also assessed during the FSMS external audits (certification and annual surveillance audits) conducted by the certification body, as a prerequisite for certification of the system, in addition to meeting the requirements of the ISO 22000:2018 standard, is the organisation's ability to consistently meet the legal requirements. These requirements may relate to:

- manufactured products and services provided,
- production processes,
- test methods for manufactured products,
- labelling,
- authorisation to operate and market the products,
- consumer rights.

The range of requirements applicable to the organisation's activities determines the duration of the audit, as well as the size and composition of the audit team (ISO/IEC 17021-1, 2015). In the event of a serious violation of legal requirements, the audit result is negative, which results in the failure to grant the organisation a certificate for the system.

The FSMS audit carried out by the certification body is one of the elements of a multifactorial approach to ensuring food safety (Powell et al., 2013). However, due to its sampling nature (the assessment of the system is based on the evaluation of a sample of information collected during the audit tests), it is not a verification of compliance with all the legal requirements applicable to the organisation's activities, as this is the responsibility of the official food control authorities. The system certificate can therefore not be seen as a declaration of full compliance with these requirements. However, due to the fact that to a certain extent the

scope and objectives of audits and inspections carried out by official food control authorities overlap, the organisation's certification for the system may to some extent justify a reduction in the frequency of inspections (Turku, Lepistö, Lundén, 2018). Therefore, a certified organisation, through the system solutions it has implemented, should be seen to be able to meet the legal requirements on an ongoing basis, as it manages its activities appropriately to ensure compliance with these requirements (International Organization for Standarization, 2022). This fosters confidence both within the organisation (management and staff) and the confidence of its external interested parties (food consumers, customers, official food control authorities, trading partners) in the FSMS as an effective tool to support the production of safe products taking into account the applicable legislation.

The assessment of compliance with legal requirements in external audits conducted by the certification body is similar in nature to the assessment during internal audits. The audit tests are designed to assess whether the adopted food safety policy, as well as the organisation's related objectives, are defined with regard to the legal requirements. The certification body's auditors also assess the extent to which management is aware of the risks of failing to meet these requirements and the effectiveness of the actions taken by the organisation to ensure compliance. It is also assessed how the organisation:

- identifies applicable legal requirements and periodically reviews changes to those requirements,
- takes into account the legal requirements and their changes in the FSMS,
- provides access to legal requirements and develops staff awareness of these requirements,
- implements the legal requirements for use in the organisation,
- conducts periodic assessments of compliance with legal requirements, including ensuring the competence of those conducting such assessments, establishing the scope and comprehensiveness of the assessment and documenting its results, and involving staff in the assessment process,
- takes the legal requirement into account when planning and carrying out internal system audits,
- incorporates the results of the periodic assessment of compliance with legal requirements in management reviews conducted by management,
- implements corrective and improvement actions for non-compliance with legal requirements.

A prerequisite for the award of the FSMS certificate to an organisation is that the auditors of the certification body gather evidence (through interviews with the organisation's management and staff, observation of the assessed processes, analysis of documentation describing the principles of the system's operation and evaluation of the records produced) of compliance with the legal requirements and the requirements of the ISO 22000:2018 standard relating to compliance with these requirements. Such evidence may include, for example:

- a food safety policy that includes a commitment to meet legal requirements,
- maintaining an up-to-date, complete list of applicable legal requirements,
- documentation of staff training on legal requirements,
- staff awareness surveys on legal requirements,
- a task, responsibility and authority sheet containing the assignment of tasks related to ensuring compliance with legal requirements to designated persons,
- reports on the periodic assessment of compliance with legal requirements,
- records of inspections carried out as part of official food controls,
- internal audit reports relating to the assessment of compliance with legal requirements,
- reports on management reviews by management dedicated to assessing compliance with legal requirements,
- non-compliance sheets and corrective actions taken in the event of non-compliance with legal requirements.

Regulatory compliance can also be assessed during periodic management reviews conducted by the organisation's management, the purpose of which is to confirm that the FSMS is relevant to the context in which the organisation operates, and is useful and effective (Dzwolak, 2019). Next to audits, the management review is the most important tool for system improvement (Dzwolak, 2009). During the review, management can assess whether the organisation's existing policies and assigned responsibility and authority related to compliance with legal requirements are appropriate and enable it to achieve its objectives in this area. Management reviews should therefore include information on:

- changes in legal requirements,
- the results of periodic assessments of compliance with legal requirements, including non-conformities identified and subsequent corrective action taken,
- the results of internal and external audits relating to compliance with legal requirements,
- the results of controls carried out by official food control bodies.

The results of the review should be an opportunity to identify compliance issues and implement improvement actions.

3.3. Criteria and metrics for assessing compliance with legal requirements

Organisations in food chain that want to effectively implement a legal compliance process should systematically measure and evaluate its results. To assess the extent to which its objectives and compliance outcomes are being met, the organisation can use criteria to describe the results achieved, as well as metrics - measurement tools that will enable it to assess the ability of the process to achieve the planned results, as well as to evaluate its effectiveness (Molenda, 2016; Rummler, Brache, 2000). The use of metrics ensures that evaluation is objective and, if carried out systematically at set intervals, enables the organisation to compare its performance over time and to analyse process trends. In addition, process monitoring enables

the organisation to identify process issues, identify process improvement needs and implement improvement actions (Bitkowska, 2017; Dobrowolska, 2017). Metrics, therefore, play a key role in process improvement and condition sound decision-making in this area (Rydzewska-Włodarczyk, Sobieraj, 2015; Wyrębek, 2016).

The ISO 22000:2018 standard does not specify requirements for the use of specific assessment criteria and metrics - these should be developed by the organisation, adapting them to its needs arising from the scope of its activities, its planned food safety objectives and the maturity level of its FSMS. When defining metrics, the organisation should ensure that they are consistent with the adopted strategy and food safety policy (Janczewska, Janczewski, 2021; Bitkowska, 2017).

Examples of criteria and metrics for assessing compliance with legal requirements that can be used within the FSMS are shown in the table 3.

Table 3.
Criteria and metrics for assessing compliance with legal requirements in FSMS

Criteria	Metrics
Results of controls carried out in the organisation by official food control authorities	Number of irregularities found as formulated in the inspection protocols
	Number of fines imposed on an organisation as a result of an inspection
	Number of administrative decisions issued against the organisation by the authority as a result of the audit
Dealing with emergency situations involving non-compliance of products with food legislation	Number of crises resulting in product recalls
	Number of emergency team meetings related to non-compliance with food legislation
	Number of notifications to the RASFF related to non-compliance of products with food legislation
Staff's knowledge of food law	Number of staff training courses on food legislation
	Results of questionnaires/tests on workers' knowledge of food legislation
Involvement of staff in ensuring compliance with food legislation	Number of reports by employees of identified cases of non-compliance with food legislation
Results of periodic internal audits for assessing compliance with food legislation	Number of food safety team meetings to assess compliance with food legislation
	Number of non-compliances found as a result of internal audits
	Number of cases where a non-compliant product has been withheld from the market
Results of laboratory tests on products	Number of test results confirming non-compliance of the product with food legislation
Costs associated with non-compliance with food legislation	Costs of withdrawing a non-compliant product from the market
	Costs of fines imposed on the organisation by the official food control authority
	Litigation costs
Image losses	Number of negative media reports related to cases of non-compliance with food law
	Number of lost customers / contracts as a result of the image crisis

Source: own elaboration.

For individual measures, the organisation can set target values (limits for meeting expectations) against which the results obtained will be compared in order to identify any deviations (Bitkowska, 2015; Rummler, Brache, 2000; Gudz, Gudz, 2020). Information on compliance performance, measured using specific criteria and metrics, should be used by the organisation's management to prioritise the updating and improvement of the FSMS, as well as

to plan and implement improvement activities. The results should also be communicated to the organisation's staff, as such actions support the creation of the organisation's food safety culture.

Systematic monitoring of compliance with legal requirements using designed meters requires determining responsibility for monitoring activities. This responsibility should be entrusted to those who are most knowledgeable in this field. In the FSMS, this responsibility is most often assigned to the food safety team.

3.4. Self-assessment of the maturity of the food law compliance process

The foundation of FSMS improvement is to know and understand the strengths and weaknesses of the processes implemented in the system. Therefore, in addition to assessing the effectiveness of the compliance process, the organisation can also assess its maturity. Process maturity can be understood as its ability to systematically improve the results obtained and considered in the context of the organisation's sophistication in applying process management methods and tools and the excellence of the implementation of process activities (Gabryelczyk, 2016).

To assess the maturity of the process of ensuring compliance with legal requirements, the organisation may use self-assessment – a method that makes it possible to assess the functioning of the process, identify its strengths and weaknesses, identify and maintain good practices related to the implementation of the process, identify opportunities for its improvement and improve the results achieved (Wiśniewska, Grudowski, 2019; Książek, Ligarski, 2015; Adamczyk, 2018). The results of the self-assessment make it possible to identify the links between compliance activities and the effects of these activities. They represent a knowledge resource that should be used by the organisation's management to make changes to the management system and the processes implemented (Szczepańska, 2017). The ISO 22000:2018 standard does not specify requirements for conducting a self-assessment, however, it can be an additional source of information for any organisation in food chain on the maturity of its food law compliance activities. These activities can be assessed as part of a separate self-assessment, or they can be assessed as part of a comprehensive FSMS self-assessment.

Self-assessment can be carried out according to different methodologies and there are many models for assessing the maturity level of the management system and the processes implemented in the system (Adamczyk, 2018). When applying self-assessment, organisations with a standardised management system in place most often use the guidelines contained in the ISO 9004:2018 standard (ISO 9004, 2018). According to these guidelines, when embarking on a self-assessment, an organisation should prepare the criteria against which it will assess its compliance solutions, as well as a scale for assessing levels of process maturity. Examples of criteria are shown in the table 4.

Table 4.
Criteria for self-assessment of the maturity of the compliance process

Obszar	Maturity level	
	Level	**Description**
Identification of legal requirements	1	Lack of formally defined rules and responsibilities related to the identification of legal requirements
		Legal requirements identification activities are carried out on *an ad hoc basis*
	2	Principles and responsibilities related to the identification of legal requirements have been formally defined
		Changes in legal requirements are monitored periodically
	3	Changes in legal requirements are monitored in a systematic and planned manner
		In the process of identifying legal requirements, the organisation uses various sources (online databases, forums and web portals, specialist press, cooperation with official food control authorities)
	4	The legal requirements identification process is effective
		Staff responsible for identifying requirements are systematically improving their competencies
		Changes in legal requirements are communicated to the organisation's staff on an ongoing basis
	5	The legal requirements identification process is systematically reviewed and updated, and any potential non-conformities are used to improve the process
Providing access to legal requirements	1	Lack of formally defined rules and responsibilities related to providing staff with access to legal requirements
	2	The rules and responsibilities associated with providing staff access to the legal requirements have been formally defined
	3	The organisation uses a variety of tool to ensure staff access to legal requirements (training, internal databases)
	4	The process of providing access to legal requirements is effective
	5	The legal requirements assurance process is systematically reviewed and updated, and any potential non-conformities are used to improve the process
Assessment of compliance with legal requirements	1	Lack of formally defined rules and responsibilities relating to conformity assessment with legal requirements
		Compliance assessment is carried out reactively, in response to food insecurity emergencies
		Results of conformity assessment are not documented
	2	The rules and responsibilities relating to the assessment of compliance with the legal requirements have been formally defined
		Evaluation of compliance with the legal requirements is carried out periodically
		Results of conformity assessment are not documented
	3	Assessment of compliance with legal requirements is carried out in a proactive, systematic and planned manner
		Personnel responsible for assessing compliance with the legal requirements systematically improve their competences
		The process of assessing compliance with the legal requirements involves the management of the organisation and personnel performing tasks that are crucial for the safety of the product
	4	The conformity assessment process is effective, identifying potential and actual non-conformities
		The results of the conformity assessment are communicated to all employees
	5	The conformity assessment process is systematically reviewed and updated, and any potential non-conformities are used to improve the process
		The organisation is aware of the hazards that may adversely affect the reliability of the assessment results and takes action to address the identified risks
		The legal requirements assessment process is integrated into the FSMS improvement process

Source: own elaboration.

A tool to support the conduct of the self-assessment can be a list of questions relating to the activities undertaken by the organisation related to the identification of legal requirements, the provision of access to regulations for staff and the periodic assessment of compliance. The assessment of the maturity level of the process using the designed criteria should be conducted on the basis of the evidence collected by the self-assessment team.

3.5. Risk associated with the process of assessing compliance with legal requirements

The ever-increasing number of legal requirements that govern an organisation's activities increases the risk of non-compliance. The FSMS can support organisations in mitigating these risks, as the system model described in the ISO 22000:2018 standard is based on the concept of risk-based thinking (ISO 22000, 2018; Rosiak, 2020). The concept is that the management of risks that may affect the ability of an organisation and its FSMS to achieve its performance targets should be an integral part of the system, and a pillar of the organisation's food safety culture (Dzwolak, 2018b; Kwiatek, Patyra, 2021). Risk management should also be an element of planning and controlling processes implemented in the system aimed at achieving the assumed effects, because each process may be associated with threats that may cause deviations from the planned results.

Organisations in food chain consider the correct evaluation of system performance, and therefore the effectiveness of system evaluation processes, as one of the key factors determining the success of FSMS implementation. The reliability of the evaluation results determines the possibility of using them to improve the system (Monge-Mora et al., 2020). The effectiveness of the FSMS can be significantly affected by the process of assessing compliance with legal requirements, and therefore, in line with the risk-based approach adopted in the ISO 22000:2018 standard, the organisation should be aware of the hazards that may adversely affect the process of this assessment and the reliability of its results, as well as the causes of these hazards (table 5).

Table 5.
Hazards associated with the process of assessing compliance with legal requirements and their causes

Hazards	Causes
– failure to carry out an assessment – inappropriate scope of assessment (failure to assess all legal provisions applicable to the organisation's activities) – lack of objectivity on the part of those conducting the assessment – improperly carried out assessment – lack of documentation of assessment results – loss or destruction of the documentation containing the assessment results – lack of access to the data necessary to carry out the assessment	– lack of assignment of responsibility and authority for conducting the assessment – lack of formalisation of the rules for conducting and documenting assessment results – the evaluators' direct reporting to the company management – lack of specific competence requirements for assessors – lack of competence of those carrying out the assessment – lack of training for assessors

– failure to include the results of periodic food law compliance assessments in management reviews – failure to take effective action in relation to non-compliances identified – failure to communicate the results of the assessment to the organisation's management	– failure to allocate funds in the organisation's budget to improve the competencies of assessors – ineffective supervision of documentation related to the assessment – lack of management commitment to maintain and improve the FSMS – failure to adequately and comprehensively identify the applicable legal requirements – low motivation and commitment of those carrying out the assessment – lack of cooperation between the organisation's staff and the assessors

Source: own elaboration.

The hazards related to the compliance assessment process, constituting a risk to the achievement of the organisation's objectives in the area of compliance, should be an impulse to introduce changes in the process (Brajer-Marczak, 2017). Therefore, once the hazards and their causes have been identified, the organisation should plan and implement actions to address them. By doing so, it can reduce the risk of negative consequences resulting from an inadequately conducted assessment, a failure to detect non-compliance with legal requirements and the provision of erroneous information on compliance status to management. These effects may include, for example:

- the lack of a reliable assessment of the effectiveness of the FSMS and thus the inability to identify needs and opportunities for improvement,
- loss of certification for FSMS due to the organisation's inability to demonstrate evidence of its ability to produce compliant safe food,
- loss of existing and potential customers who demand a certified FSMS from the organisation or who make cooperation with the organisation dependent on the effectiveness of the system.

4. Discussion

The assessment of compliance with food law under FSMSs has not been studied so far and, therefore, has not been extensively covered in the literature on the comprehensive approach to food safety management. Thus, the options presented in the paper for conducting assessments of compliance with legal requirements as part of system audits and management reviews, as well as the proposed criteria and measures of assessment of compliance with food law and the criteria for self-assessment of the maturity of the process of ensuring compliance with legal requirements fill the identified research gap.

Modern food safety management must take into account the needs of modern organisations in food chain regarding the implementation of an organisation management model making it possible to achieve goals in the area of ensuring compliance with legal requirements and to minimise the risk of non-compliance. Therefore, in order to ensure the effectiveness of FSMSs implemented in organisations in food chain and, consequently, to enhance the safety of food placed on the market, the FSMS model should be extended to include requirements requiring organisations to periodically assess compliance with legal requirements.

The organisation's use of proposed methods and tools for assessing compliance with legal requirements suggested in the paper will ensure a comprehensive approach to assessment. However, not all organisations will have to use such a broad scope of assessment - it can be flexibly adapted to their needs.

The obtained results made it possible to positively verify the research hypothesis. On the one hand, the lack of inclusion of requirements for the periodic assessment of compliance with legal requirements in the ISO 22000:2018 standard means that organisations in food chain may find it unnecessary to design and formalise their systemic solutions in this respect. This may result in an ineffective assessment of compliance that will not provide the organisation's management with reliable information about the status of compliance. On the other hand, the absence of such requirements may make it difficult for auditors of the certification body to assess the organisation's ability to meet legal requirements consistently and to evaluate the effectiveness of solutions adopted by the organisation in this area.

The research undertaken in this paper should be continued. Its aim should be to identify and evaluate systemic solutions related to food law compliance assessment that are used by organisations with an FSMS in place, as well as to validate the proposals presented in this paper in respect of their practical application and the identification of potential limitations of their application depending on various conditions of functioning of the organisation.

5. Conclusions

The process of assessing compliance with legal requirements is one of the most important processes in FSMSs implemented in organisations in food chain, as it provides management with information on the compliance status of the organisation's activities with the law with sufficient frequency, enables the detection of possible non-compliance and the taking of corrective action. Therefore, this process should be an integral part of the assessment and improvement of the effectiveness of the system and the results achieved by organisations in the area of food safety.

Based on the study, it can be concluded that the lack of inclusion in the ISO 22000:2018 standard of requirements that, following the example of other standards for management systems (e.g. ISO 14001:2015, ISO 45001:2018), would explicitly oblige organisations in food chain to periodically assess compliance with legal requirements, may be a factor that reduces the effectiveness of FSMSs. Thus it is essential that, despite the absence of such an obligation, organisations develop and implement their own system solutions to provide them with information on their compliance performance. Only this approach will ensure that FSMSs are an effective tool to support organisations in producing safe food that meets the requirements under food law. Perhaps as a result of the successive revisions of the ISO 22000 standard, conducted from time to time by the International Organisation for Standardisation, such requirements will be included in the FSMS model. This should be seen as an opportunity to increase the efficiency of the systems, improve the safety of food on the market and consequently increase consumer health protection.

In summary, based on the results of the conducted study, the following conclusions can be formulated:

1. The FSMS model described in the ISO 22000:2018 standard that is intended to address the needs of organisations in food chain with regard to compliance with food law requirements should evolve in the area of requirements concerning the assessment of compliance with these requirements.
2. Organisations that want to increase their capacity to meet legal requirements and respond flexibly to changes in these requirements should formalise activities related to the periodic assessment of compliance with food law.
3. When designing and formalising activities related to the assessment of legal compliance within the implemented FSMS, organisations should not rely solely on the requirements of the ISO 22000:2018 standard – they should also refer to standards that provide guidance for the assessment of standardised management systems (e.g. ISO 19011:2018, ISO 9004:2018).
4. In order to ensure the effectiveness of the assessment of compliance with legal requirements and, consequently, minimise the risk of non-compliance, it is essential to eliminate risks that may affect the reliability of the assessment results.

The considerations presented in this paper are of theoretical importance, as they complement knowledge of the limitations of the FSMS model described in the ISO 22000:2018 standard in terms of requirements relating to the assessment of compliance with legal requirements, as well as knowledge of the methods and tools that can be used to assess compliance. They also have practical applications, as they can be used by organisations in food chain with an FSMS in place to design and implement methods and tools that will support their food law compliance assessment activities. They can also be an inspiration for organisations with other standardised management systems in place, which oblige organisations to ensure compliance with legal requirements and assess this compliance.

The results of the research have a number of implications for a wide group of parties interested in food safety:

1. From the organisation's in food chain perspective, they can help increase their ability to produce safe food that meets the requirements of food law. This enables organisations to create a positive image among all of their stakeholders and, consequently, enhance their competitiveness.
2. From the consumers' perspective, they can build their confidence in the safety of food on the market.
3. From the perspective of official food control authorities, they can foster positive relationships with organisations in food chain under supervision.
4. From the state's perspective, they can promote the competitiveness of the food market, foster the improvement of public health and minimise the risk of food crises.
5. From the perspective of certification bodies, they can support the assessment of compliance with legal requirements through external audits carried out in organisations and build confidence in certificates for FSMSs issued by the body.

The criteria and measures of assessment of compliance with food law and the criteria of self-assessment of the maturity of the process of ensuring compliance with legal requirements proposed in the work are of a very general nature. This results in some limitations on their applicability for organisations in food chain whose activities are determined by various factors, such as the size of the organisation, the organisational structure or the specifics of the business. They should, therefore, be seen as proposals which, before being implemented, should be adapted by organisations to their needs and the context of their business.

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APPROACH TO GOALS AND FINANCIAL SITUATION OF FAMILY BUSINESSES

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Purpose: The aim of this article is to examine the relationship between the primary goals of family businesses and their financial performance. This study seeks to determine whether a focus on family-oriented or business-oriented goals has a significant impact on the financial outcomes of these enterprises, and, if so, which orientation yields superior results.
Design/methodology/approach: To address the research objective, a survey was conducted among 300 managers of family businesses. The collected data was subsequently analyzed using statistical methods to answer the research questions posed.
Findings: The findings indicate a considerable diversity among family businesses in terms of family versus business orientation. While no direct correlation was found between orientation (family or business-focused) and overall financial evaluation, specific financial metrics revealed notable effects. Analysis demonstrated that a business-oriented focus, rather than a family-oriented one, positively influenced turnover, profit, financial liquidity, market share, employee numbers, as well as sales and asset profitability.
Research limitations/implications: The research was based on respondents' subjective evaluations of both the goals of their family business and its financial condition, including key financial metrics. Although subjective assessments are inherently prone to bias, they are likely a reasonable reflection of reality in this case. However, future studies could benefit from incorporating objective financial data from the enterprises.
Originality/value: Both financial status and goal orientation are critical to the survival and growth of family businesses. However, there remains a gap in the literature concerning studies that combine these aspects, particularly with regard to family versus business-oriented goals. The insights provided by this study may assist family business managers in understanding the interactions between financial performance and goal orientation within their companies.
Keywords: family business, family business goals, goals and financial performance.
Category of the paper: research paper.

1. Introduction

The functioning of family businesses, which represent essential components of most economies (Perri, Peruffo, 2017; Sokołowska, Böhlich, Dziadkiewicz, 2024; Mashele, Mouton, Pelcher, 2024; Kurowska-Pysz, Czart, Kot, 2024), is shaped by their unique characteristics (for further details on family business attributes, see Safin, 2007; Yolal, Çetinel, 2010; Ratten et al., 2017; Maloni, Hiatt, Astrachan, 2017). These businesses, like all enterprises, require a stable financial standing to survive; however, this is not the only crucial factor. The intertwining of family and business subsystems (Davis, Tagiuri, 1989) means that, alongside business objectives, family businesses are also driven by a range of family-oriented goals (see Aparicio et al., 2017; Binz et al., 2017). Consequently, both goal-setting processes (Della Piana et al., 2017) and performance evaluation (Astrachan, 2010) are more complex. These subsystems operate according to different logics, values, and principles, which can sometimes lead to tensions and prioritization challenges (Pecis, Ge, Bauer, 2024; Raghavan, 2024). Insufficient management of these divergent objectives may prevent growth or even lead to the company's downfall (Ihionu, Maureen, Aneke, 2024). Therefore, it is essential that family business managers successfully balance family and business goals, ensuring optimal outcomes, including financial performance.

However, it remains uncertain how, and to what extent, the specific structure of goals in family businesses affects their financial performance. Thus, the objective of this article is to assess whether a relationship exists between the key goals pursued by family businesses and their financial outcomes. This analysis seeks to answer whether a family-oriented or business-oriented focus significantly impacts financial performance, and if so, which orientation yields better results. The structure of this article is as follows: Literature Review, Methodology, Results and Discussion, and Conclusion.

2. Literature review

The coexistence of two distinct subsystems within family businesses—the family and the business—and their interactions (El Masri et al., 2017) make managing these entities particularly demanding and complex (Aparicio et al., 2017). Therefore, to achieve success, family business managers must not only meet the requirements of both subsystems (Williams et al., 2019a) but also align goals that may sometimes be in conflict. Consequently, the set of goals pursued within family businesses encompasses both business and family-oriented objectives (Binz et al., 2017). The literature commonly distinguishes between family-oriented and business-oriented goals, as well as between economic and non-economic (Raghavan, 2024)

or, alternatively, financial and non-financial goals (Kurowska-Pysz, Czart, Kot, 2024). Although family goals are frequently equated with non-financial objectives and business goals with financial objectives, an increasing number of authors recognize that some family goals may be financial in nature, and conversely, some business goals may be non-financial (Binz et al., 2017). Consequently, some scholars advocate a four-category approach to family business goals: financial/economic business goals, non-financial/non-economic business goals, financial/economic family goals, and non-financial/non-economic family goals (Basco, 2017; Aparicio et al., 2017; Vajdovich et al., 2021; Raghavan, 2024). Non-financial goals arising from family involvement play a particularly crucial role, as they can substantially influence firm behavior (Chrisman et al., 2012; Berrone, Cruz, Gomez-Mejia, 2012), contribute to heterogeneity among firms (Ng, James Jr, Klein, 2020), and affect the pursuit of business objectives and financial outcomes. On the other hand, poor financial results achieved by a family business may discourage family members from further involvement in the company (Mahto et al., 2010) and obstruct the achievement of other goals, including family-oriented ones.

The financial performance of family businesses has been an area of intense study for many years, as it depends on a variety of factors, including ownership structure, company size, and the presence of the founder in management. Researchers predominantly focus on evaluating the impact of family involvement on performance and identifying mediating factors that influence these relationships (Garcia-Castro, Aguilera, 2014; Miralles-Marcelo, del Mar Miralles-Quirós, Lisboa, 2014; Badrul Muttakin, Khan, Subramaniam, 2014; Wang, Shailer, 2017; Déniz-Déniz, Cabrera-Suárez, Martín-Santana, 2020). Numerous studies reveal differences in financial performance between family and non-family businesses that stem from family involvement. However, there is no consensus regarding the direction and strength of this influence. Some studies indicate a positive impact of family involvement on performance (Lee, 2006; Allouche et al., 2008; Mazzi, 2011; González et al., 2012; Wagner et al., 2015; Leopizzi, Pizzi, D'addario, 2021; Stryckova, 2023), while others report no such effect (O'Boyle Jr, Pollack, Rutherford, 2012). Certain studies highlight a positive impact in specific areas and a negative one in others (Özer, 2012; Gallucci et al., 2020), variable influence (Anderson, Reeb, 2003; De Massis et al., 2013), or even a wholly negative effect (Cucculelli, Micucci, 2008; Cho, Miller, Lee, 2018; Miroshnychenko et al., 2024). Wagner et al. (2015) emphasize that the financial standing of family businesses appears most favorable when assessed using Return on Assets (ROA). Schell et al. (2019) demonstrate that family members' involvement in a family business positively affects innovation and performance, but only when family and business goals are aligned.

One of the key factors influencing the performance of family businesses is the company's orientation. A family business may adopt a more business-oriented or family-oriented approach, which significantly impacts various aspects of operations and strategic decision-making (Putri, Viverita, 2019). Scholarly literature highlights that family businesses frequently face the

challenge of balancing family needs with the demands of running an efficient business. On one hand, there is strong pressure to preserve family values and meet the expectations of family members, which may lead to decisions driven by loyalty, emotions, or family tradition rather than rational business considerations. On the other hand, companies must operate within a dynamic and competitive business environment where performance is critical to survival and growth (De Massis et al., 2018). Some studies suggest, however, that an orientation towards family goals can positively influence company performance. Déniz-Déniz, Cabrera-Suárez, and Martín-Santana (2020) indicate that strong family identification with the company can foster stability and commitment to long-term development, which may result in better financial outcomes under favorable market conditions. According to Alves and Gama (2020), family businesses achieve better financial results when they incorporate F-PEC aspects of family involvement and a culture of family values. Furthermore, they conclude that improved performance in family businesses may be linked to aligning the company with its non-financial goals. Lee and Marshall (2013) found that two goals positively influenced the long-term performance of enterprises: a positive reputation among customers and company growth. In practice, however, conflicts often arise between family logic and business logic, and effectively balancing these two orientations can be a critical success factor (Mazzi, 2011; Aparicio et al., 2017).

Accounting for the diversity of approaches taken by family businesses toward their goals is essential for a proper evaluation of their performance. As Núñez-Cacho Utrilla and Grande Torraleja (2012) observed, assessing the effectiveness of family businesses should not be limited solely to financial indicators and economic metrics; other aspirations must also be considered. Financial success may not always be the primary objective of family businesses (Chua, Chrisman, Steier, 2003; Mahto et al., 2010). Kragl et al. (2023) found that non-family managers tend to focus more on economic goals, while family managers seldom neglect non-economic goals. Chua et al. (2018) demonstrated that performance evaluation is contingent on the specific system of goals adopted by the enterprise. These systems, rooted in differing strategies, lead individual family businesses to assign varying levels of importance to different goals (Williams Jr et al., 2019b). Thus, the goals of family businesses should be approached holistically, taking into account the orientation adopted by each particular entity.

3. Materials and Methods

The issues analyzed in this article are part of a broader survey conducted among managers of family businesses. The survey questionnaire included two questions regarding the company's orientation (either towards family or business goals). In the first question, respondents evaluated the importance of achieving twelve specified goals—six family-oriented and six

business-oriented goals (Table 1). The evaluation was conducted using a 5-point Likert scale, where 1 indicated that the goal was insignificant and 5 indicated that the goal was of critical importance. In the second question, respondents were presented with nine pairs of mutually exclusive family and business goals (Table 2) and were asked to select the one they considered more important in each pair.

Table 1.
Family business goals evaluated by respondents, divided into family-oriented and business-oriented goals

Business-oriented goals	1. ensuring the financial well-being of family members who own the business
	2. ensuring the continuity of the family business
	3. building a positive image of the family and the family business within society
	4. maintaining family cohesion by uniting members around a common good
	5. fostering family members' identification with the business
	6. upholding family values and high ethical and moral standards in business
Family-oriented goals	7. building strong relationships with contractors and employees
	8. a thorough understanding of customers' needs and expectations
	9. delivering high-quality products and services
	10. improving the financial standing of the enterprise
	11. expanding the enterprise and increasing the scale of operations
	12. enhancing the company's innovation

Source: own study.

Responses to the first question were scored as follows:

- 0 points – responses of 3, indicating moderate importance,
- 1 point – responses indicating that family goals are of critical importance (responses of 5 or 1, depending on the goal),
- 0.5 points – responses indicating that family goals are of high importance (responses of 4 or 2, depending on the goal),
- - 1 point – responses indicating that business goals are of critical importance (responses of 5 or 1, depending on the goal),
- - 0.5 points – responses indicating that business goals are of high importance (responses of 4 or 2, depending on the goal).

Table 2.
Pairs of alternative family and business goals

1.	keeping the business within the family	scaling up operations
2.	providing employment for family members	employing competent and skilled workers
3.	increasing the family's income level	investing in the company's growth
4.	avoiding conflicts within the family	avoiding conflicts within the business
5.	ensuring the family's financial security	ensuring the financial security of the business
6.	retaining decision-making authority in day-to-day operations	utilizing the expertise of professional managers in executive positions
7.	preserving family norms and values within the business	adapting the company to external ideological and environmental requirements
8.	avoiding risk	achieving greater profits through new ventures
9.	maintaining a long-term operational perspective	rapid return on invested capital

Source: own study.

Responses to the second question were scored as follows:

- 1 point – selecting the family-oriented goal from the pair,
- -1 point – selecting the business-oriented goal from the pair.

The average of these processed data positioned each of the surveyed companies on a scale ranging from -1 point (full orientation towards business goals) to 1 point (full orientation towards family goals).

The scale constructed in this manner was subjected to reliability analysis using Cronbach's Alpha coefficient. The Cronbach's Alpha result reached a satisfactory value of 0.75. Removing any individual item from the scale would not have significantly increased this value, so the scale was used in further analysis in its current form.

The financial situation of the company was assessed by respondents through responses to a question comprising 10 statements (Table 3) rated on a 5-point agreement scale, where 1 indicated "strongly disagree" and 5 indicated "strongly agree." Respondents were asked to specify the extent to which each statement applied to their company.

Table 3.
Descriptions illustrating the financial situation of the company

No.	Description
1.	the company can handle a significant, unexpected expense
2.	the financial future of the company is secure
3.	the financial situation of the company allows it to achieve any financial goal it sets
4.	the owning family can enjoy life due to how we manage the company's finances
5.	the owning family has no financial problems
6.	as a family business, we do not worry that our finances will fail
7.	making a charitable donation would place a financial burden on the company
8.	at the end of the month, the company has cash reserves
9.	the company is overdue on payments to creditors
10.	the financial situation of the business determines its success

Source: own study.

The final value of the scale was the average of the scores given (with two reverse-worded statements recoded accordingly). Thus, the possible range of the constructed scale was from 1 point (poor financial condition of the company) to 5 points (good financial condition of the company).

The Cronbach's Alpha coefficient for the calculated scale was 0.79. However, an analysis of individual items indicated that removing two items ("Making a charitable donation would place a financial burden on the company" and "The company is overdue on payments to creditors") would significantly increase the overall reliability of the scale. Removing these two items from the financial condition assessment scale raised the Cronbach's Alpha to 0.89. This revised version of the scale (consisting of eight items) was therefore considered final and used in further analyses.

Additionally, to assess the financial situation, respondents were asked to evaluate changes over the past three years in the following metrics: turnover, profit, debt, financial liquidity, market share, number of employees, sales profitability, and asset profitability. They could select

one of the following responses: downward trend, variable trend, stagnation, upward trend, or refusal to answer. For analysis purposes, "refusals to answer" were removed (resulting in varying sample sizes, *n*), and variable trends and stagnation were combined into a single category to ensure the scale had an ordinal measurement level.

All of this data is intended to test the hypothesis that family businesses with a stronger focus on business goals achieve better financial/operational outcomes than those with a stronger focus on family goals.

4. Results and Discusssion

The average value of the goal orientation scale in the surveyed group of enterprises was -0.12. This value was close to the midpoint of the proposed scale (0.00) but deviated slightly toward the negative, indicating a business-oriented orientation. These results suggest that the surveyed family businesses maintain a relatively balanced approach to goals, with business goals slightly outweighing family goals. This ability to balance both perspectives is neither common nor easy to achieve, yet it undoubtedly allows for more effective and efficient operation (Mazzi, 2011).

The scale value for the company most oriented toward family goals was 0.52, while the company most inclined toward business goals achieved the maximum possible deviation in that direction (-1.00). These results indicate that the surveyed family businesses included entities with a purely business orientation, for which family goals are secondary; however, there were no companies focused solely on family needs while completely disregarding business objectives. This finding somewhat confirms that managing a family business, like any other enterprise, must be based to some extent on a business-oriented foundation.

Table 4.
Company goal orientation scale – descriptive statistics

Variable:	M	Me	Min.	Max.	SD
company goal orientation scale (range: from -1 pt. to 1 pt.)	-0.12	-0.14	-1.00	0.52	0.32

M – mean; Me – median; Min. – minimum value of the distribution; Max. – maximum value of the distribution; SD – standard deviation.

Source: own study.

The average value of the company financial situation assessment scale was 3.33, with a median of 3.25, indicating that, overall, the companies participating in the study rated their financial situation as average. These results are not particularly surprising, as respondents often select the middle option when evaluating such aspects, especially if they do not fully know or prefer not to answer.

The research sample included companies that rated their financial situation in both the lowest possible way (1.00) and the highest (5.00). This shows that among the surveyed family businesses, there are enterprises in excellent financial condition that do not need to worry about this aspect of their operations, as well as companies that are concerned about their survival. It should be noted, however, that this is a subjective assessment that may not always reflect reality, especially if the person managing the business is the family business owner.

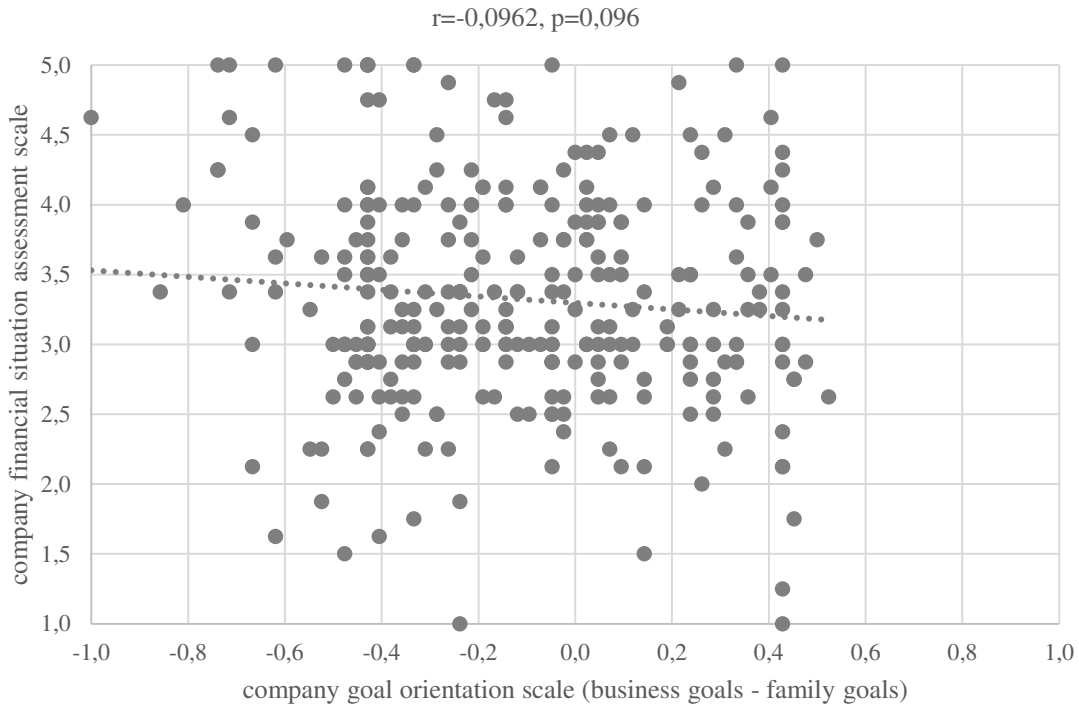
Table 5.
Financial situation assessment scale – descriptive statistics

Variable:	M	Me	Min.	Max.	SD
financial situation assessment scale (range: from 1 pt. to 5 pt.)	3.33	3.25	1.00	5.00	0.78

M – mean; Me – median; Min. – minimum value of the distribution; Max. – maximum value of the distribution; SD – standard deviation.

Source: own study.

To test the research hypothesis posed in the previous section, the two scales—company goal orientation and financial situation assessment—were first compared. This comparison is presented in a chart in the form of a coordinate system, with the axes representing the two analyzed scales and the points representing the individual companies surveyed. It is evident that significantly more companies rate their financial situation very positively (value above 4.5) than very negatively (value below 1.5). A trend line was also plotted to illustrate any potential correlation between the variables. This line indicates a decline in the financial situation assessment score as the orientation shifts more toward family goals. However, the applied Pearson's linear correlation coefficient r did not reveal a statistically significant correlation between the analyzed variables ($p > 0.05$). This means that, in this case, no relationship can be confirmed between a company's orientation toward family or business goals and its financial situation assessment.



r – Pearson's linear correlation coefficient, p – statistical significance.

Figure 1. Assessment of the company's financial situation vs. company goal orientation.

Source: own study.

Subsequently, the results of the company goal orientation scale were compared with changes in performance metrics over the past three years. Spearman's rank correlation coefficients indicated that only one of the analyzed metrics (debt) was not significantly associated ($p > 0.05$) with company goal orientation. For the remaining metrics, statistically significant correlations ($p < 0.05$) with goal orientation were established. Each confirmed correlation was negative and statistically weak in strength. Thus, as the orientation toward family goals increased, metrics such as turnover, profit, financial liquidity, market share, number of employees, and profitability of sales and assets decreased. This suggests that a family-oriented focus does not favor business development in these areas, likely due to a lesser emphasis on improving these metrics. Weaker results in liquidity and profitability may also stem from the absence of a professional financial director or manager.

Table 6.
Changes in company metrics over the last three years vs. company goal orientation

Variable:	M	Me	Min.	Max.	SD
financial situation assessment scale (range: from 1 pt. to 5 pt.)	3.33	3.25	1.00	5.00	0.78

Metric:	n	Average company goal orientation scale in different categories of indicator change			Statistical significance:
		downward trend	variable trend/stagnation	upward trend	
sales	276	0.02	-0.09	-0.17	**r_s=-0.157717 p=0.008671**
profit	278	0.00	-0.09	-0.17	**r_s=-0.152129 p=0.011090**
debt	254	-0.14	-0.11	-0.09	r_s=0.041233 p=0.512997
financial liquidity	273	0.04	-0.10	-0.18	**r_s=-0.163018 p=0.006950**
market share	274	-0.01	-0.08	-0.18	**r_s=-0.177152 p=0.003258**
number of employees	279	0.06	-0.11	-0.19	**r_s=-0.148228 p=0.013194**
sales profitability	265	0.02	-0.09	-0.20	**r_s=-0.179178 p=0.003425**
asset profitability	258	0.03	-0.10	-0.19	**r_s=-0.160507 p=0.009812**

n – sample size, rs – Spearman's rank correlation coefficient, p – statistical significance.

Source: own study.

The results obtained correspond with findings from other studies. For example, Blanco-Mazagatos et al. (2024) demonstrated that when a family emphasizes continuity and ownership from a long-term perspective, the level of debt in family businesses is higher; however, other family goals they examined did not affect the debt levels of family firms. Molly et al. (2019) show that family goals have an indirect impact on the overall debt ratio through family representation in management. Kotey (2005) indicates that growth in family-oriented businesses is approached cautiously, as failure poses a risk to the family's finances. Research by Lutz and Schraml (2011) confirms a negative correlation between employing a financial director and family goals, such as independence and control. Meanwhile, studies conducted by Biel and Ślusarczyk (2022) suggest that the level of achievement of family business goals is only slightly correlated with developmental trends in selected financial metrics.

In summary, analysis of the collected research material demonstrated that a focus on business goals (rather than family goals) supports the growth of seven metrics describing the company's condition. Although such a relationship was not found for the financial situation assessment, the results obtained are sufficient to support the research hypothesis.

5. Conclusion

The financial situation and goal orientation are two issues with a significant impact on the functioning of family businesses. Without adequate financial results, family businesses will not be able to survive and pursue other objectives. On the other hand, the pursuit of various family goals, which are largely non-financial in nature, also affects the financial and developmental capacities of these enterprises. It is therefore essential to be able to balance goals appropriately and to remember that the performance assessment of family businesses should account for family objectives and not rely solely on financial metrics.

The results obtained in the study confirm the considerable heterogeneity among family businesses in terms of family or business orientation. Most companies manage to balance their goals reasonably well, although some adopt more extreme approaches, focusing significantly more on either a business or family orientation. This choice, in turn, has financial implications. Although no relationship was found between family or business goal orientation and the overall financial assessment of family businesses, such an effect is evident when analyzing specific metrics. Of the 8 metrics analyzed, 7 demonstrated such an impact, with debt being the only exception. The analysis showed that a focus on business goals rather than family goals positively influences turnover, profit, financial liquidity, market share, number of employees, as well as sales and asset profitability.

The conclusions drawn from the conducted research may be useful for both owners and managers of family businesses. They indicate that a shift in focus toward business goals can have positive effects on financial performance. However, the analyses conducted are not without limitations. The first limitation is the reliance on the subjective opinions of managers (particularly in assessing the financial situation on a Likert scale) rather than on specific numerical results. Opinion-based studies are always somewhat subjective; however, in family businesses, feelings and emotions are often as significant a measure as financial results. Additionally, a different selection of goals might have influenced the study's results to some extent, but it seems that the overall findings would likely remain similar.

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FUZZY TOPSIS IN OCCUPATIONAL RISK MANAGEMENT ASSESSMENT

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Purpose: The purpose of this article is to propose and practically verify the use of the fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method for comparing and evaluating occupational risk management in manufacturing companies.
Design/methodology/approach: The adopted approach was verified through a questionnaire survey conducted at four furniture industry companies with similar employment size, product mix and volume. The evaluation criteria were eight detailed occupational risk assessment processes that make up the risk management process. The assessments were carried out by independent experts. Verbal and scoring assessments were used.
Conclusions: With the help of the ordered fuzzy TOPSIS method, the surveyed companies were ranked and the best and worst implemented occupational risk assessment process was identified. The research confirmed the usefulness of the fuzzy TOPSIS method in the area of occupational risk management.
Limitations of the study: The main limitations relate to subjectivity in the selection of experts and subjective expert judgment. This work may inspire the verification of other multi-criteria decision-making methods for their suitability in the field of occupational safety, including their fuzzy counterparts.
Practical implications: The presented approach can be an important tool for improving occupational risk management and, in general, occupational health and safety management in manufacturing companies.
Social implications: In the area of occupational risk management, there is a lack of practically validated tools that decision-makers can use in their decision-making process for shaping safe and healthy working conditions.
Originality/Value: The use of the fuzzy approach in OHS management is particularly beneficial, as it allows experts to evaluate various criteria using the most commonly used linguistic variables. The fuzzy TOPSIS method has already been used for many years to evaluate alternatives in many different areas, while the application, with ordered fuzzy numbers in the field of occupational risk management, is original.
Keywords: occupational risk management, MCDM, fuzzy TOPSIS, manufacturing companies.
Article category: research article.

1. Introduction

Occupational risk management is a key process in ensuring safe and healthy working conditions in all types of organizations, regardless of their size. The implementation of this process is driven by numerous regulations of both local and international nature. Numerous risk analysis and assessment models are available in the literature (Marhavillas et al., 2011; Rausand, Haugen, 2020; Liu et al., 2023). They confirm the continuing need for improved management in this area (Babut, Moraru, 2018; IEC 31010:2019; Pisarczuk, 2021).

According to the basic concept of risk management per se, the process of occupational risk management consists most broadly of two main stages: analyzing and assessing risks and controlling risks (Tixier, 2002, IEC 31010:2019; de Oliveira, et al., 2022).

In the risk analysis and assessment stage, four main activities are carried out: gathering the information needed to assess risks, identifying risks, estimating risks, and determining the level of acceptability. In contrast, five main activities are carried out in the area of risk control: analyzing options for implementing preventive measures, deciding on appropriate measures, implementing these measures, monitoring their implementation, and evaluating their effectiveness. Associated with each of these activities, which can be thought of as sub-processes of risk management, are specific issues that decision-makers must confront during the implementation of each sub-process.

At the stage of risk analysis, the basic problem is the correct selection of information sources for hazard identification and the use of appropriate data collection methods, since the same hazard can cause different consequences (IEC 31010:2019).

The problem at the risk estimation stage is the proper selection of methods in relation to the previously identified risks. Risk estimation methods are plentiful (Tixier, 2002; Rausand, 2013), but not all of them are appropriate for a given risk and in a given situation. The key problem at the risk assessment stage is the correct determination of the level of tolerance, control and non-acceptance of risk. The decision in this regard depends on many different considerations (financial, personnel, organizational, etc.) (Moseman, 2012).

The main problem at the stage of analyzing preventive options is the adoption of an appropriate methodology for selecting preventive and/or protective measures (Hollnagel, 2008; Jensen, 2019; Klimecka-Tatar et al., 2023). These measures of a technical, organizational and/or behavioral nature should be considered in terms of factors such as the effectiveness of the solution, cost-effectiveness, feasibility and implementation time, psychological effect, subjective perception by the employees involved, etc. (Manuelle, 2005; Tabor, Moraru, 2022).

Problems such as appropriate planning of activities, proper allocation of needed resources, identification of responsible persons, and determination of the timing of implementation taking into account the possibility of implementation within the established timeframe are related to decision-making on prevention (Marhavillas et al., 2011).

At the stage of implementation of preventive measures, there are mainly problems related to the practical implementation of planned activities in accordance with the adopted schedule (IEC 31010:2019), while at the stage of monitoring - problems of appropriate selection of the scope and detail of ongoing control of planned activities (Main, 2012).

Problems related to the last (in the sense of analysis) stage in the risk management cycle, i.e. the evaluation of the effectiveness of prevention, concern the correctness of assessing the actual reduction in the level of risk after the application of selected preventive measures.

All of these presented problems mean that the decision-maker may not achieve the goal that the occupational risk management process is supposed to serve, which is the continuous and real improvement of working conditions. Accordingly, systematic efforts are being made to develop methods and tools that will facilitate the resolution of these problems, and the effective management of the occupational risk assessment process.

Nowadays, methods and tools are being sought outside the so-called traditional area of interest (such as AHP) paying attention to advanced methods and tools of multi-criteria decision-making (MCDM) (Nowak et al., 2020). Although multi-criteria decision-making is an integral part of occupational risk management, the use of more advanced tools to support this process (e.g. TOPSIS, VIKOR, PROMETHEE) is still little practiced and rarely described in the H&S literature.

The purpose of this article is to propose and verify the application of the fuzzy TOPSIS method, using directed fuzzy numbers, to compare and evaluate occupational risk management.

The TOPSIS method is a tool used in the decision-making process for linear ordering of alternatives (Hwang, Yoon, 1981; Tzeng, Huang, 2011). The method is based on the use of a measure of relative distance from the best solution, which is the benchmark, and from the worst solution, which is the anti-benchmark. The fundamental objective of TOPSIS is to identify an alternative that would have maximum relative proximity to the pattern and minimum relative proximity to the anti-pattern. Nowadays, the most widely used fuzzy TOPSIS method (Chen, Hwang, 1992) uses fuzzy set theory according to Zadeh (Zadeh, 1965).

In contrast, the directed fuzzy numbers (Ordered Fuzzy Numbers) model was proposed in 2002 (Kosinski et al., 2003). The main advantages of directed fuzzy numbers include the ability to go through multiple operations without losing accuracy and the ability to infer backwards.

The application of the TOPSIS method with directed fuzzy numbers, presented in this article, to the assessment of occupational risk management is original.

2. Methodology

The use of a fuzzy approach in assessing occupational risk management is particularly beneficial, as it allows experts to evaluate various criteria using the most commonly used linguistic variables. The paper uses blurring of grades by extending their ranges with fuzzy uncertainty intervals, which simplifies calculations. The approach is captured in the following calculation procedure:

1) Aggregation of criteria scores using the arithmetic mean.
2) Create a fuzzy decision matrix *X* using directed fuzzy numbers:

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1N} \\ x_{21} & x_{22} & \dots & x_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ x_{M1} & x_{M2} & \dots & x_{MN} \end{bmatrix} \quad (1)$$

where $x_{ij} = \left(l_{ij}\ \ 1_{ij}^{-}\ \ 1_{ij}^{+}\ \ p_{ij}\right)\ (i = 1, 2, \dots M; j = 1, 2, \dots N)$ are directed fuzzy numbers. The fuzzy decision matrix is formed by converting the sharp evaluations x_{ij}^{*} into evaluations expressed by directed fuzzy numbers x_{ij}.

3) Create a normalized fuzzy matrix Z:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \dots & z_{1N} \\ z_{21} & z_{22} & \dots & z_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ z_{M1} & z_{M2} & \dots & z_{MN} \end{bmatrix}, \quad (2)$$

where:

$$z_{ij} = \begin{cases} \left(\dfrac{l_{ij}}{\max\limits_{i} p_{ij}}\ \dfrac{1_{ij}^{-}}{\max\limits_{i} p_{ij}}\ \dfrac{1_{ij}^{+}}{\max\limits_{i} p_{ij}}\ \dfrac{p_{ij}}{\max\limits_{i} p_{ij}}\right) when\ C_j - \text{"profit"} - type\ criterion \\ \left(\dfrac{\min\limits_{i} p_{ij}}{l_{ij}}\ \dfrac{\min\limits_{i} p_{ij}}{1_{ij}^{-}}\ \dfrac{\min\limits_{i} p_{ij}}{1_{ij}^{+}}\ \dfrac{\min\limits_{i} p_{ij}}{p_{ij}}\right) when\ C_j - \text{"loss"} - type\ criterion \end{cases} \quad (3)$$

4) Calculation of weights w_j individual criteria, according to the maximum deviation method (Wang, 1998):

$$w_j = \frac{H_j}{\sum_{j=1}^{n} H_j}, where: H_j = \sum_{i=1}^{m} H_{ij} \quad (4)$$

and

$$H_{ij} = \sum_{k=1}^{m} d(a_{ij}, a_{kj}), where: i \in \{1, 2, \dots, m\}, j \in \{1, 2, \dots, n\} \quad (5)$$

Hence the scalar vector of weights: $w = [w_1, w_2, \dots w_N]$, where $w_N \in \mathbb{R}\ (w_N > 0, n = 1, 2, \dots N)$ is the weight of the nth criterion, with $w_1 + w_2 \dots + w_N = 1$.

5) Create a weighted normalized fuzzy matrix V:

$$V = \begin{bmatrix} v_{11} & v_{12} & \dots & v_{1N} \\ v_{21} & v_{22} & \dots & v_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ v_{M1} & v_{M2} & \dots & v_{MN} \end{bmatrix}, \tag{6}$$

where: $v_{ij} = z_{ij} \times w_j \ \ (i = 1, 2, \dots M; j = 1, 2, \dots N)$.

6) Finding the pattern A^+ and anti-pattern A^- for ratings against each criterion, whereby:

$$A^+ = (v_1^+ , v_2^+, \dots v_N^+),$$
$$\text{where: } v_j^+ = \left(\max_i l_{v_{ij}} \ \max_i 1_{v_{ij}}^- \ \max_i 1_{v_{ij}}^+ \ \max_i p_{v_{ij}}\right), j = 1, 2, \dots, N \tag{7}$$

and

$$A^- = (v_1^- , v_2^-, \dots v_N^-),$$
$$\text{where: } v_j^- = \left(\min_i l_{v_{ij}} \ \min_i 1_{v_{ij}}^- \ \min_i 1_{v_{ij}}^+ \ \min_i p_{v_{ij}}\right), j = 1, 2, \dots, N \tag{8}$$

7) Calculation of the distance of each variant's ratings from the pattern and anti-pattern using the following relationships:

$$d_i^+ = \sum_{j=1}^{N} d\left(v_{ij} , v_j^+\right) \ and \ d_i^- = \sum_{j=1}^{N} d\left(v_{ij}, v_j^-\right) \ \ for \ i = 1, 2, \dots M \tag{9}$$

where:

$$d(A, B) = \sqrt{¼[(l_A - \ l_B)^2 + (1_A^- - \ 1_B^-)^2 + (1_A^+ - 1_B^+)^2 + (p_A - p_B)^2]}, \tag{10}$$

when: $A = (l_A \ 1_A^- \ 1_A^+ \ p_A) \ and \ B = (l_B \ \ 1_B^- \ \ 1_B^+ \ p_B)$.

8) Determination of the synthetic measure of variant evaluations CC_i using the relative proximity of variant evaluations to the pattern and anti-pattern:

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-}, i = 1, 2, \dots M \tag{11}$$

The shorter the distance of the variant's evaluation from the pattern, and at the same time the greater the distance from the anti-pattern, the closer the value of the measure is to 1.

9) Create a ranking for M variants based on linear ordering of synthetic measures CC_i, gdzie $i = 1, 2, \dots M$.

In structuring the problem, criteria C, for assessing the level of implementation of the occupational risk management process, were defined, which correspond to the following stages of the process: C_1 - Identifying risks, C_2 - Assessing risks, C_3 - Assessing risks, C_4 - Analyzing

preventive options, C_5 - Deciding how to prevent, C_6 - Implementing preventive actions, C_7 - Monitoring preventive actions, C_8 - Evaluating the effectiveness of prevention.

After determining the evaluation criteria, possible alternative A solutions were established on the basis of four furniture industry companies A_1, A_2, A_3 and A_4, with similar product mix, market position and employment size in the range of 50 to 99 people.

At the problem modeling stage, four E experts, using a specially prepared questionnaire, first evaluated the relevance of criteria C_1-C_8, using a seven-point scale from 1 - *not relevant* to 7 - *very relevant* for evaluation.

Then, using a second questionnaire, experts assessed the level of implementation of each sub-process of occupational risk management in each of the surveyed companies separately. The implementation of each sub-process (criterion) was evaluated independently of the results of the evaluation of the other criteria, using a seven-point linguistic scale from *bad* to *excellent*.

The resulting language scores were assigned corresponding fuzzy ratings: *Wrong* (W) – (0.0 0.5 1.5 2.0) *Very poor* (VP) – (1.0 1.5 2.5 3.0), *Poor* (P) – (2.0 2.5 3.5 4.0), *Medium* (M) – (3.0 3.5 4.5 5.0), *Good* (G) – (4.0 4.5 5.5 6.0), *Very good* (VG) – (5.0 5.5 6.5 7.0), Excellent (E) – (6.0 6.5 7.5 8.0).

3. Results

Table 1 summarizes the linguistic evaluations of individual criteria C_1-C_8 given by the experts to individual companies A_1, A_2, A_3 and A_4.

Table 1.
Expert linguistic evaluations of criteria C for the surveyed companies A_1, A_2, A_3 and A_4

	A_1				**A_2**				**A_3**				**A_4**			
	E_1	**E_2**	**E_3**	**E_4**	**E_1**	**E_2**	**E_3**	**E_4**	**E_1**	**E_2**	**E_3**	**E_4**	**E_1**	**E_2**	**E_3**	**E_4**
C_1	VP	W	VP	P	P	P	M	VP	P	VP	M	P	VP	VP	P	VP
C_2	G	G	VG	M	VP	VP	VP	VP	M	M	G	P	G	M	VG	G
C_3	M	P	M	G	G	M	VG	G	M	P	G	M	VG	M	E	E
C_4	M	G	M	P	P	VP	M	P	VG	M	E	E	G	M	VG	G
C_5	P	M	VP	P	G	G	M	VG	VG	E	M	E	M	M	G	P
C_6	P	M	VP	P	G	G	M	G	VG	G	VG	E	M	M	M	M
C_7	P	VP	M	P	M	P	G	M	G	G	G	G	M	P	M	G
C_8	P	P	P	P	P	VP	P	W	P	P	P	P	VP	W	P	VP

Source: own study.

According to the prepared procedure, the obtained assessments were aggregated. The result of the aggregation is shown in Table 2.

Table 2.
Aggregate fuzzy C-criteria ratings for surveyed companies A_1, A_2, A_3 and A_4

	A_1	A_2	A_3	A_4
C_1	(1.00 1.50 2.50 3.00)	(2.00 2.50 3.50 4.00)	(2.00 2.50 3.50 4.00)	(1.25 1.75 2.75 3.25)
C_2	(4.00 4.50 5.50 6.00)	(1.00 1.50 2.50 3.00)	(3.00 3.50 4.50 5.00)	(4.00 4.50 5.50 6.00)
C_3	(3.00 3.50 4.50 5.00)	(4.00 4.50 5.50 6.00)	(3.00 3.50 4.50 5.00)	(5.00 5.50 6.50 7.00)
C_4	(3.00 3.50 4.50 5.00)	(2.00 2.50 3.50 4.00)	(5.00 5.50 6.50 7.00)	(4.00 4.50 5.50 6.00)
C_5	(2.00 2.50 3.50 4.00)	(4.00 4.50 5.50 6.00)	(5.00 5.50 6.50 7.00)	(3.00 3.50 4.50 5.00)
C_6	(2.00 2.50 3.50 4.00)	(3.75 4.25 5.25 5.75)	(5.00 5.50 6.50 7.00)	(3.00 3.50 4.50 5.00)
C_7	(2.00 2.50 3.50 4.00)	(3.00 3.50 4.50 5.00)	(4.00 4.50 5.50 6.00)	(3.00 3.50 4.50 5.00)
C_8	(2.00 2.50 3.50 4.00)	(1.25 1.75 2.75 3.25)	(2.00 2.50 3.50 4.00)	(1.00 1.50 2.50 3.00)

Source: own study.

Using formula (1), a fuzzy decision matrix was created, containing ordered fuzzy aggregate values of the criteria ratings for each alternative.

Then, using formulas (2) and (3), a normalized fuzzy decision matrix was constructed (all evaluation criteria were profit type). Table 3 summarizes the values of normalized fuzzy evaluations of each criterion.

Table 3.
Normalized fuzzy C-criteria scores for surveyed companies A_1, A_2, A_3 and A_4

	A_1	A_2	A_3	A_4
C_1	(0.250 0.375 0.625 0.750)	(0.500 0.625 0.875 1.000)	(0.500 0.625 0.875 1.000)	(0.313 0.438 0.688 0.813)
C_2	(0.667 0.750 0.917 1.000)	(0.167 0.250 0.417 0.500)	(0.500 0.583 0.750 0.833)	(0.667 0.750 0.917 1.000)
C_3	(0.429 0.500 0.643 0.714)	(0.571 0.643 0.789 0.857)	(0.429 0.500 0.643 0.714)	(0.714 0.789 0.929 1.000)
C_4	(0.429 0.500 0.643 0.714)	(0.286 0.357 0.500 0.571)	(0.714 0.789 0.929 1.000)	(0.571 0.643 0.789 0.857)
C_5	(0.289 0.357 0.500 0.571)	(0.571 0.643 0.786 0.857)	(0.714 0.786 0.929 1.000)	(0.429 0.500 0.643 0.714)
C_6	(0.286 0.357 0.500 0.571)	(0.536 0.607 0.751 0.821)	(0.714 0.786 0.929 1.000)	(0.429 0.500 0.643 0.714)
C_7	(0.333 0.417 0.583 0.667)	(0.500 0.583 0.750 0.833)	(0.667 0.750 0.917 1.000)	(0.500 0.583 0.750 0.833)
C_8	(0.500 0.625 0.875 1.000)	(0.313 0.438 0.688 0.813)	(0.500 0.625 0.875 1.000)	(0.250 0.375 0.625 0.750)

Source: own study.

In turn, using formulas (4) and (5), the criteria weights were calculated. Table 4 summarizes the scoring of the criteria by each expert and the corresponding weights.

Table 4.
Expert scoring of each criterion C and corresponding weights

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
E_1	7	6	5	3	6	5	5	3
E_2	5	5	4	3	6	5	3	3
E_3	6	5	5	4	7	4	3	5
E_4	7	6	4	4	6	4	4	6
Weights	0.154	0.093	0.093	0.093	0.080	0.093	0.154	0.241

Source: own study.

Hence, the scalar vector of weights took the form: w = [0.155, 0.093, 0.093, 0.093, 0.093, 0.080, 0.093, 0.154, 0.241]. Using the normalized fuzzy matrix and the calculated weights, according to formula (6), a weighted normalized fuzzy decision matrix was obtained with the following values - Table 5.

Table 5.
Weighted fuzzy criteria ratings for surveyed companies A_1, A_2, A_3 and A_4

	A_1	A_2	A_3	A_4
C_1	(0.039 0.058 0.096 0.116)	(0.077 0.096 0.135 0.154)	(0.077 0.096 0.135 0.154)	(0.048 0.067 0.106 0.125)
C_2	(0.062 0.070 0.085 0.093)	(0.016 0.023 0.039 0.047)	(0.047 0.054 0.070 0.078)	(0.062 0.070 0.085 0.093)
C_3	(0.040 0.047 0.060 0.066)	(0.053 0.060 0.073 0.080)	(0.040 0.047 0.060 0.066)	(0.066 0.073 0.086 0.093)
C_4	(0.040 0.047 0.060 0.066)	(0.027 0.033 0.047 0.053)	(0.066 0.073 0.086 0.093)	(0.053 0.060 0.073 0.080)
C_5	(0.023 0.029 0.040 0.046)	(0.046 0.051 0.063 0.069)	(0.057 0.063 0.074 0.080)	(0.034 0.040 0.051 0.057)
C_6	(0.027 0.033 0.047 0.053)	(0.050 0.056 0.070 0.076)	(0.066 0.073 0.086 0.093)	(0.040 0.047 0.060 0.066)
C_7	(0.051 0.064 0.090 0.103)	(0.077 0.090 0.116 0.128)	(0.103 0.116 0.141 0.154)	(0.077 0.090 0.116 0.128)
C_8	(0.121 0.151 0.211 0.241)	(0.075 0.105 0.166 0.196)	(0.121 0.151 0.211 0.241)	(0.060 0.090 0.151 0.181)

Source: own study.

On the basis of the weighted normalized fuzzy decision matrix, using formulas (7) and (8), the pattern and anti-pattern were identified, and then, using formulas (9) and (10), the distances of each evaluation from the pattern and anti-pattern were calculated - Table 6.

Table 6.
Distances from pattern d^+ and anti-pattern d^-

	A_1		A_2		A_3		A_4	
	d^+	d^-	d^+	d^-	d^+	d^-	d^+	d^-
C_1	0.039	0.000	0.000	0.038	0.000	0.038	0.029	0.009
C_2	0.000	0.046	0.047	0.000	0.016	0.031	0.000	0.046
C_3	0.026	0.000	0.013	0.013	0.026	0.000	0.000	0.026
C_4	0.026	0.013	0.040	0.000	0.000	0.040	0.013	0.026
C_5	0.034	0.000	0.011	0.023	0.000	0.034	0.023	0.011
C_6	0.040	0.000	0.016	0.023	0.000	0.040	0.026	0.013
C_7	0.052	0.000	0.026	0.026	0.000	0.051	0.026	0.026
C_8	0.000	0.060	0.045	0.015	0.000	0.060	0.060	0.000

Source: own study.

Finally, based on formula (11), synthetic measures of CC_1 evaluations were calculated for individual companies A_1, A_2, A_3 and A_4, which amounted to A_1: 0.358, A_2: 0.412, A_3: 0.872 and A_4: 0.472, respectively.

The final ranking (step 9 of the calculation procedure) shows that with such adopted evaluation criteria and such, established relationship of their importance, the company A_3, because $A_3 > A_4 > A_2 > A_1$, performs the risk assessment process best.

4. Discussion

A key problem within the framework of this study was deciding how to determine the weights of the evaluated criteria. The most common solution is for the decision-maker to set the weights arbitrarily or to use averaged expert opinions, within the framework of procedures available in the literature. In contrast, the present study used a solution based on the maximum deviation method.

In this method, it is assumed that if a certain criterion assumes very different values between alternatives, it plays an important role in the process of selecting the best solution and should have a high weight; while if the values of a criterion differ little between alternatives, such a criterion has little importance and low weight. At the same time, it should be noted that all the adopted evaluation criteria are of the same nature - stimulants (the more, the better), which is due to the adopted process model of occupational risk management, which may also be different.

The specific nature of the various sub-processes of occupational risk management means that verbal terms are most often used to assess the level of their implementation. Obtaining quantitative data (for indicators) is more labor-intensive, and in many cases very difficult. Also problematic is the sharing of some information with others, especially in the form of indicators.

5. Summary

Occupational risk management is a sequence of decision-making processes, many of which are multi-criteria in nature. Therefore, it is important to search for and develop tools to assist decision-makers in their efforts to improve this process, and thus improve occupational health and safety. Since the process of occupational risk management is, by its very nature, complex, and cannot be described by a single parameter, the most desirable approach to assessing the implementation of this process is multivariate analysis, and consequently multivariate (multi-criteria) methods.

This work represents an original application of directed fuzzy numbers and the TOPSIS method to the assessment of occupational risk management. The proposed approach is advantageous in situations of vague and uncertain information, which we face with linguistic expert assessments.

The TOPSIS method used, in the proposed approach, is not the only method of ordering, but it is one of the best known and best described. On the other hand, the use of ordered fuzzy numbers has broadened the scope of the method's application to a hitherto underrepresented area, which is occupational risk management.

With the proposed approach, the occupational risk management processes implemented in four manufacturing companies were compared and ranked, which made it possible to identify the best and worst implemented.

The presented research and analysis confirmed the usefulness of the fuzzy TOPSIS method in the field of occupational safety, to assess, compare and identify the companies with the best and worst implementation of the occupational risk management process.

The approach used in the paper is relatively simple, and any spreadsheet can be used to perform the mathematical operations, which is especially important for small and medium-sized enterprises.

This paper can inspire the search for further applications of the fuzzy TOPSIS method, both in the field of occupational safety and for the application of ordered fuzzy numbers within other numerous multi-criteria decision-making methods.

In the context of the results obtained, further research work is planned, including practical verification of the usefulness of various methods for solving decision-making problems involving other key issues in the field of occupational health and safety management.

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SUCCESSIONAL MATURITY OF FAMILY BUSINESSES: SIGNIFICANCE, THEORETICAL FOUNDATIONS, AND PRACTICAL CHALLENGES OF A MODEL BUILDING

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Purpose: The main aim of the article is to analyse the role of successional maturity in the management transition of Polish family businesses. It investigates which organisational, cultural, and emotional factors contribute to successful succession, focusing on ensuring business continuity while preserving family values.
Design/Methodology/Approach: The research methodology involves a systematic literature review and analysis of industry reports related to succession planning in family businesses. The study draws upon existing maturity models like CMMI, BPMM, and EFQM and assesses their applicability in the context of family businesses to develop a tailored successional maturity model.
Findings: The study identifies that early succession planning and the adoption of formalised maturity assessment tools significantly improve the likelihood of a successful generational transfer in family firms. It suggests a need for a specific successional maturity model incorporating both organisational and emotional readiness.
Research Limitations/Implications: The research is primarily conceptual and based on secondary data sources. Empirical validation through case studies and quantitative surveys with family businesses is recommended to confirm the proposed model's effectiveness.
Practical Implications: The article provides a framework for family businesses to assess their readiness for succession, which can guide strategic planning and risk management. The proposed model aims to support family firms in sustaining long-term competitive advantage through structured succession processes.
Social Implications: By improving the success rate of business succession, the findings could contribute to the economic stability of family firms, which are crucial for the economies of many countries, including Poland. The study also emphasises the importance of preserving family values and traditions in the business transition process.
Originality/Value: The article introduces the concept of "successional maturity" as a distinct type of organisational maturity. The proposed model integrates traditional organisational maturity frameworks with elements unique to family businesses, such as emotional readiness and value integration.
Keywords: succession planning, family businesses, successional maturity, organisational maturity, process maturity, succession management.
Category of the paper: Research paper.

1. Introduction

Family Family businesses constitute a significant pillar of the economy in many countries, including Poland. The share of such firms in the EU economy currently ranges between 68-75%, reflecting their growing role within the economic system (Haber, 2015; Więcek-Janka, Lewandowska, 2017). These entities are characterised by a unique blend of family life and business activities, which enables effective utilisation of human resources and talents in management. However, this merging of two distinct areas of entrepreneurial activity can also lead to conflicts arising from the overlap of professional and personal relationships (Jeżak, Popczyk, Winnicka-Popczyk, 2004; Zellweger, Nason, Nordqvist, 2012).

Faced with the challenges of succession, family businesses are confronted with a crucial dilemma: how to ensure continuity of management while preserving family values (Zellweger, 2017). In Poland, many companies established in the 1980s and 1990s are currently in the process of being transferred to the next generation (Lewandowska et al., 2016; PwC Polska, 2023; Bank Pekao S.A., 2024). The succession process, which is one of the most complex and sensitive moments in the life of a family business, often encounters barriers due to a lack of formalisation and delays in decision-making by the founders, which can negatively impact the stability of the enterprise (Adam, Kuchta, Stanek; PwC Polska, 2023). Furthermore, research indicates that only about 30% of family businesses in Poland successfully transition to the second generation, with a mere 6% reaching the third generation (Blikle, 2015).

Successional maturity, as an element of organisational maturity, can be defined as the comprehensive readiness of both the business and the family to undergo the succession process. This readiness encompasses both formal and emotional aspects of the firm's functioning. Successional maturity becomes a crucial factor influencing the success of generational transfer of ownership and leadership. As De Massis, Di Minin, and Frattini (2015) point out, a well-considered approach to succession not only enables companies to survive but also to adapt to a dynamically changing business environment.

2. Research objective and research methodology

The primary aim of this article is to conduct an in-depth analysis of the role of successional maturity in the process of transferring management in Polish family businesses. The author endeavours to understand which organisational, cultural, and emotional factors influence the effectiveness of succession, which is crucial for the longevity and stability of family firms. Successional maturity is defined here as an organisation's ability to prepare for generational change while maintaining the coherence of family values and operational efficiency.

The research hypothesis of this article posits the relevance of developing dedicated tools for assessing successional maturity, which will support family firms in effectively planning and implementing succession. The model proposed by the author aims not only to evaluate the current state of successional maturity but also to indicate directions for further improvement to ensure the stability and long-term development of the enterprise.

The research methodology is based on a systematic literature review and an analysis of available industry reports related to succession and the management of family businesses. The article includes a detailed review of the scientific literature, focusing on previous research concerning organisational maturity, process maturity, and change management. Particular attention was paid to the literature addressing the cultural and emotional aspects of succession, which have a direct impact on the ability of family businesses to survive generational transitions.

The starting point was an analysis of existing maturity models, such as the Capability Maturity Model Integration (CMMI), Business Process Maturity Model (BPMM), and EFQM Excellence Model, which were adapted to the context of family firms. The purpose of this review was not only to understand the theoretical frameworks of these models but also to identify gaps that could be addressed in a new model dedicated to assessing successional maturity. The analysis also included a review of Polish legislation related to succession to evaluate the impact of legal regulations on the succession process in family businesses.

Based on the results obtained, preliminary assumptions were developed for creating a successional maturity model tailored to the specific needs of family businesses in Poland. This model builds upon existing concepts of organisational and process maturity but also incorporates new elements, such as the emotional readiness of successors, the organisation's ability to manage change, and the capacity to integrate family values with business objectives.

3. Literature review (role of succession)

Succession in family businesses is not merely a formal process of transferring ownership but also a deeply rooted process in family values, involving the assumption of managerial roles and the maintenance of organisational culture (Eisenstadt, 2003; Blikle, 2015; Zellweger, 2017). The preparation of successors encompasses the development of professional competencies alongside the cultivation of family traditions, which is crucial for preserving the firm's core values. Niemczal (2015) highlights that the succession process often involves emotional tensions, particularly when intergenerational conflicts arise, which can affect the smoothness of the succession process. The literature emphasises that early involvement of successors in managing the business and the development of their soft skills can significantly

increase the likelihood of successful succession (Bohdziewicz, 2014; Blikle, 2015; Zellweger, 2017; Sułkowski, Marjański, 2017; Romanowska, 2019; Thier, 2024; Bank Pekao S.A., 2024).

In recent years, Polish legislation has introduced significant changes aimed at facilitating the succession process in family businesses. A breakthrough was the enactment of the Succession Management Act in 2018, which allows for the continuation of business operations after the owner's death, significantly reducing the risk of business discontinuity (Sejm RP, 2018). This law provides enterprises with a tool to appoint a succession manager, ensuring operational continuity and minimising the risk of inheritance-related conflicts. Another significant step was the introduction of the Family Foundation Act in 2023, which allows for more efficient management of family assets and their transfer to subsequent generations without the need to divide assets (Sejm RP, 2023). These new regulations aim to support long-term succession planning and enhance the stability of family firms, as confirmed by analyses conducted by the Ministry of Development and Technology. As a result of these changes, family businesses have gained new tools to facilitate more organised and effective succession planning (Ministerstwo Rozwoju i Technologii, 2021, 2022, 2023).

The literature increasingly highlights that legal framework and the formalisation of the succession process, which are essential elements of successional maturity, can play a crucial role in ensuring the longevity of family firms (Bank Pekao S.A., 2024; Urbaniec, 2024). Despite the introduction of appropriate legal regulations, data from the Ministry of Development and Technology (Ministerstwo Rozwoju i Technologii, 2022) indicate difficulties in implementing these provisions in practice, often due to a lack of legal education among business owners and a low number of formally appointed successors. Despite growing awareness of the importance of succession planning, studies indicate that only 40-45% of Polish family firms have a formal succession plan (PwC Polska, 2023). This is often due to the reluctance of owners to transfer management, leading to delays in decision-making and insufficient preparation of successors (Their, 2024). A report by the Polish Agency for Enterprise Development (PARP, 2024) highlights that the key areas for improvement include the formalisation of succession processes and increased advisory support.

The analysis of cases where firms successfully completed the succession process revealed that the use of maturity assessment models, such as BELIEFS™ (Lewandowska, 2020), was of key importance. Companies that implemented this or similar models often engaged external advisors, which contributed to the smooth transfer of management. As noted in studies by Urbaniec (2024), collaboration with experts and the use of organisational maturity assessment tools enhance the chances of successful succession. Best practices include mentoring for successors, formal succession planning, and fostering open communication within the company (Brajer-Marczak, 2014; IFR, 2015; KPMG, 2017). These examples demonstrate that proper preparation of successors and formalisation of succession processes can significantly impact the stability and future development of family businesses in Poland (IFR, 2024).

Conducted analyses confirm that companies that plan the succession process in advance and formalise their actions have a higher likelihood of successfully transferring management to the next generation (Lewandowska, 2020; PwC Polska, 2023). In Poland, only about 30% of family businesses successfully transition to the second generation, with a mere 6% reaching the third generation (Blikle, 2015). Initiating preparations early, covering both formal and emotional aspects, significantly reduces the risk of failure in the succession process, which is crucial for the stability and further development of family enterprises (Niemczal, 2015; De Massis, Di Minin, Frattini, 2015).

Utilising external consultancy is also key, as it can support the development of comprehensive succession plans, contributing to a smoother management transition (Urbaniec, 2024). Another essential factor is preparing future successors not only in terms of management skills but also in terms of family values and organisational culture. This ensures the continuity of traditions and adaptation to a changing economic environment (Deloitte, 2017; Lewandowska, 2019a, 2019b; Roszko-Wójtowicz, 2016). Qualitative research conducted in Poland has shown that inadequate preparation of successors is one of the main reasons for failures in the succession process (Blikle, 2015).

Studies indicate that the lack of formal succession plans and delays in decision-making by founders can lead to destabilisation of enterprises during the handover of management to successors (Adam, Kuchta, Stanek, 2022; PwC Polska, 2023). As noted by Lewandowska (2020), early preparation of both the outgoing leader and the future successor is essential to minimise the risk of failure. Unfortunately, many Polish companies are still unprepared for planning long-term succession strategies, as also confirmed by industry reports (Ministerstwo Rozwoju i Technologii, 2022).

Succession in family businesses often encounters various organisational and emotional barriers that can significantly hinder the transfer of management (Thier, 2024). Niemczal (2015) points out that delays in planning arise not only from the lack of formal strategies but also from the resistance of founders themselves, who fear losing control over the company they have built over the years. Furthermore, successors often lack the necessary competencies and experience to meet the demands of managing the enterprise, which complicates the succession process even further (Blikle, 2015). There is often a lack of support in the form of training and mentoring programmes that could prepare the younger generation to take on key roles. As indicated in the studies by Urbaniec (2024), a critical element is the development of an organisational culture that supports open communication and transparency in the succession process.

4. Literature review (organisational maturity)

The concepts of organisational maturity, as well as its various types, such as process, quality, and production maturity, are closely interrelated and refer to different but complementary aspects of an organisation's functioning. All these concepts aim to assess an organisation's ability to operate efficiently, improve processes, and achieve strategic objectives. The concept of **successional maturity** is a relatively new term, making it valuable to position it within the existing, well-established types of organisational maturity.

Organisational maturity refers to the overall level of advancement of an organisation in managing all its aspects—from strategy, human resources, and organisational culture to operational management. It reflects a company's capability to achieve strategic goals through integrated management systems that enable efficient resource utilisation and adaptation to a changing environment. Organisational maturity is an overarching concept that encompasses other types of maturity, such as process, quality, and production maturity. Companies with high organisational maturity manage risk, quality, and resources more effectively, which facilitates a smoother transfer of management to subsequent generations (Fink, 2013; Leflar, Siegel, 2013; Stachowiak, 2024). Assessing organisational maturity involves areas such as customer orientation, leadership, employee engagement, and a process-based approach. Organisational maturity supports the succession process in family businesses, ensuring stability and long-term competitive advantage (Adamczyk, 2018, pp. 344-350).

Ewa Więcek-Janka and Adrianna Lewandowska (2017) propose a model of maturity for family businesses as a specific form of organisational maturity, taking into account ownership structures and family involvement in management. This model consists of five levels: from potentially family-run firms, through single-generation enterprises, to multigenerational businesses that have successfully undergone succession. Family values, which significantly influence the strategy and identity of the company, are particularly important in multigenerational enterprises where not only shares but also traditions are passed on (Więcek-Janka, Lewandowska, 2017, pp. 164-173). As firms mature, they professionalise their management by implementing formal procedures, which enhances efficiency and competitiveness.

Organisational maturity encompasses both technical and social aspects, supporting a faster adaptation to changes, particularly in the context of succession. Tomasz B. Kalinowski (2011) presents a model for assessing process maturity based on Total Quality Management (TQM) and Business Process Management (BPM), aimed at diagnosing the state of processes and identifying areas for improvement (Kalinowski, 2011, pp. 173-176). A key premise is assessing an organisation’s capability to systematically improve and enhance process efficiency using models such as Capability Maturity Model Integration (CMMI). Kalinowski emphasises that a process-oriented approach enables firms to identify strengths and weaknesses and plan

improvements, thereby enhancing both operational and strategic outcomes (Kalinowski, 2011, pp. 176-179). He distinguishes between two assessment approaches: a continuous representation, focusing on selected processes, and a staged representation that evaluates the entire organisation, which is beneficial for long-term planning. The application of these models provides benefits such as better integration of management techniques and improved collaboration with stakeholders, which increases organisational competitiveness.

Adam Skrzypek (2014, 2022) analyses the concept of organisational maturity and its impact on business performance. He defines it as the level of development at which an organisation effectively applies management tools, thereby enhancing efficiency and its ability to adapt to changing market conditions (Skrzypek, 2014, pp. 8-9; 2022, pp. 52-56). This maturity relies on employee competencies, accountability, and readiness for change, which are critical for competitiveness and innovation growth (Skrzypek, 2014, pp. 9-11; 2022, pp. 56-59). According to Skrzypek, achieving higher levels of maturity enables more effective process management, leading to better resource utilisation and the ability to respond swiftly to market changes. Achieving maturity requires the implementation of a culture of continuous improvement, which should be integrated into the organisation's strategy (Skrzypek, 2022, pp. 60-63). Thus, organisational maturity not only supports the management of current processes but also allows for anticipating future challenges and adjusting strategies to dynamic conditions (Skrzypek, 2014, pp. 11-12).

In summary, organisational maturity is a process that includes the development of managerial competencies, employee training, and operational optimisation. It should be systematically monitored and developed within the company's strategy to ensure the long-term achievement of objectives.

Wiesław Łukasiński (2016) analyses the impact of organisational maturity on the effectiveness of quality management, defining maturity as the level at which an organisation manages quality-oriented processes and resources. The author developed a model consisting of five levels of quality maturity, considering criteria such as process management and customer orientation. He places particular emphasis on organisational culture, which promotes engagement in quality and cooperation, supported by strong leadership (Łukasiński, 2016). Implementing a quality-oriented approach requires change management, including employee training and adapting existing processes. The author also identifies factors that shape comprehensive quality management, the essence of quality-oriented management, and perceiving the organisation as an open system adapting to its environment. Łukasiński highlights significant links between quality maturity and organisational development, illustrated by empirical studies that show how quality-oriented management contributes to increased efficiency and long-term growth (Łukasiński, 2016).

Process maturity is a component of organisational maturity, focusing on an organisation's ability to manage and optimise its internal processes (West, 2013; Chevers, 2023). It includes evaluating the level of organisation, standardisation, and process optimisation, which leads to

increased efficiency and cost reduction. Process maturity is often assessed using models like Capability Maturity Model Integration (CMMI) or Business Process Maturity Model (BPMM), which help identify the development stage of organisational processes—from chaotic and unstructured to fully optimised and managed. Through well-established management standards, these organisations are more resilient to succession risks, as their structures and procedures are defined and stabilised, making the business less dependent solely on the founder and facilitating the continuity of operations under new leadership (Szewczyk, 2018, pp. 16-17; 2023). Developing process maturity allows family businesses to better utilise resources and improve operational efficiency, which translates into greater competitiveness. Mature organisations invest in process optimisation and innovation, enabling not only survival but also growth in a changing market environment (Szewczyk, 2023, pp. 51-53).

Renata Brajer-Marczak (2014) explores the varying levels of process maturity across different organisational departments and their impact on management efficiency. She notes that implementing a process-based approach is not uniform, which can lead to disparities affecting the achievement of strategic goals. The process maturity models serve as diagnostic tools, helping to assess the current state of processes within an organisation and identify development directions (Brajer-Marczak, 2014, pp. 19-22). A key conclusion she reaches is the need to balance maturity levels across departments, which promotes better integration and increases organisational efficiency. Brajer-Marczak highlights that maturity models can be used for self-assessment and benchmarking, helping organisations identify areas for improvement. The balanced development of process maturity is crucial for improving management systems and increasing competitiveness in a changing environment (Brajer-Marczak, 2014, pp. 22-25).

Marcin Gałuszka (2011) examines various process maturity models and their application in improving organisational efficiency. He emphasises that in a complex business environment, maturity models help diagnose and enhance internal processes, which supports better resource utilisation. Gałuszka discusses six models, including international ones (Harrington, CMMI, ISO 9004) and Polish ones (Grajewski, Nowosielski, Gruchman). All these models are based on a multi-level maturity scale, allowing firms to gradually improve their processes (Gałuszka, 2011, pp. 66-69). These models assume that organisations must stabilise operations at each level before moving to the next. For example, Harrington's model includes six levels, from unknown processes to world-class processes. In contrast, CMMI offers two assessment representations—staged and continuous—which allow for comprehensive analysis, while ISO 9004 focuses on quality management and continuous improvement (Gałuszka, 2011, pp. 69-71). Despite their differences, all these models are based on core principles, such as process identification, institutionalisation, and improvement. They serve as tools for planning improvements and benchmarking, helping organisations enhance efficiency and competitiveness.

Grzegorz Grela (2013) discusses the importance of measuring process maturity to improve management efficiency. Process maturity is defined as an organisation's ability to optimally manage resources through stable and measurable processes, supporting the achievement of strategic goals. Organisations with high process maturity make better use of their resources, increasing their competitiveness (Grela, 2013, pp. 170-172). Grela analyses various process maturity assessment models, such as CMM, BPMM, and ITIL, highlighting that selecting the right model and analysing collected empirical data are critical. Research conducted on a sample of Polish firms revealed that most organisations are at a medium level of maturity—processes are identified but not always managed effectively (Grela, 2013, pp. 172-176). The author suggests that companies should strive for higher process maturity through continuous process improvement and greater stakeholder engagement. Increased process maturity supports better adaptation to market changes, which is crucial for long-term organisational development.

Paweł Mielcarek (2017) presents a model for assessing process maturity, defining it as an organisation's ability to systematically improve processes and manage resources, which leads to better results (Mielcarek, 2017, pp. 8-9). The model covers three key areas: organisational environment, process management, and obtained value, enabling a comprehensive assessment of both the entire organisation and specific processes. It consists of six levels, ranging from chaotic processes to fully optimised ones, contributing to cost reduction and better risk management. Achieving this maturity requires managerial commitment and a supportive organisational culture. Mielcarek distinguishes three primary functions of assessment: descriptive (understanding the current state of the organisation), improvement-focused (identifying areas for enhancement), and comparative (benchmarking) (Mielcarek, 2017, pp. 10-12). The model aids in process optimisation and increases organisational flexibility, which is crucial in a dynamic business environment.

Innovation Maturity focuses on an organisation's ability to generate and implement innovations. Companies with a high level of innovation maturity can systematically introduce new products, services, or processes, which translates into a competitive advantage. Models of innovation maturity involve assessing creativity, innovation management, and collaboration with external partners. Łukasz Widła-Domaradzki and Anna Tarnawa (2019) present the Innovation Maturity Index (WDI), which measures an organisation's capacity to implement innovations and enhance processes to increase competitiveness. This index evaluates infrastructure, management, relational capital, and innovation returns, analysing data on expenditures, human resources, and collaboration (Widła-Domaradzki, Tarnawa, 2019, pp. 4-12). Research conducted on a broad sample of enterprises helped refine the assessment methodology. A key finding highlights the need for continuous monitoring and adaptation of the index to better reflect changes in the level of innovation among companies. The WDI index enables benchmarking across industries and identifies areas for improvement, supporting the stimulation of innovative activities (Widła-Domaradzki, Tarnawa, 2019, pp. 13-25).

Implementation Maturity refers to an organisation's ability to effectively transform innovative ideas, technologies, or projects into real, functioning products, services, or processes. This includes the ability to manage the entire implementation process—from testing and prototyping to full-scale deployment and integration with existing organisational structures. Examples of assessment models that help measure this level include Technology Readiness Levels (TRL) and the Implementation Maturity Model. Adam Mazurkiewicz et al. (2010) presents the Implementation Maturity Assessment (SDW) methodology, which aims to determine the readiness level of technology for implementation. It focuses on evaluating technical aspects and the advancement of R&D activities, without considering business models. The methodology is based on TRL and Engineering Manufacturing Readiness Levels (EMRL), enabling a comprehensive assessment of implementation readiness. The SDW method consists of two stages: a general assessment using control questions and a detailed evaluation that includes more advanced criteria (Mazurkiewicz et al., pp. 5-10). The results assist in planning commercialisation and minimising risks. The use of this method enhances innovation and competitiveness through the effective implementation of research findings (Mazurkiewicz et al., pp. 16-17).

HR Maturity focuses on the effectiveness of human resource management, including recruitment, employee development, talent management, and organisational culture (Kearns, 2010). Models such as the HR Maturity Model help assess an organisation’s capacity to maximise its employees’ potential. Bogdan Nogalski and Przemysław Niewiadomski (2019) analyse the maturity level of enterprises in managing human resources, emphasising that strategic management includes the optimal use of employee potential and continuous skill enhancement (Nogalski, Niewiadomski, 2019, pp. 155-159). According to the authors, organisations implementing a culture of continuous improvement (kaizen) can maintain a competitive advantage. The research methodology, based on self-assessment, allows companies to determine their maturity level in HR management, considering factors such as employee engagement and training effectiveness. Firms that actively engage employees achieve higher efficiency and innovation (Nogalski, Niewiadomski, 2019, pp. 160-164). Implementing continuous improvement strategies increases employee satisfaction and better resource utilisation, which supports the achievement of long-term goals.

Quality Maturity concerns an organisation's ability to manage quality in a comprehensive and integrated manner (Skrzypek, 2013). This means systematically implementing and improving quality management systems (e.g., ISO 9001). Quality maturity relates to an organisational culture where quality is a priority and to the methods and tools for quality management used in everyday operations. Katarzyna Hys (2016) analyses models of quality maturity that help organisations assess and improve their quality management practices. She emphasises that the maturity of the quality management system is crucial for organisational performance, enabling systematic monitoring and process improvement. She discusses, among others, the ISO 9004 model, which includes five levels of maturity, ranging from a lack of

formalisation to best practices leading to long-term success (Hys, 2016, pp. 175-180). Hys indicates that adaptation and continuous process improvement are essential for maintaining competitiveness. Organisations with a quality-oriented approach respond more quickly to market changes, improving operational results. Models such as EFQM and Deming can enhance an organisation's ability to manage quality, as well as its flexibility and survival in a competitive market (Hys, 2016, pp. 181-184).

In addition to the types of organisational maturity mentioned above, other types are distinguished in management and quality sciences:

- Production Maturity relates to managing production and technological processes, including resource optimisation, waste reduction (lean management), and the integration of modern technologies such as Industry 4.0 (Gajdzik et al., 2025).
- Project Maturity refers to an organisation's ability to manage projects, including resources, schedules, and risks. Models like the Project Management Maturity Model (PMMM) assess project execution effectiveness (Pries & Quigley, 2012; Price, 2014).
- Digital Maturity encompasses the integration of new technologies (AI, data analytics) within the organisation, supporting better decision-making and adaptation to changing market conditions (Chevers, 2023; Gajdzik et al., 2025).
- Strategic Maturity involves the ability to formulate and implement strategies and adjust plans to market conditions, helping achieve long-term objectives (West, 2013).
- Risk Management Maturity focuses on identifying and managing risks, enabling organisations to anticipate threats related to operations, finances, and regulations (Hopkinson, 2010; Bąk, Jedynak, 2023).
- Sustainability Maturity assesses an organisation's ability to integrate sustainability principles, minimise environmental impact, and promote Corporate Social Responsibility (CSR) (Loura, Dickinson, 2019; Rao et al., 2024).
- Relational Maturity focuses on managing relationships with clients and partners, which is crucial for effective supply chain management (Bourne, 2009).

5. Discussion and future research

Each of the types of maturity mentioned in the previous subsection plays an important role in organisational management and can be measured using specialised models and tools (Hopkinson, 2010; Loura, Dickinson, 2019; Van Nuland, Duffy, 2020; Bąk, Jedynak, 2023; Crawford, 2021; Stachowiak, 2024). In practice, many organisations utilise these maturity models. These models not only help to manage more effectively but also to achieve long-term strategic goals and build a competitive advantage. Maturity models are not only tools for improvement but also key elements of development strategies in a changing market

environment. In this way, the conducted literature analysis confirms the validity of the research hypothesis posed at the beginning of the article.

Table 1.
Types of organisational maturity

Type of maturity	Descryption	Models used	Key benefits
Organisational	Refers to the overall level of an organisation's advancement in managing aspects such as strategy, organisational culture, and human resources. It encompasses leadership, change management, and customer orientation.	BELIEFS™, Capability Maturity Model Integration (CMMI), European Foundation for Quality Management (EFQM)	Stability, long-term competitive advantage, improved change management.
Process	Focuses on managing internal processes. Models help assess the level of standardisation and optimisation of processes.	Capability Maturity Model Integration (CMMI), Business Process Maturity Model (BPMM)	Efficiency, cost reduction, improved readiness for succession.
Innovation & implementation	Relates to the organisation's ability to implement innovations. It includes managing creativity and collaboration with partners.	Innovation Maturity Index (IMI), Technology Readiness Levels (TRL)	Better utilisation of employee potential, increased innovation.
HR	Assesses the effectiveness of human resource management, including recruitment, employee development, and organisational culture.	HR Maturity Model	Lepsze wykorzystanie potencjału pracowników, wzrost innowacyjności.
Quality	Refers to comprehensive quality management.	ISO 9004, EFQM, Deming	Increased flexibility, ability to survive in the market.

Source: own study based on literature review.

The concept of organisational maturity and process maturity can serve as a starting point for developing an effective model of succession maturity. These two types of maturity encompass a broad range of organisational management aspects, including leadership, organisational culture, change management, and human resource development. These elements are crucial for successful succession in family businesses, where it is essential not only to prepare successors but also to adapt the entire organisation to new leadership. It appears that existing models can be utilised in the creation of a succession maturity model, such as:

- Capability Maturity Model Integration (CMMI), used to assess the maturity of organisational processes, can be adapted to evaluate a company's readiness for succession.
- Business Process Maturity Model (BPMM) can be applied to assess succession management in family businesses, focusing on the standardisation and optimisation of succession procedures.
- EFQM Excellence Model is useful in evaluating overall organisational maturity, including quality management, which is crucial for ensuring smooth succession.

- ISO 9004:2018 focuses on enhancing an organisation's ability to achieve sustainable success through quality management, encompassing leadership, employee engagement, and strategic planning. This model can be used to assess succession readiness, as it promotes continuous improvement and long-term planning, facilitating smooth succession and fostering a quality culture that enhances organisational stability.

In light of the limitations in the current literature, further research should focus on developing tools for assessing succession maturity that allow for a more objective evaluation of a company's readiness to pass on management to the next generation (Kalinowski, 2011; Szewczyk, 2018). Empirical analyses on the effectiveness of various succession strategies are also necessary to identify best practices for Polish family businesses. Additionally, leveraging modern technologies, such as artificial intelligence, can support the succession planning process, particularly in risk assessment and the identification of potential challenges (PwC Polska, 2023).

As part of ongoing research into the succession maturity of family businesses, the authors plan to develop a comprehensive model that will enable a systematic assessment of a company's readiness to undergo the succession process. The primary objective of the planned study is to develop a measurement tool that will allow for the evaluation of succession maturity levels in family businesses. The inspiration for creating such a model comes from previous analyses highlighting the critical role of formalising succession processes and preparing both successors and the organisations themselves for this transition (Lewandowska, 2020; Szewczyk, 2018).

The planned tool will be based on existing models of organisational maturity assessment, primarily such as BELIEFS™ and the Process and Enterprise Maturity Model (PEMM) (Adamczyk, 2018; Kalinowski, 2011). The succession maturity model will be tailored to the specific characteristics of family businesses, taking into account key aspects such as the emotional readiness of senior leaders, successors' competencies, and the formalisation of succession processes. The model will consist of five maturity levels:

1. Initial (lack of formal succession processes).
2. Repeatable (basic processes identified but lacking full formalisation).
3. Defined (formalisation of the succession plan and definition of roles).
4. Managed (monitoring and optimisation of succession processes).
5. Optimising (continuous improvement and adaptation to changing conditions).

To develop assessment indicators, the methodology similar to that used in the Innovation Maturity Index (Widła-Domaradzki, Tarnawa, 2019) will be applied. The indicators will encompass structural aspects (organisational readiness and succession plan formalisation), emotional aspects (senior leader's readiness to transfer control and the preparation level of successors), and relational aspects (support level from family members and employees) (Gałuszka, 2011; Grela, 2013; Szewczyk, 2023).

The assessment of succession maturity will involve a quantitative approach using surveys and a qualitative approach through in-depth interviews. Surveys will target owners and successors of Polish family businesses, aiming to identify key variables influencing the succession process. The plan includes collecting data from at least 200 enterprises, allowing for statistical analysis (PwC Polska, 2023). In-depth interviews with business owners and experts in management and business psychology will provide insights into the subjective experiences related to the succession process (Blikle, 2015; Urbaniec, 2024).

Advanced statistical methods are planned for data analysis, such as multiple regression (to determine the relationships between individual factors and the level of succession maturity), correlation analysis (to identify key determinants of succession), and case studies in the form of an in-depth analysis of specific family businesses that have either successfully or unsuccessfully undergone the succession process (Niemczal, 2015).

From existing organisational and process maturity models, the proposed succession model adopts the following elements:

- *Structural approach:* similar to BPMM models, this model includes the formalisation of processes, systematic planning, and monitoring of organisational readiness.
- *Process approach:* the methodology for assessing the degree of organisation and optimisation of internal processes is borrowed, allowing the identification of key areas for improvement, similar to CMMI models.
- *Continuous improvement:* the model is based on the principle of continuous process enhancement, akin to quality models (e.g., ISO 9004), which helps family businesses better manage generational transitions.

What is new in the succession maturity model are elements that consider the specific nature of family businesses, such as:

- *Emotional and relational readiness:* the model considers psychological aspects and the dynamics of family relationships (including the senior leader's readiness to transfer the business and the successor's preparation to take on a leadership role).
- *Integration of family values:* the model takes into account cultural and axiological aspects of business management, which distinguishes it from more technical and process-oriented organisational maturity models.
- *Adaptability to change:* the model emphasises flexibility and the organisation's ability to adapt to dynamic changes in the market environment, which is particularly crucial in the context of multi-generational business management.

6. Conclusions

The conclusions drawn from the analysis indicate that succession plays a crucial role in ensuring the longevity and stability of family businesses. Succession, as a process of transferring management and values to the next generation, requires careful preparation, as the future of the company depends on its proper execution. Early succession planning and the application of appropriate assessment tools, such as organisational maturity models, significantly increase the chances of successful leadership transition and maintaining business continuity.

In this context, there emerges a need to distinguish the category of succession maturity as a specific type of organisational maturity. Succession maturity combines elements of human resource management, strategic planning, and building organisational culture, which are essential for a smooth transfer of leadership and continuity of business operations. This is particularly important in family businesses, where the transfer of management encompasses not only organisational structures but also family values and traditions.

To address these needs, it is essential to develop a new model of succession maturity that builds upon existing concepts such as Capability Maturity Model Integration (CMMI) and Business Process Maturity Model (BPMM), while also taking into account the unique characteristics of family businesses. The new model will draw from well-established approaches to assessing organisational and process maturity but will be enriched with new elements, such as the emotional readiness of the family to transfer control, the ability to adapt in a dynamic environment, and the management of family values. This model will thus serve as a comprehensive tool supporting the succession process, enhancing management efficiency and the long-term competitiveness of family enterprises.

The innovation of the proposed succession maturity model lies in creating a new tool that goes beyond existing organisational and process maturity models by integrating elements specific to family businesses. The model combines organisational, emotional, and relational aspects, making it more holistic and tailored to the unique challenges of succession in family enterprises.

This article represents the initial phase of a broader research project, the primary objective of which is to develop an effective model of succession maturity for family businesses. This model will form the foundation for a comprehensive tool for measuring and managing succession maturity. It aims to serve advisors and entrepreneurs planning succession within their firms.

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THE IMPACT OF LOGISTICS AND MARKETING CUSTOMER SERVICE IN E-COMMERCE FOR FREIGHT FORWARDING AND INTERNATIONAL TRANSPORT

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Purpose: The aim of the study is to present the importance of logistic and marketing customer service in e-commerce on the example of the TSL industry. The subject of the study concerns the area related to enterprises in the transport, forwarding and logistics industries in Poland.
Methodology: Survey research is the most popular method of social research, therefore, in order to obtain the data necessary to achieve the aim of the work, a research tool, a survey questionnaire, was used.
Findings: A detailed analysis confirmed that logistics and marketing activities are a key element of business management, and are also a particularly important tool for competing on the e-commerce market and enabling contact with potential buyers.
Originality/value: The publication covers the subject of impact of logistics and marketing customer service on e-commerce. Combining interdisciplinary research in the areas of management and quality science with economics and finance.
Keywords: e-commerce, logistic customer service, internet marketing**.**
Category of the paper: Research paper.

1. Introduction

The opening of companies to global markets has rapidly increased their logistics needs. The lack of knowledge and appropriate infrastructure about newly entered markets and regulations in these markets has caused companies to turn to 3rd party logistics companies. The fluctuations in the markets and changes in demand force companies to avoid high investments and minimize their fixed costs. Instead of investing for the future they cannot

predict, companies aim to turn their costs into variables by using the resources of a 3rd party and paying as much as they use (Sevim et al., 2008).

The nature of development trends in terms of the nature and opportunities created by the broadly understood electronic market depends on all technological changes that directly shape the specificity of modern trade. The specificity of preferential changes in consumer behavior determines the needs and requirements of business, thus influencing the overall demand for goods and services offered via e-commerce websites (Alt, Zbornik, 2003; Oh et al., 2003).

All protection with the final image of the discussed function are considered to be connectors integrated with the electrical installation, all with notes on the methods used to properly respond to economic changes occurring in the closer system, as well as in each entity present on the market. The conditions that are ultimately dictated by the virus epidemic are determined by the influence that is the basis for occurring in the device, as well as the alternative implementations that are determined to be specific ultimately find their way into the products. By constituting the building block of operating methods and strategies, companies operating in the area of e-commerce provide access to maximize results, as well as advanced performance functions that are a consequence of their business concepts, which not only influence customers in their service, but also all possible logistics and marketing tools to create their products, which are available at the level of companies dealing with substitute products. Excessive liability occurs primarily in the case of activities undertaken as part of the use of TSL, which, due to their nature, require the use of individual actions that concern interdisciplinary rivals (Zunder, Islam, 2011).

Using the considerations contained in the analysis of terminology related to the TSL industry, its essence and impact on the degree of economic development of a given country, all aspects and regularities occurring in the correlation should be taken into account. Referring to the characteristics of the development of logistics, transport and forwarding services, it can be noted that from year to year there is a noticeable increase in the level of popularity of this sector of activity (Anand, Grover, 2015; Pawłowska, 2015).

Moreover, delving into the considerations contained in the literature on the subject, it is worth emphasizing that "the condition of the TSL industry and the enterprises operating in it is always the result of the situation in industry and trade. However, predicting the effects of complex processes on the TSL industry in conditions of serious fluctuations in the economic situation is an extremely difficult issue" (Glistau et al., 2016). Taking into account the history of the last decade, Poland has achieved a relatively high level of expansion of the thematic area (growth by 3.8% per year in relation to GDP) compared to other countries belonging to the European Union. The development of e-commerce undoubtedly contributed to achieving this result, which enabled and intensified the need to use, among others, transport services for transporting goods purchased via the Internet to end recipients (Berg et al., 2017).

Based on the experience created by the situation related to the outbreak of the coronavirus pandemic in 2020, it seems reasonable to emphasize the position that all economic activities conducted during this period were completely subordinated to the conditions then prevailing. Absolute economic stagnation forced enterprises to adapt to a new, unknown reality at that time, which required the implementation of modern solutions in response to changing restrictions and other economic difficulties. Hence, the TSL industry, like other sectors of the economy, is undergoing rapid changes (Di Ciommo, Shiftan, 2017).

A milestone in improving the processes related to transport, forwarding and logistics, as well as increasing the quality of these activities, was the publication by the European Commission of a communication on the "green corridors" mechanism to maintain a stable situation in the field of transport for the benefit of the entire European economy. The presented solutions were primarily concerned with securing the liquidity of the supply chain by reducing the time spent on inspections and additional activities related to border services (Komisja Europejska, 2020).

Summarizing all the above aspects related to the functioning of TSL companies during the coronavirus pandemic, it must be undoubtedly stated that it was an extraordinary period, which consequently led to a significant development of this industry due to a change in society's way of thinking about shopping habits and a shift in preferences towards online trade (Gulc, 2017). The difficulties that have arisen over the years have prevented the full development of transport and logistics organizations, changing their business approach and aspirations solely to survive in an extremely difficult period for the entire world economy. Taking into account the above regularities, it should be stated that the pandemic period has changed and transformed the framework and nature of the TSL industry (Tokarski, Wolak, 2023).

Referring to the international space, it is necessary to emphasize the impact of individual factors on the overall picture of the economy in the area of the title industry. Nevertheless, referring to the considerations contained in the literature on the subject, it is worth emphasizing that "a global logistics network is a physical structure of logistics services for suppliers and recipients on a global scale, integrating this economic space in all dimensions" (Sarkis et al., 2017). All activities undertaken as part of the global functioning of the TSL industry are adapted to the opportunities and needs created by the global market. The second aspect taken into account when modifying logistics processes is the integration of individual market segments. Noticeable connections between various economic spheres are based on broadly understood process flows undertaken as part of their activities, striving to minimize financial outlays and time (Dumas et al., 2018; Kayikci, 2018).

2. Motivation and purpose

In the light of technological changes and the development of digitalization, e-commerce as one of the forms of doing business has developed significantly in recent years, thus influencing the way the economy functions in economic terms. The element determining the possibility of access to the tools offered by e-commerce is undoubtedly the Internet, which by its nature influences reality, thus providing new opportunities to operate in constantly changing conditions. In Poland, the discussed trade model gained popularity as it flourished in other countries of the world. This regularity is confirmed by statistical data that show a significant increase in the value of the e-commerce market (Choi, 2019).

The overall value of the e-commerce market has increased significantly, which is undoubtedly due to the development of the Internet in Poland. Based on specific values, it is reasonable to emphasize the relationship between the growth rate and the passage of time. In 2001, the value of the e-commerce market was estimated at approximately PLN 200 million, while in 2010 it reached PLN 15.5 billion. The last period that best illustrates the growing popularity of this business model is 2014, when the total market value in Poland amounted to PLN 27 billion (CBOS, 2020).

Referring to modern times, it should be noted that e-commerce in Poland is still developing from a prospective perspective. However, due to the nature of this trend, one can talk about a complete change in the current cause of growth. Available data from 2018-2021 shows that the intensification of the e-commerce market was caused primarily by technological progress and the desire to learn about various forms of shopping. The changes in 2020-2021 can be considered revolutionary, as the number of stores physically available to consumers decreased significantly (Drapers, 2021). This was primarily due to the coronavirus pandemic, which somehow forced society to modify its current lifestyle, including the issue of making transactions. Due to the introduction of various restrictions in Poland that directly affected enterprises, they were often forced to reorganize the way they conducted trade and even transfer this activity to the virtual space (Forsal, 2021). It is also worth noting that the reason for the rapid increase in the popularity of e-commerce was the fact that older people who had not previously used this form of shopping joined the existing group of users. Moving on to modern times, i.e. 2022-2024, the discussed growth rate of e-commerce has slowed down slightly due to weakening demand caused by, among others, high level of inflation. Nevertheless, the above market needs stabilized at a sustainable level, taking into account the significant number of immigrants, which was directly related to the outbreak of the war in Ukraine (The Expert Sender, 2020).

Anticipating market changes over the next four years, a significant increase in the overall value of the e-commerce market is still expected. Its balance for 2022 amounted to PLN 109 billion, and this year it is expected to increase by 13.7% to PLN 124 billion.

According to forecasts, the following years will also be characterized by an increase in the market value by approximately 10-11% compared to the previous year, which indicates its harmony and balance in the discussed process. The latest data included in the above analysis refer to 2027, when the ceiling is estimated at PLN 187 billion. Based on available statistical data and information on the actual state of the Polish economy, experts do not predict significant breakdowns or slowdowns in the development of the e-commerce market, however, the occurrence of any deviations should not significantly affect these forecasts (CBOS, 2023).

One of the most crucial pillars of retail e-commerce is logistics. A mistake in the logistics field can cause the e-commerce platform or company to lose customers. Therefore, the process from the moment consumers place their product orders to the moment the products in question are delivered to the consumer (forward) and until the product to be returned is collected from the consumer and returned to the system in the most economical way (backwards) must be managed with an effective logistics system. To create such a system, 5 points must be taken into consideration. These are reliability, economy, time, service flexibility and information (Deliçay, 2021).

3. Methodology

The aim of this study was to determine the importance of customer service on the e-commerce market, thus hypothesizing that logistics and marketing activities are a key element of enterprise management and are also a particularly important tool for competing on the e-commerce market and enable contact with potential customers. In order to determine the degree of influence of the verified variable, the frequency of purchases in the virtual space, shopping preferences and the subjective opinion of respondents from a wide range of e-commerce in the TSL industry were also analysed.

The detailed objectives of the study included, among others:

- assessment of the impact of individual customer service activities in the virtual sphere on the purchasing decisions of potential customers,
- analysis of the importance of information and data provided by enterprises operating on the Internet,
- examining the importance of logistics and marketing solutions used in e-commerce,
- comparison of the specificity of customer service in traditional sales channels and online activities based on the subjective experiences of respondents,
- verification of the frequency of use of modern solutions offered by online stores,
- identification of potential difficulties and problems related to the purchase of goods via e-commerce tools.

Returning to the method used in the study, it should be noted that it was based on an anonymous survey that was made available to a selected group of recipients via the Internet (Aponowicz, 2015). Therefore, the research area was the entire country, and the sample selection method was non-random. People were examined, regardless of age and gender. The questionnaire was made available in the third and fourth quarter of 2023. A total of 100 respondents participated in the study, the characteristics of the study population are summarized in Table 1.

4. Results

4.1. Interaction between consumer and customer service

When considering the aspect of the impact of consumer interactions with customer service on social media platforms on purchasing decisions, it should be emphasized that in most cases (64%) it is noted that respondents often verify the level and speed of this service and this to some extent influences their final purchase choices. About 24% of respondents declared that they always analyse the above aspects of their purchasing intentions before finalizing the transaction. Interaction with customer service does not influence purchasing decisions for only 12% of respondents.

Another issue that directly affects research on the importance of logistics and customer service marketing in e-commerce is the impact of information regarding delivery time. Almost the majority of respondents indicated that this factor determines their purchasing decisions, i.e. 51% of respondents indicated that information regarding delivery time is important when making purchasing decisions, while 39% of respondents emphasized that this information is rather important. A total of 10% of the surveyed people believed that the issue of delivery time is not a key factor when making purchasing decisions.

Referring to the importance of e-consumers being able to effectively track their parcels, there is a tendency that buyers value this option in the context of making purchasing choices (85% in total). Only 10% indicated that the examined factor was rather unimportant to them. Only 5% of respondents consider this option completely useless.

As the results below show, the majority of respondents indicated that the ecological and marketing logistics practices used by online stores do not in any way influence their purchasing decisions (46%), while 34% of respondents try to take these aspects into account when making transactions in online stores virtual space. Only 20% emphasized that they always take into account ecological and marketing aspects.

Referring to the aspect of consumer preferences in terms of loyalty programs used by enterprises as part of their activities on the Internet, it should be noted that the majority of respondents (56%) were of the opinion that they try to make purchases in the virtual space in stores offering additional benefits as part of these loyalty programs. The next segment consisted of respondents (30%) for whom this factor is not a reason to choose a specific company or the offer it offers. Nevertheless, as many as 14% of respondents emphasized that they only choose companies that use loyalty programs to encourage potential buyers.

When it comes to the importance of new products and discounts offered by companies, the vast majority of respondents (62%) indicated that they always pay attention to these factors when making final purchasing decisions. Around 32% of respondents chose a neutral answer, that respondents sometimes take into account current news and discounts, while only 6% consider these factors to be completely unimportant.

Starting from research on the subjective assessment of the quality of marketing communication from online stores (e.g. e-mails, push notifications), most respondents are familiar with the marketing content sent (66%), while 29% of respondents claim that this content is promotional tools that are completely unnecessary and they never open them. Only 5% emphasized that they always verify what a given company has to offer.

Moving on to examine the importance of individual logistics and marketing factors, it should be emphasized that the majority of respondents consider fast and reliable delivery (41%) and communication and information about the shipment status (33%) to be the most important aspects of consumer choices. Next, they chose an easy and hassle-free process of returning the purchased goods (14%) and high quality of packaging and product protection (8%). Only 4% of respondents declared that none of these factors affects their loyalty to a specific online store.

4.2. The impact of logistics and marketing customer service in e-commerce

When analysing the importance of logistics marketing and logistics services in e-commerce for the choice of a given online store by potential buyers, it should be emphasized that the vast majority - 69% of respondents believe that additional logistics services are crucial. About 21% of respondents expressed a similar opinion, stating that these elements are rather important to them. Only 10% of all respondents chose not very much impact or no impact at all.

When asked about their preferences for different delivery options, 45% of respondents indicated that they valued this option when shopping online. For 26% of respondents, a variety of delivery options is rather important. Around 7% indicated the lack of total impact of the examined factor on purchasing decisions, while for 9% this element was rather unimportant. The answer that customers have no major preferences regarding delivery options was chosen by 13%.

Data from this market shows that the majority of respondents have contacted customer service to obtain marketing information about products or promotions (76% in total). Only 8% of respondents are not at all interested in obtaining this information, while 16% of respondents have not had such a need yet.

When it comes to personalized gifts or discounts as part of customer service, as many as 44% of respondents emphasized that they had received such an offer and that it influenced their purchasing decisions. In the case of 22%, the mentioned gifts or discounts had no influence on the final choice of the company. Nevertheless, it should be noted that a total of 34% of respondents did not receive such forms encouraging them to take advantage of a given offer, including 9% of respondents who are not entirely interested in receiving this type of messages.

Referring to the subjective assessment of the impact of logistics and customer service marketing on trust in online stores among respondents, as many as 45% indicated that this business element is particularly important from the point of view of trust in a given seller. About 24% of respondents took a similar position, emphasizing that this factor has a significant impact on their final decisions. As for the remaining answers, 21% of respondents believe that logistics and marketing services do not determine their purchasing choices. Only 10% of respondents base their trust in online stores on factors other than customer service.

Referring to the importance of logistics and customer service marketing in e-commerce, comparing it with the traditional form of trade, as many as 72% of respondents said that in the case of e-commerce this business element is more important. For 17% of respondents, customer service in terms of logistics and marketing is more important in stationary branches, and 11% of respondents see no difference in the above issue.

When examining the influence of other customers' opinions on purchasing decisions made within a given company operating on the Internet, it is worth paying attention to the significant percentage of respondents who often pay attention to the opinions of other consumers (60%). As many as 28% base their purchasing decisions on reviews, while 12% do not take this factor into account when making their own choices and needs.

Taking into account the experience of the surveyed people in terms of improvements in the logistics or marketing of a given online store, after expressing an opinion or complaint, a large diversity of respondents' answers can be noticed. However, the largest number of responses is the belief that respondents saw little improvement in these transactional aspects (27%). Around 21% of respondents received better customer service after submitting comments, and in the area of logistics this answer was indicated by 15% of respondents. As many as 18% of all respondents emphasized that they had not noticed any changes in the level of service, while 19% had not yet had the opportunity to express their opinion on the subjective aspects of e-commerce experiences.

4.3. The impact of the development of e-commerce on improving the quality of freight forwarding services and international transport

Analysing the degree of use of various technologies (e.g. mobile applications, chatbots) when conducting online transactions in order to obtain better support, the vast majority of respondents indicated that they regularly use these tools to conveniently make purchases and track the status of orders (74%). Only 18% of respondents use modern solutions less often, while 5% of respondents declared that they do not use these methods at all. The last segment is respondents who are not sure whether they use these technologies, because I have not yet had the opportunity to use mobile applications or chatbots when shopping online.

Another analysed aspect was the impact of the development of e-commerce on improving the quality and availability of transport and logistics services. The vast majority of respondents indicated that they had noticed significant improvements in the quality of transport and logistics services in their region since the development of e-commerce. As a result, delivery times have shortened and the availability of various delivery options for goods is also available (54%). About 18% of respondents said that this change was unnoticeable, emphasizing that delays and delivery problems still occur. Around 17% of respondents expressed uncertainty in this aspect, while 11% of all respondents chose the answer that the development of e-commerce could improve the quality and availability of transport and logistics services, but they did not notice it because they use the same company's transport.

Analysing the level of development of logistics and transport services in terms of the requirements posed by e-commerce, the vast majority of respondents (49%) undoubtedly noticed these changes. About 33% of respondents say the same, indicating that they are not sure of their answer, but believe that they have noticed an improvement in the quality of services provided in the TSL industry thanks to the rapid development of e-commerce. Only 18% have not noticed any changes in the logistics and transport industry.

Referring to the subjective assessment of challenges or problems related to e-commerce affecting the quality of customer service in the TSL industry, respondents indicated that, in their opinion, the most noticeable factor is the difficulty of demand, which may lead to restrictions in the availability of means of transport and warehouses (32%). As the second answer, respondents indicated an increase in the number of orders, which may cause delays in deliveries and their implementation (27%). The issue of returns policy was raised by 14% of respondents, stating that it may involve additional logistical burden. Another factor that, according to respondents, affects the quality of customer service in the TSL industry (12%) was the competitiveness of companies determining the need to reduce the prices of services provided. Nevertheless, as many as 15% of respondents agreed with all the above statements, claiming that all these factors may determine the essence of the level of consumer service created.

The last issue examined is the importance of the impact of e-commerce on the traditional shopping segment. In this case, the vast majority of respondents (68%) emphasized that e-commerce has influenced their approach to shopping, which is why they are increasingly choosing this shopping method due to convenience, large selection and easy access to products. The development of the e-commerce industry did not influence further actions of 23% of respondents. Only 9% of respondents emphasized that they did not have a specific opinion on the research topic.

5. Conclusions

Taking into account the above research results on the importance of logistics and customer service marketing in the e-commerce space, it can be concluded that e-commerce is undoubtedly a branch of trade that is subject to continuous dynamic transformation and development (Qurtubi et al., 2021). Therefore, in their answers, respondents emphasized that their purchasing decisions made in the virtual space have become the norm, which is increasingly replacing traditional forms of sales. Equally important, respondents noticed a significant improvement in the quality and availability of transport and logistics services, which is a direct result of the requirements and needs created by e-commerce. Entrepreneurs conducting business on the Internet should primarily pay attention to ensuring timely deliveries and the possibility of locating the shipment by buyers, because in the eyes of customers this is of great importance when choosing a potential offer. Nowadays, in which the transport and logistics industry is characterized by a high degree of development, one must also take into account the need to choose the delivery of purchased goods. This is one of the main factors of logistic customer service, which directly affects the final purchase decision, mainly due to everyday duties and other activities that prevent the constant presence of a given entity in a given place (Fajczak-Kowalska, Tokarski, 2023).

Another aspect that should be given special attention is the growing popularity of the use of modern tools and solutions offered in online commerce. This consistently increases the attractiveness of this sphere of trade, encouraging potential recipients to use these methods of concluding and executing transactions. However, due to the breadth of the subject of e-commerce, it is also necessary to emphasize the essence of difficulties and problems related to the purchase of goods, which in the eyes of respondents may interfere with the proper course of purchasing processes. These include, among others: growth in the number of orders, increased demand for transport and storage services, returns policy and competitiveness (Tokarski, Dąbrowska, 2023). All these factors determine the overall shape of the e-commerce market in terms of requirements for preventing possible delays, process burdens or reducing service prices, which may directly affect the quality of consumer service provided. Therefore,

when analysing the above area, it can be concluded that the constant development of e-commerce is also associated with additional, often unplanned struggles, limiting the smoothness of processes carried out in the entire logistics area (Tokarski, Fajczak-Kowalska, 2024).

It is also necessary to interpret the obtained research results directly relating to the sphere of marketing, which significantly determines the competitiveness of a given offer. Thanks to the promotional activities undertaken, a relationship is often created between consumers and the company that goes beyond sales needs and determines the size and quality of the group of target recipients (Tokarski, Bielecki, 2024). Despite the above-mentioned development of e-commerce, it is worth mentioning that organizations selling on the Internet do not always take into account the current problems of buyers and the resulting consequences (Bielecki et al., 2024). The subjective opinions of respondents undoubtedly indicated deficiencies in the appropriate adaptation of their business to the emerging difficulties encountered when shopping on the Internet. Therefore, it seems important to focus on improving the quality of existing customer service processes in order to increase the efficiency and effectiveness of the organization.

Taking into account the above considerations regarding the conclusions of the study, it can undoubtedly be stated that the aspects of logistic and marketing customer service in e-commerce are particularly important for potential buyers, thus creating a basis for making decisions that will meet all their expectations and requirements. The above regularities clearly confirm the hypotheses, therefore logistics and marketing activities are a key element of managing enterprises in the virtual space and enable them to implement the adopted strategies in changing economic conditions. Moreover, logistics and marketing customer service is an important tool for competing on the e-commerce market, and its marketing dimension itself allows entities to establish contact with a potential customer.

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Appendix

Table 1.
Characteristics of the study population

Criterion		Surveyed population	Percentage of respondents
Gender of the respondent	man	44	44%
	woman	56	56%
Age of the respondent	up to 20 years	17	17%
	21-25 years old	41	41%
	26-35 years old	19	19%
	36-45 years old	13	13%
	46-55 years old	10	10%
Marital status	married	31	31%
	single	65	65%
	other	4	4%
Education	basic	0	0%
	basic vocational	6	6%
	medium	26	26%
	higher	68	68%
Professional status	unemployed	3	3%
	learner/student	38	38%
	manual worker	20	20%
	white-collar worker	29	29%
	freelance profession	0	0%
	own business activity	7	7%
	pensioner, retiree	3	3%
Financial situation	good	26	26%
	bad	8	8%
	average	66	66%
Gross monthly income level per 1 person in a household	I have no income	3	3%
	up to PLN 1,000	7	7%
	1,001-1,500 PLN	5	5%
	1,501-2,000 PLN	2	2%
	2001-2500 PLN	6	6%
	2,501-3,000 PLN	17	17%
	over 3,000 PLN	48	48%
	I refuse to answer	12	12%
Place of residence	city	79	79%
	village	21	21%

Source: own study based on empirical research.

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IMPACT OF QUALITY MANAGEMENT SYSTEM ON RESPONSIBLE FOOD PRODUCTION

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Purpose: The aim of the article is to obtain an answer to the research question "What is the level of impact of each of the eight selected aspects of the ISO 9001 QMS on three selected reference areas defined in relation to the tasks assigned to one of the sustainable development goals, which is Responsible Production and Consumption?
Design/methodology/approach: The study was conducted on 26 enterprises of the food industry in the meat sector. The research tool was a questionnaire. Google Form was used for the study, while ensuring anonymity. Descriptive statistics was used to analyze the study results. The scope of the article includes the theoretical background, a description of the research methodology, presentation of the study results, analysis of the results and conclusions.
Findings: The study confirms the importance of quality management systems in promoting sustainable development in companies. The study shows that implementing a quality management system has a significant impact on reducing food losses during production, promoting local products and using ecological waste management practices. Respondents emphasized the importance of top management involvement in the process of implementing a quality management system and measuring the results achieved by the company.
Research limitations/implications: The directions of future research may be diverse and cover many areas in the field of responsible production and process standardization. Research limitations may be related to lack of trust, lack of knowledge about the structure of management systems, or employee concerns about management evaluation. High priority importance in the scope of the issues raised should be assigned to the topic of food safety culture.
Originality/value: According to the Web of Science database the topic of "quality management systems and responsible food production", there are 108 publications (taken up indirectly) and none of the articles presents research results in the scope taken up in this study. The article may be addressed to entrepreneurs who are participants in the food chain and researchers who want to develop the subject.
Keywords: quality management systems, responsible production, sustainable development, improvement.
Category of the paper: Research paper.

1. Introduction

Standardization is an activity aimed at achieving the optimal (in given circumstances) degree of order within a given scope by establishing provisions intended for common and repeated application, relating to existing or potential problems (Act of 12 September 2002 on standardization). The purpose of standardization may be to develop process flow patterns, standardize selected purchasing parameters, or define required behaviors. The scope depends on the goal that has been adopted and may include one element or product parameter, or many parameters or activities of the entire organization (Frąś, 2015).

The international standard ISO 9001, which is the basis for implementing the Quality Management System ISO 9001 (QMS), is one of the most popular standards, with compliance confirmed by external certifications. The popularity of this quality management system results from many factors, including the organization's focus on the customer and meeting their requirements, and the general nature of the standard, which means that its requirements can be implemented not only by manufacturing companies, but also by service companies, local government units, or business organizations. Due to the general nature of the requirements of the above-mentioned standard, the quality management systems implemented in individual companies may differ significantly in terms of the method of implementation, form, and scope (Clacer-Cortes, 2007; Tarí, Molina-Azorín, 2010). The ISO 9001 standard presents in its content a set of requirements, both general, which apply to the entire organization, as well as detailed ones concerning individual areas of management in the company, including: the context of the organization, leadership, planning, support, operational activities, evaluation of the effects of action, and improvement.

The high level of competition and the continuous development of companies in the food industry require continuous improvement and the introduction of better and better solutions. Companies strive to improve work organization and achieve greater customer satisfaction, which is crucial to achieving business success, but provided that the quality management system is reliably implemented, which is a demanding and time-consuming process (Szatkowski, 2014). In the literature, the benefits of introducing a QMS are most often divided into two groups: internal and external (Ružele, Zgirskas, 2021). The internal benefits of functioning quality management systems include (Adomaitiene et al., 2022):

- increased involvement of the company's employees in the performance of assigned tasks at all levels of the organization,
- improving the operation of the decision-making system and the flow of information,
- organizing the basic areas of the organization's activities, such as marketing, production, planning, etc.,
- establishing clear powers and tasks of organizational units,

- ensuring repeatable products, which directly translates into a lower frequency of complaints,
- significant reduction of operating costs and increase in production diversity through appropriate management of processes in the organization,
- better identification of the needs of individual organizational units,
- improving the way threats and their effects are identified - the possibility of risk management,
- implementation of a training effectiveness assessment system and a periodic employee evaluation system,
- improving the effectiveness of achieving the organization's goals,
- motivation to improve the functioning of the organization,
- shaping a culture of quality and effective internal communication.

The external benefits of quality management systems are as follows (Hamrol, 2017; Psomas et al. , 2014):

- greater credibility in the eyes of the customer, especially on foreign markets,
- significant improvement of the organization's image,
- increasing the competitiveness of the organization on the market,
- reading and analysing signals coming from the market, thus improving communication between the organisation, the customer and the supplier,
- systematizing the methods of confirming and executing customer orders,
- the ability to compare yourself with other organizations in terms of analyzing the results achieved,
- easier contact with the organization's environment: state institutions, banks, competitors and cooperators on the foreign market.

In the case of the food industry, the benefits of introducing a QMS mainly concern the prevention of hazards related to product safety. In addition, thanks to the QMS, it is possible to ensure the repeatability of the product, the awareness and knowledge of employees are raised and their efficiency is increased. It also influences the improvement of the processes used and their continuous improvement, as well as increasing the efficiency and transparency of the organization's operations. All this makes consumers certain that the products are manufactured in a safe and hygienic manner, which significantly increases customer trust. Moreover, the introduction of a QMS also facilitates international food trade (Kędzior, Prasińska, 2005).

The introduction of QMS is also associated with many difficulties. During the implementation process, companies encounter many barriers and challenges. It is a mistake for management to plan too many changes in too short a time, which may result in a lack of acceptance on the part of employees and contribute to making mistakes and superficial performance of tasks. In the phase of achieving goals, barriers related to communication within the organization may occur. Psychological barriers among management and employees are also

an important element. Most of them result from fear of the unknown and the lack of ability to cope with new situations (Dobrowolska, 2003; Gnilakiewicz, 2017). In the food industry, according to survey research conducted by A. Kaźmierczak and D. Kołożyn-Krajewska (2010), the difficulties include:

- change in employee mentality (59%),
- problems with truly understanding the rules of the system (42%),
- too little financial outlay for system implementation (42%),
- lack of time for employee training (26%),
- lack of GHP/GMP rules (21%),
- inability to identify real threats (20%),
- too many critical points designated (12%).

Difficulties often result from the fact that many people imagine the introduction of a quality management system as a continuous inspection, not realizing how important a role it plays in the effective production of safe food, which is important, among others, in the context of sustainable development (Walaszczyk, 2016).

The idea of sustainable development is an important element of international law. The most important international documents describing the issue of sustainable development include Agenda 2030 and the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. In Poland, the principle of sustainable development has gained constitutional status and has been included in Article 5 of the Constitution of the Republic of Poland, and the definition of sustainable development is included in the act entitled "Environmental Protection Law". It states that it is "such socio-economic development in which the process of integrating political, economic and social activities takes place while maintaining natural balance and the durability of basic natural processes, in order to guarantee the possibility of meeting the basic needs of individual communities or citizens of both the current generation and future generations".

The 2030 Agenda for Sustainable Development lists, among others, the following tasks under Responsible Production and Consumption:

- implement sustainable consumption and production programmes for all countries,
- ensure sustainable management and efficient use of natural resources,
- halve the global amount of food wasted per capita in retail and consumption, reduce food losses during production and distribution, including losses occurring during harvest,
- significantly reduce waste generation through prevention, reduction, recycling and reuse,
- encourage companies, especially large and international ones, to implement sustainable development practices and include information on this in their regular reports,
- support developing countries in strengthening their scientific and technological capacities to create more sustainable consumption and production patterns.

The foundations of sustainable production are based on linking the production process with the concept of limiting the use of resources and the environmental impact of the product. This concept therefore refers to all stages of the product life cycle – from design to the end of its life (Czaplicka-Kolarz, Kruczek, 2013).

The PARP report shows that entrepreneurs are more likely to take action to promote sustainable production. 50% of respondents say they encourage customers to make informed purchasing decisions, 27% say they educate customers and suppliers on social and ecological responsibility, and 21% include relevant information on the impact on the environment on labels. The meat industry in particular has attracted a lot of attention from scientists. Meat and its production have become a controversial topic in public debates because it covers many aspects of sustainable development. Meat leaves a much larger climate footprint than plant-based food (Arneth, Rabin, 2019). Meat consumption is one of the most frequently discussed topics in broader public debates on sustainable food systems, climate change, and healthy eating, which, due to the huge interest of people, encourages even more research and analysis (Sanford et al., 2021). In the Polish agri-food industry, the meat and dairy sector is one of the main sectors of animal production. According to the estimates of the Polish Meat Association, the meat industry in Poland employs over 100,000 people in slaughter and processing and 1 million people in agriculture. Meat and milk are the main goods exported to EU countries, which is why they must meet not only a number of requirements in force in our country, but also those abroad. The negative health impacts of meat and ethical beliefs are driving more and more people to become vegetarians, replacing it with plant-based and lab-grown meats, which are considered a more sustainable option (Dolgin, 2020; Thompson, 2017). Despite this, global meat consumption continues to grow, with particularly high growth in low- and middle-income countries. It is worth mentioning that meat production requires significantly more land and water than plant-based food production, and as a result has a greater impact on the environment and climate (Desiere et al., 2018; Lynch et al., 2018; Lynch et al., 2020). It is necessary to educate and build awareness from the youngest generations (Johnston et al., 2019; Vainio, 2019; van der Weele et al., 2019). In addition to changes on the consumer side, technological improvements will also be needed to make the production of meat products more sustainable. However, it should be borne in mind that the transformation of systems into more sustainable ones requires many institutional, legal, behavioral, and technological changes at various levels (Afsana et al., 2021).

The aim of the article is to obtain an answer to the research question posed as a result of the review of the subject literature: *What is the level of impact of each of the eight selected aspects of the ISO 9001 QMS on three selected reference areas defined in relation to the tasks assigned to one of the sustainable development goals, which is Responsible Production and Consumption?*

The aspects of the ISO 9001 QMS being examined are:

1. Conducting analyses of the external and internal context of the enterprise.
2. Management based on a process approach.
3. Involvement of top management in the implemented processes.
4. Involvement of employees in the implemented processes.
5. Risk management in relation to the implemented processes.
6. Planning of operational activities.
7. Traceability of products.
8. Measurement of the effects of activities.

The reference areas of Responsible Production and Consumption (RPC) are:

1. Reducing food losses in the production process.
2. Promotion of local products/raw materials.
3. Ecological waste management.

2. Methods

Research subjects

Due to the controversial nature of the meat industry's impact on sustainable development issues, in particular in the area of Responsible Production and Consumption, it was decided to refer to companies belonging to the meat sector of the food processing industry. The study was aimed at employees of the meat industry, mainly employees of the quality department and technologists. The research sample was purposive, which means that a selected group of companies from the adopted location and industry and industrial sector was included in the study. The companies in which the respondents work are located in the Greater Poland Voivodeship and Lodz Voivodeship. 26 out of 90 companies, with representatives of which contact was established by phone or e-mail, expressed their willingness to participate in the study. The study included companies mainly involved in slaughter and cutting of meat and the production of meat products. The average time of operation of the surveyed companies on the market is about 24 years. Five of the surveyed companies declare that they have been operating on the market for 30 years. 16 companies participating in the study have been operating for less than 30 years. Only five companies are more than 30 years old. The entities participating in the study can also be classified according to the size of the companies: 31% are companies employing 50-249 employees and more than 250 employees, 27% are companies employing 10-48 employees and 11% are companies employing 1-9 employees. 85% of the companies participating in the study declared that they have management standards, while 15% do not have any management standards - these are mainly micro and small enterprises. Among the management standards that the companies have, they most often mentioned: ISO 9001 (Quality

Management System), ISO 14001 (Environmental Management System) and HACCP (Food Safety Assurance System).

Research tool

The survey was conducted using Google Form, ensuring anonymity. The survey questionnaire consisted of nine questions. At the beginning of the survey, the company's profile was placed, which included questions (1-5) concerning, among others, the company's time of operation on the market, the number of people employed in the company, and the management standards introduced in the company. The next questions (6-8) were aimed at checking to what extent (on a scale of 1-5) the respondents assessed the company's responsibility towards: ensuring consumer safety when consuming manufactured products, ensuring consumer health from consuming manufactured products and environments.

The key question in the survey questionnaire was the last question, in which a selected point had to be marked from a scale of 1 to 5, where 1 means – minimal impact of a given QMS aspect on a given RPC area, 2 – small impact of a given QMS aspect on a given RPC area, 3 – medium impact of a given QMS aspect on a given RPC area, 4 – large impact of a given QMS aspect on a given RPC area, 5 – very large impact of a given QMS aspect on a given RPC area. The following areas of reference were mentioned: reducing food losses in the production process, promoting local products/raw materials and ecological waste management. The aspects examined were conducting analyses of the external and internal context of the enterprise, management based on the process approach, involvement of top management in the implemented processes, involvement of employees in the implemented processes, risk management in relation to the implemented processes, planning of operational activities, traceability of products and measurement of activity effects.

Research methodology

The initiation of the study began with a reference to the existing state of knowledge. For this purpose, the literature review method was used. This process aimed to provide a comprehensive and up-to-date summary of knowledge on the impact of quality management systems on sustainable development. After reviewing the research results in the field of responsible production in Poland and worldwide, with particular emphasis on the food industry, it was found that the meat industry has the least published research. After identifying the research gap, the purpose of the study was determined. Then, the area in which the study would be carried out was selected, after which a list of companies with contact information was determined and the research method was selected.

For the purposes of the study, a primary data collection technique was used – a questionnaire survey. The study took about six weeks. The study involved 26 companies out of 176 located in the Greater Poland Voivodeship and Lodz Voivodeship, which is about 15%. With this number of respondents, descriptive statistics was used, calculating the average values of the indications. After collecting the responses from the survey, the data was exported to an Excel spreadsheet, which allowed for easier data management and processing. It was ensured that all

the necessary data, questions and answers were correctly recorded and included in the exported file. After importing the data into the program, the data was prepared for further analysis, incorrect, incomplete answers were removed and the data was properly sorted. After preparing the data, its analysis was started. The relevant data was filtered and sorted, arithmetic averages were calculated from them, and tables were developed for grouping the data. In order to visually present the research results, the Excel charting function was used.

3. Results

In terms of the company's responsibility to ensure consumer safety from consuming manufactured products, respondents were asked to mark an answer on a scale of 1-5, where 1 means very low, 2 - low, 3 - average, 4 - high, and 5 very high responsibility. The results of the study showed that respondents rated their company's responsibility to ensure the safety of consuming manufactured products very highly - as many as 80.8% marked the highest answer on the scale - 5 and 19.2% - rated the responsibility as 4. In terms of the company's responsibility to ensure consumer health from consuming manufactured products, the answers were not as clear as in the case of the previous question. 57.7% of respondents marked an answer on a scale of 5, 38.5% - answer - 4, and 3.8% - answer 3. The responsibility of companies towards the environment was rated as the highest (5) by 42.3% of respondents, 50% - answer - 4, and 7.2% - answer 3.

In the main part of the study concerning the impact of each of the eight selected QMS aspects on three selected reference areas defined in relation to the tasks assigned to one of the sustainable development goals, which is Responsible Production and Consumption, the respondents had to mark the level of impact of the aspect on a scale of 1-5 . In order to present the results of the study in a coherent way - based on the assigned values on the scale - an arithmetic mean was calculated in relation to the eight examined QMS aspects. Fig. 1 shows the impact of the examined QMS aspects on reducing food losses in the production process, Fig. 2 shows the impact of QMS aspects on the promotion of local products/raw materials and Fig. 3 shows the impact of QMS aspects on ecological waste management. The analysis of the study results is presented in the Discussion section.

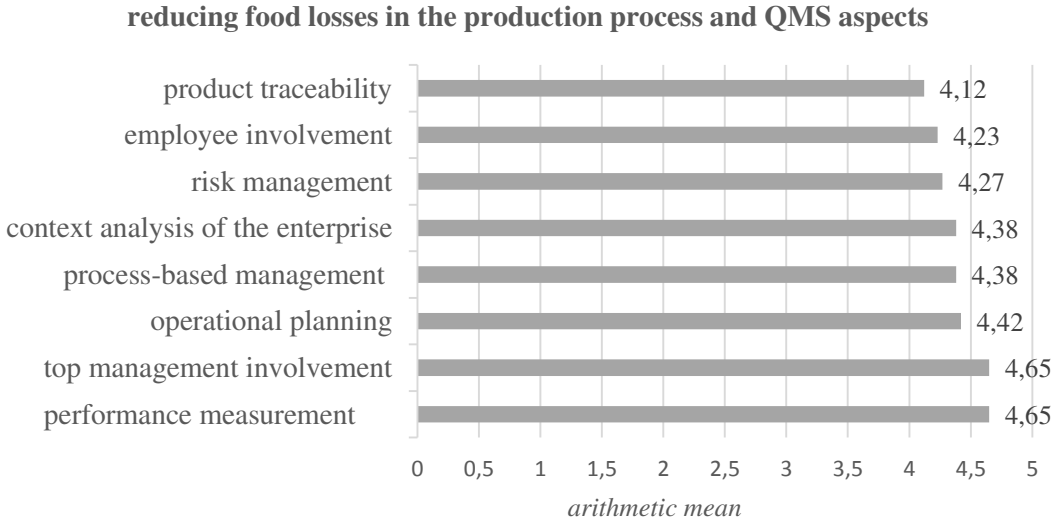

Figure 1. The impact of QMS aspects on reducing food losses in the production process.
Source: own study based on own research.

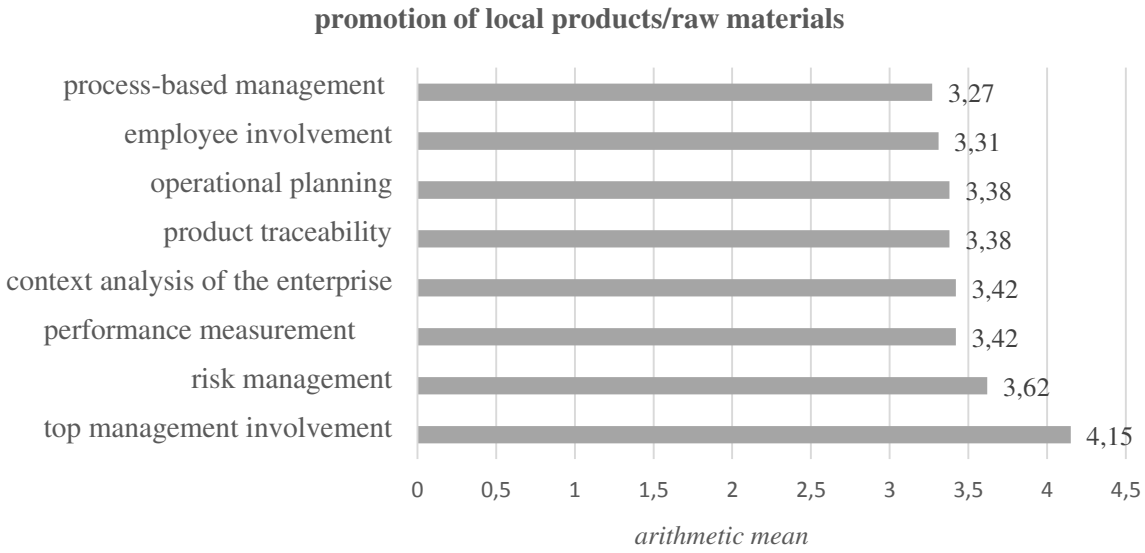

Figure 2. Impact of QMS aspects on the promotion of local products/raw materials.
Source: own study based on own research.

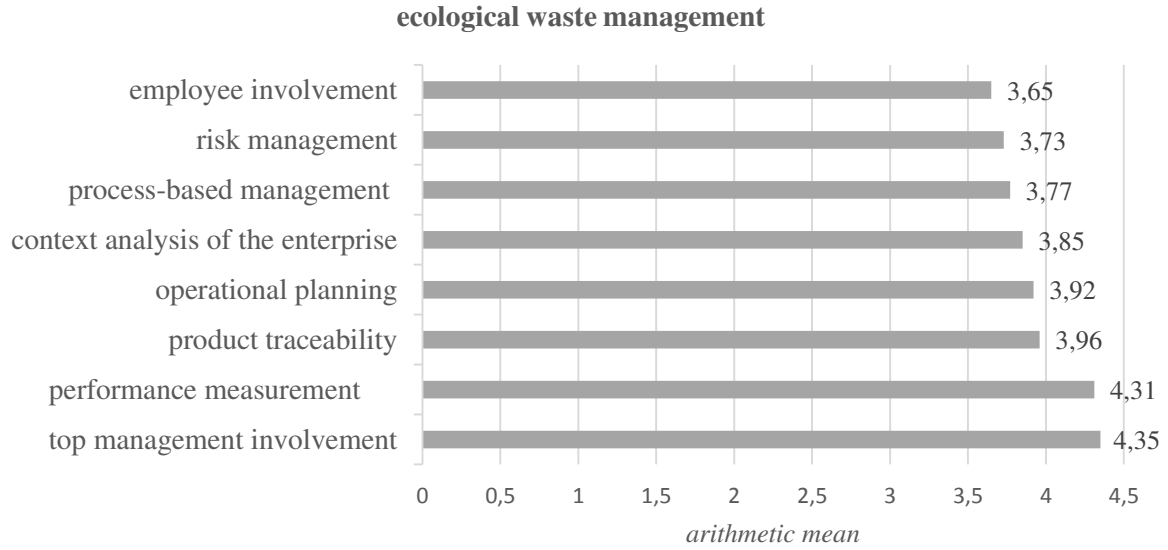

Figure 3. The impact of QMS aspects on ecological waste management.
Source: own study based on own research.

4. Discussion

The first of the areas analyzed was "reduction of food losses in the production process" in relation to eight selected QMS aspects. All the QMS impact aspects examined obtained an arithmetic mean above 4 in this respect, which means that the respondents believe that each of them has a significant impact on reducing food losses. According to the respondents, the greatest impact on reducing food losses in production is equally exerted by the measurement of the effects of activity (4.65) and the involvement of top management in the implemented processes (4.65), while the smallest (although still high) is traceability of products (4.12).

The area of "promotion of local products and raw materials" received significantly lower scores than the area of "reduction of food losses" analyzed above, which indicates that respondents claim that QMS aspects have a medium impact on the promotion of local products as one of the areas of Responsible Production and Consumption. Only one aspect achieved an arithmetic mean (out of the scores awarded on a scale of 1-5) above 4 and that was "involvement of top management in the implemented processes" (4.15). The lowest score was recorded for the aspect of "management based on a process approach" (3.27).

"Ecological waste management" has higher results than "promotion of local products/raw materials", but lower than "reduction of food losses in the production process". Ecological waste management is most influenced by the involvement of top management in the implemented processes (4.35) and measurement of the effects of activity (4.31). The lowest - by the involvement of employees in the implemented processes, which is a very surprising

result. Low arithmetic means resulting from the awarded ratings on the scale - in the case of ecological waste management, may indicate insufficient awareness of entrepreneurs about the impact of production on the natural environment and ecology.

The detailed analysis of the survey results relating to each of the eight selected aspects of the quality management system is presented below.

The impact **of conducting analyses of the external and internal context** on reducing food losses in the production process was assessed by 46% of respondents as large and very large – 46%. Only 8% considered this impact as medium. The impact on the promotion of local products/raw materials was assessed by 38% of respondents as medium, and 35% as large. Four respondents indicated a small impact, which constitutes 15% of the answers, and only three very large – 12%. However, in the case of ecological waste management, the response indicating a large impact of conducting analyses of the organizational context is much higher, as 58% of the respondents indicated this answer. Medium and very large impact was indicated by 15% and 19% of the respondents, respectively. On the other hand, small and minimal impact was indicated by two people, which constitutes only 8% of all answers.

The impact **of management based on the process approach** on reducing losses in the production process was assessed by 92% of respondents, as well as in the case of conducting analyses of the internal and external context – as large 46% and very large 46%. Only two respondents indicated that the impact is medium, which is 8% of all responses. The strength of the impact on the promotion of local products and raw materials was assessed by 54% of respondents as medium, by 15% as small, by 19% as large and by 12% as very large. On the other hand, the impact on ecological waste management was considered by 58% as large, 19% as medium and 15% as very large. Only 8% consider this impact as minimal and small.

The impact of **top management involvement** in the implemented processes on the three reference areas was assessed mainly as high and very high. The impact on reducing losses in the production process was mainly assessed by respondents as very high - 73%. 19% of respondents indicated a high impact, and only 8% an average impact. In the case of promoting local products/raw materials - 54% of respondents indicated a high impact, 31% a very high impact and only 15% an average impact. A very high impact of the aspect of top management involvement on ecological waste management was indicated by 54% of respondents, 27% a high impact and 19% a medium impact.

The impact of **employee involvement** in the implemented processes on the three reference areas was not assessed as consistently by the respondents as the impact of management involvement. A very large and large impact of employees on reducing food losses in the production process was indicated, which constitutes 84% of all responses. There were also responses indicating a medium impact - 12% and a minimal impact - 4%. In the case of the area of promotion of local products and raw materials, the responses according to the respondents are very diverse. One respondent indicated a minimal impact, five respondents indicated a small

impact, nine indicated a medium impact, seven indicated a large impact, and four indicated a very large impact, which constitutes 15% of all responses. Also in the case of the question about ecological waste management, the responses differ significantly - 38% of respondents indicated a large impact, 27% indicated a medium impact, and 23% indicated a very large impact. 8% of respondents indicated a minimal impact, and 4% indicated a small impact.

The impact of **risk management** in relation to implemented processes on reducing food losses in the production process was assessed as high by 58% of respondents. The second most common response was the one concerning a very high impact – 35%. Medium impact was indicated by only 8% of respondents. The impact on the promotion of local products and raw materials was assessed mainly by respondents as medium – 42% and high – 42%, which constitutes 84% of all responses. 12% indicated a very high impact, and only 4% small. On the other hand, the impact of risk management on ecological waste management was assessed as high by as many as fourteen respondents, which constitutes more than half of all responses – 54%, 25% indicated a medium impact, 15% a very high impact, and small and minimal impact were indicated by 4% of respondents each.

The impact **of planning operational activities** on reducing food losses in the production process is very high for thirteen respondents - 50%, and high for eleven - 42%. Only 8% indicated a medium impact. The impact on the promotion of local products/raw materials according to five respondents is low -19%, ten medium -38%, seven high -27% and four very high - 15%. In the case of the third reference area, as many as 54% of respondents indicated a high impact, 23% very high, 15% medium and 8% low.

Product traceability has a large impact – 42% and a very large impact – 38%. 12% indicated an average impact, and only 8% a small impact. The impact on the promotion of local products/raw materials was assessed by 70% of respondents as average – 35% and large - 35%, a small impact was indicated by five respondents - 19%, and a very large impact by only three - 12%. As for the third reference area, as many as half of the study participants assessed the impact of product traceability on ecological waste management as large, 27% very large, 15% medium, and 8% small.

The vast majority, as many as 20 respondents, claim that **measuring the effects of action** has a very large impact on reducing food losses in the production process, which constitutes over 75% of the responses. The remaining respondents indicated a large impact - 12% and a medium impact - 12%. In the case of promoting local products/raw materials, 10 respondents indicated a large impact, and 9 medium impact, which gives over 70% of all responses. 12% of respondents indicated a very large and small impact, and only one respondent indicated a minimal impact. A very large impact on ecological waste management was indicated by 14 respondents (over 50%), 27% indicated a large impact, 15% medium impact, and 4% small impact.

The study showed that more and more companies, not only large ones, but also smaller ones, declare that they have a quality management standard. The respondents also showed a high assessment of the responsibility of companies to ensure the safety of their consumers. Additionally, the respondents emphasize the importance of the responsibility of companies to ensure the health of consumers by offering high-quality meat products. Consumers care about the quality of food that meets the required standards regarding composition, nutritional value, and is free from harmful substances. The respondents also claim that companies are to a large extent responsible towards the environment. Issues related to environmental protection, such as reducing greenhouse gas emissions, minimizing water and energy consumption, and rational waste management, are key in the case of sustainable development. The study shows that implementing quality management systems has a significant impact on reducing food losses during production, promoting local products and materials, and using ecological waste management practices. Respondents emphasized the importance of top management involvement in the process of implementing a quality management system and measuring the results achieved by the company. The monitoring and measurement process is multi-faceted and its proper implementation significantly improves the efficiency of the functioning of enterprises, both within the internal and external context - including aspects of sustainable development (Walaszczyk, Mnich, 2024).

5. Summary

The research allowed us to obtain an answer to the research question *What is the level of impact of each of the eight selected aspects of the ISO 9001 QMS on three selected reference areas defined in relation to the tasks assigned to one of the sustainable development goals, which is Responsible Production and Consumption?* The research confirms the importance of quality management systems in promoting sustainable development in enterprises and provides a basis for further research in this area. The directions of future research related to sustainable development in the meat industry in the context of using multi-aspect management tools may be diverse and cover many areas. Research on this subject is a relatively new area of research (especially in Poland), which results from the growing ecological awareness and interest in the impact of meat production on the natural environment. According to the Web of Science database and the query conducted regarding the topic of "quality management systems and responsible food production", publications on the given topic (taken up indirectly) occur in the number of 108. Figure 4 presents the distribution of these publications according to the areas/sciences to which they refer.

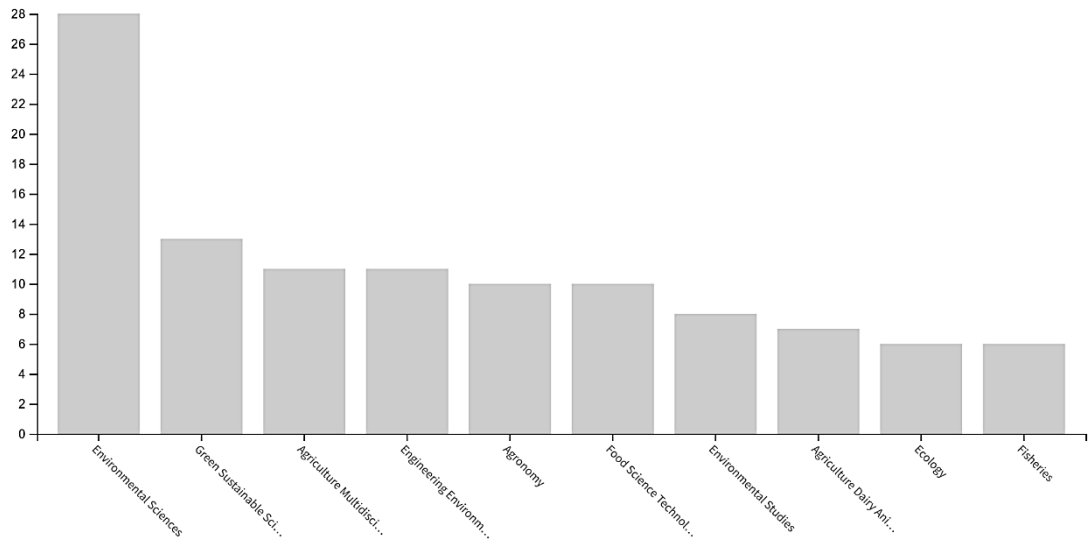

Figure 4. Query results for publications within the topic "quality management system and responsible food production".

Source: citation report from www.webofscience.com.

Due to the issues being addressed, however, it is necessary to bear in mind the possibility of research limitations related to the lack of trust, lack of knowledge regarding, for example, the structure of management systems or concerns about the assessment by management. High priority in terms of the issues being addressed should be assigned to the topic of food safety culture (Walaszczyk, Mnich, 2021).

The introduction of a sustainable management approach is not only socially responsible, but also contributes to the long-term success of the organization, strengthening its reputation, improving efficiency and creating greater value for stakeholders. It is therefore worth conducting research and developing quality management systems and food safety assurance and management systems that will serve to promote sustainable development at various socio-economic levels.

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IMPLEMENTATION OF MODERN FILMS IN THE PROCESS OF MASS PACKAGING OF BOTTLES BASED ON THE CIRCULAR ECONOMY

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Purpose: The aim of the article is to analyze the harmfulness of the process of mass packaging of bottles depending on the heat-shrinkable film used in the process and the source of electricity supply.
Design/methodology/approach: To achieve the main objective of the article, LCA analysis, gate-to-gate, was conducted within the specified system boundaries and a functional unit was adopted. The analysis was conducted in SimaPro software, using the ReCiPe 2016 method, which allows for the assessment of impacts by classifying and characterizing emissions and resource consumption based on the impact on human health, ecosystem and resources.
Findings: The research has shown that within the accepted limits of the studied system, the variant with the smallest potential environmental impact is the process of mass packaging using film with the addition of recyclate. Analysis of the process power source scenarios has shown that powering the process with energy obtained from wind is characterized by the least harmfulness in the three studied damage categories.
Research limitations/implications: The limitations of the study include several key aspects that may affect the results and their interpretation. Firstly, incomplete access to input data poses a challenge, as it limits the precision of the analysis and may lead to bias in assessing the environmental impact of the studied processes. Another limitation is the boundaries of the studied system, which may be insufficient to encompass all potential interactions and influences beyond the directly studied process.
Practical implications: The obtained results can be used as a basis for introducing changes in the optimization of the mass packaging process of bottles to reduce its harmfulness.
Originality/value: The analysis performed doesn't focus on the entire life cycle of a specific shrink film (as was done in the studies available so far) but focuses on comparing the environmental impact of the mass packaging process of bottles depending on the type of film used. The aim of this analysis is to assess the potential environmental impact of the process using biodegradable film with the addition of recyclates compared to the process variant with traditional film.
Keywords: mass packaging process, LCA, impact on environment.
Category of the paper: research paper.

1. Introduction

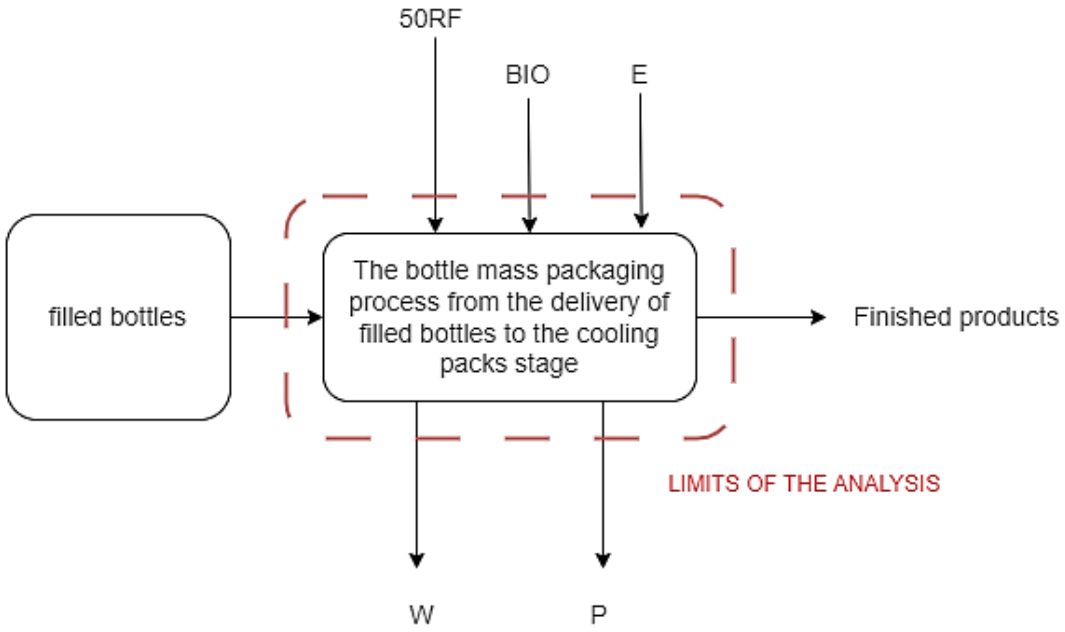
The circular economy is an economic model that aims to reduce the consumption of raw materials and reduce waste generation through appropriate management, including reuse (Kirchherr J., 2017; Yang, 2023). This concept considers all phases of a product's life cycle, from design through production, use, and disposal. Striving to reuse waste is essential. The main advantages of implementing this model include reducing waste and limiting the emission of harmful pollutant (Sikorska, 2021; Nikolaou, 2021). Due to this fact, the film packaging industry is struggling with enormous pressure to adapt to prevailing trends. The use of plastics in packaging accounts for as much as 40% of their total use (Torres-Giner, 2023). Traditional films made of plastics are durable, flexible and highly resistant to external factors (Jordan, 2016). They enable safe and durable transport of products, including food. However, their wide use is also associated with a large amount of film waste, which after use requires appropriate management to reduce the harmful impact on the environment (Zeilerbauer, 2024). Alternative solutions to plastic films are appearing on the market, e.g. biodegradable films. They are produced from renewable sources and often have similar functional properties to conventional plastic films, e.g. polyethylene (Pirsa, 2020; Kibirkštis, 2022). The main products of biodegradable plastics decomposition are water, carbon dioxide, inorganic compounds or biomass. In the case of such a solution, there is no accumulation of waste, which can be a solution with a potentially less negative impact on the environment (Swetha, 2023; Flury, 2021).

In order to determine the potential impact on the environment, a life cycle analysis (LCA) is used, which can provide a comprehensive assessment of the impact of the studied object on the environment at all stages of its life cycle (Walichnowska, 2023). De Sadeleer et al. (de Sadeleer, 2024) compared the environmental impact of non-biodegradable mulch film with biodegradable ones in Nordic conditions using LCA. The authors showed that in the conditions studied, the use of non-biodegradable materials leads to lower negative environmental impacts in the whole life cycle. Vidal et al. (Vidal, 2007) compared the environmental impact of a new biodegradable film made of modified starch and polylactic acid with a conventional film. The studies showed a lower negative environmental impact for biodegradable films. Bala et al. (Bala, 2022) compared the environmental impact of using biodegradable poly-lactic acid bags, pure and reinforced with nanolays, in comparison to conventional alternatives made of polyethylene and polypropylene. The authors showed that polylactic acid film reinforced with nanoclays can be an alternative to conventional polymers in terms of mitigating climate change and reducing the use of fossil resources. Choi et al. (Choi, 2018) compared the carbon footprint generated by packaging films based on LDPE, PLA and PLA/PBAT blends depending on the disposal scenario. The study showed that the variant with PLA with landfill film was characterized by the lowest amount of carbon dioxide emissions. In the case of the PLA/PBAT

with incineration variant, the greatest harmful impact was demonstrated. Based on the results obtained, the authors indicate that incineration was the least favourable variant in terms of CO_2 emissions. Many other comparative environmental analyses of the use of biodegradable plastics with conventional ones can be found in the literature (Ingrao, 2017; Jeswani, 2023; Chitaka, 2020). These studies often show a lower negative impact on the environment for biodegradable products, but there are many doubts about biodegradability depending on environmental conditions. Chen et al. (Chen, 2016) write that choosing the right waste management scenario, such as recycling, incineration with energy recovery, can be important for minimizing the impact on the environment. The choice of the right type of material should be made based on a full life cycle analysis, considering local conditions, both environmental and infrastructural. The studies provided usually concerned the entire life cycle of biodegradable films and their comparison with traditional ones. In this article, the authors conducted a life cycle analysis within the specified limits of the examined mass packaging process system using various types of heat-shrinkable films, including biodegradable films. This analysis is a response to the search for modifications to the process of mass packaging of bottles in heat-shrinkable film to reduce its negative impact on the environment.

2. Methods

The process of mass packaging of bottles in heat-shrinkable film is associated with the appearance of film waste in the economy, therefore it is considered appropriate to undertake research on the implementation of modern films that reduce the harmfulness of the process. So far, the series of articles has considered the impact of changing the heat-shrinkable polyethylene film to film with a 50% addition of recyclate (Walichnowska, 2024) and film 100% recycled (Walichnowska, 2024) on the harmfulness of the mass packaging process. The research showed that the tested batch of film with 50% recyclate addition has similar functional properties of the film compared to the conventional solution, so it can replace traditional film in the process of mass packaging of bottles. In the case of 100% recycling film, large differences were observed between the functional properties compared to polyethylene film, therefore further considerations were proposed within the composition of such film to improve its mechanical properties. Continuing the considerations in the scope of reducing the harmfulness of the process of mass packaging of bottles, a life cycle assessment (LCA) analysis was conducted, gate to gate, comparing how changing the film to biodegradable film would affect the harmfulness of the tested process within the assumed boundaries of the tested system. The tested system included the stages from the delivery of filled bottles to the line transporting them to the heating oven, where the film is shrunk (Figure 1). The functional unit in this analyse was 1000 packs.



E – electricity in process, 50RF – used recycled film, BIO – used biodegradable film, P – pollution in the form of greenhouse gas emissions (CO_2, SO_2, SF_6, N_2O), W – waste in the form of unusable packs.

Figure 1. Diagram of the process of mass packaging of bottles including input and output data.

Source: own study.

The research was conducted using SimaPro 9.6. The LCA analysis applied the ReCiPe 2016 method, which converts various categories of environmental impact – such as greenhouse gas emissions and water consumption – into measurable units. This method distinguishes between two levels of detail: midpoint and endpoint. Endpoint indicators integrate results from the midpoint level and present the overall impact on human health, ecosystems, and resources, allowing for broader contextual interpretation.

At the beginning of the study, the input data, which consist of energy flows and the material used in the process of mass packaging of bottles, were collected and calculated. The data was organized and presented in Table 1. Data for variants A and B come from an actual facility where bottles are packed in heat-shrinkable film. Due to limited access to information on biodegradable films, the same data were assumed for variant C as for variant B. The analysis compared process variants differing in the heat-shrinkable film used. In the first variant A, traditional film (LDPE) and small amounts of recycled film were assumed, in variant B – films with 50% addition of recyclates (50RF), and in variant C biodegradable film (BIO) from polylactic acid (PLA), which is obtained from plant raw materials such as corn, sugar beets or sugar cane.

Table 1.
The amount of energy used and films in analysed variant

Parameter, unit	Variant A	Variant B	Variant C
Energy, kWh	46.10	67.81	67.81
LDPE, kg	31.53	-	-
50RF film, kg	3.83	31.57	-
BIO film, kg	-	-	31.57

Source: own study.

Additionally, a scenario analysis was conducted to examine the impact of changing the power source on the harmfulness of the mass packaging process using biodegradable film. The following scenarios were analysed:

- scenario I: energy from country's mix,
- scenario II: energy from wind farm,
- scenario III: energy from country's mix and gas to the film shrinking stage.

3. Results

The analysis examined the potential impact of the process of mass packaging of bottles on the environment, depending on the heat-shrinkable film used. The study conducted using the ReCiPe 2016 method showed that the process variant using biodegradable films (assuming the use of the same amount of film per 1000 shrink-wraps) causes a greater environmental burden in the three tested categories compared to the variant with the film with the addition of recyclates (Table 2). In the category of damage to human health and ecosystems, the highest potential impact values were determined for the variant with BIO film, while in the category of damage to resources, variant A is characterized by the highest potential impact.

Table 2.
LCA analysis results for the tested process variants

Damage category, unit	Variant A	Variant B	Variant C
Human health, DALY	1.77×10^{-4}	5.97×10^{-5}	2.79×10^{-4}
Ecosystems, species.year	7.54×10^{-7}	2.39×10^{-7}	1.24×10^{-6}
Resources, $	9.77	1.24	8.16

Source: own study.

In the next step, an analysis of the impact of changing the power source was carried out, which showed that the potentially smallest impact in the category of human health damage was shown by scenario II, in which the tested process was powered by energy obtained from renewable sources (figure 2). The largest potential impact was shown for scenario I, which is 10.2 Pt and is greater by about 47% compared to the scenario with energy obtained from wind. The scenario with the use of gas in the film welding stage is characterized by a greater potential impact by about 44% compared to scenario II.

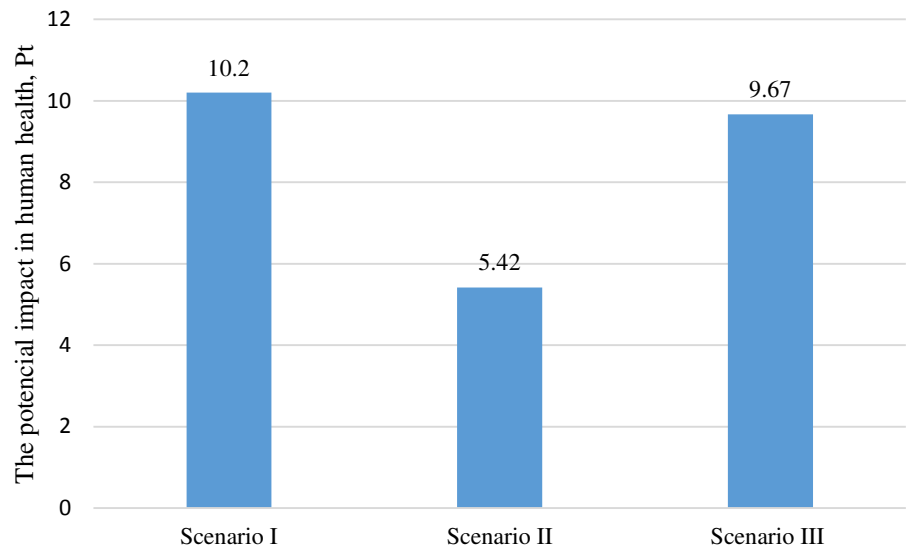


Figure 2. The impact of the mass bottle packaging process in the damage category human health, Pt. Source: own study.

The potential impact of the studied process scenarios on the damage categories ecosystems was also demonstrated, where similarly to the human health damage category, the scenario using energy from a renewable source was characterized by the lowest potential impact on the environment at the level of 0.481 Pt (figure 3). Scenarios I and III showed similar values of the potential impact by about 35% higher compared to the process powered by wind energy.

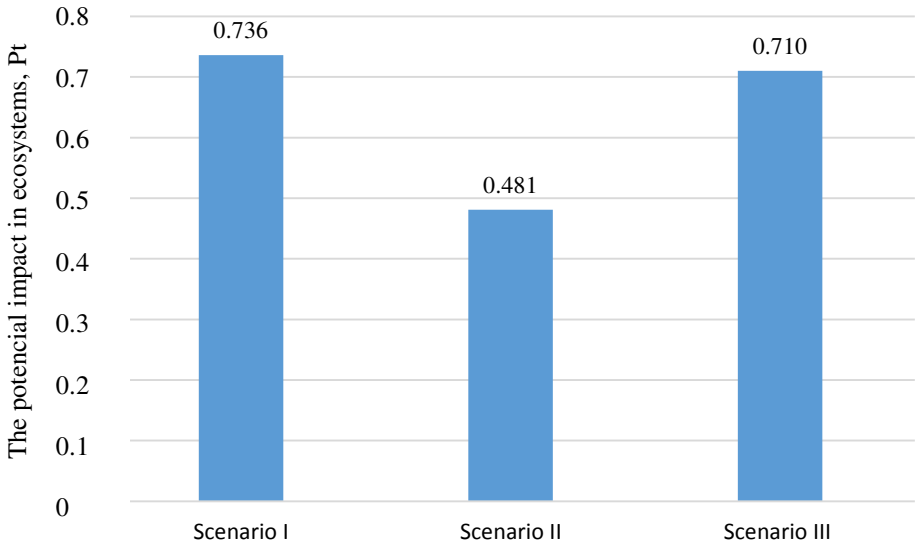


Figure 3. The impact of the mass bottle packaging process in the damage category ecosystems, Pt. Source: own study.

In the category of damage resources the smallest potential impact on the environment was shown, similarly to the two previous categories, for scenario II of the examined mass packaging process of bottles. The potential impact in this category of damage is about 40% smaller than in the two other analysed cases. The scenario in which the process was supplied with wind energy is characterised by an impact of 3.38 Pt (figure 4).

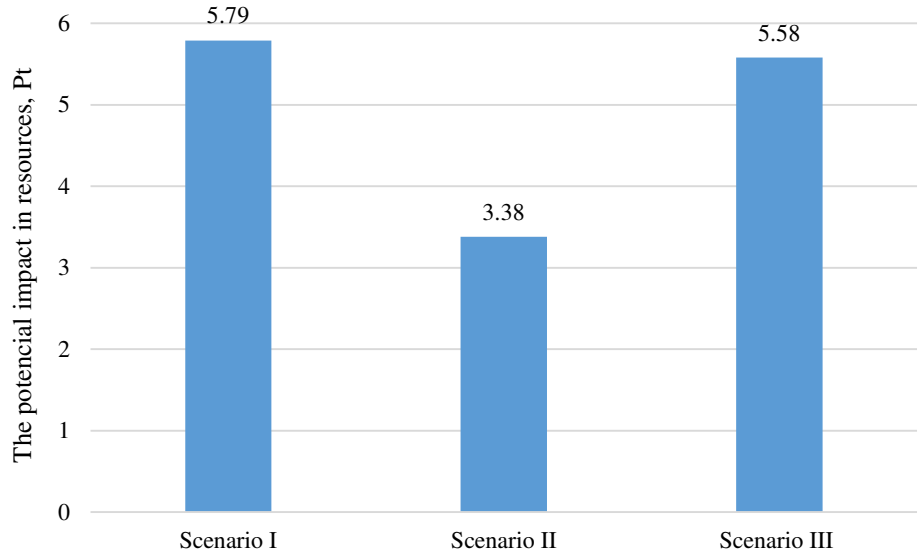


Figure 4. The impact of the mass bottle packaging process in the damage category resources, Pt. Source: own study.

4. Discussion

The analysis carried out showed the potentially smallest environmental impact of the process variant in which recycled film was used. The use of biodegradable film in the process, compared to the use of traditional film, reduces damage only in the resources category from $9.77 to $8.16. The production process of traditional film (marked as LDPE) is associated with high consumption of non-renewable resources, including e.g. crude oil, because of which the damage within this category in the tested process variants is the highest. Biodegradable films decompose quickly, which from a general point of view is beneficial for the environment. The process may be accompanied by the formation of substances harmful to human health and ecosystems. In the literature, researchers indicate ecological problems related to the decomposition of biodegradable films (Moshood, 2022; Wu, 2021; do Val Siqueira, 2021). During decomposition, microplastics may be formed, which can penetrate ecosystems. Additionally, biodegradation carried out in uncontrolled conditions, e.g. in landfills, may cause the emission of greenhouse gases, including methane, which affects global warming. Proper and effective biodegradation of plastics requires specific conditions for industrial composting, which are a major challenge nowadays. (Narancic, 2018; Haider, 2019).

The analysis indicated a potentially lower environmental impact in the variant using recycled film. Although films of this type do not degrade, they can be reprocessed and reused multiple times. This approach aligns with global trends in sustainable development, reduces the demand for primary raw materials, and decreases the amount of waste sent to landfills. Recycling the film minimizes excessive energy consumption associated with producing

primary films, thereby lowering carbon dioxide emissions and contributing to climate change mitigation. Recycled films are processed in a closed cycle, where the material is reused to create new products that retain their original functionality (Ballestar, 2022; Seier, 2023). Environmentally, they can be a more sustainable option, provided waste is managed responsibly and the recycling process is efficient (Koinig, 2022).

Technological processes are integral to the economic development of every country. The mass packaging of bottles in heat-shrinkable film, like any other process, consumes large amounts of electricity, which increases its potential environmental impact in cases of improper energy management. To reduce the negative impact of this process on the environment, it is essential to explore new energy solutions that can minimize its harmful effects (Hamed, 2022). For this purpose, an analysis of power supply scenarios for the mass bottle packaging process was carried out, which showed that powering the process with energy obtained from a wind farm reduces the harmfulness of the process in all three categories of damage, i.e. human health, ecosystems, resources.

The analysis carried out is subject to certain limitations. The analysis used input data from a specific production line, with specific operating and performance parameters. Analysing other technological lines that differ in energy efficiency and productivity, the obtained results may differ. The analysis assumed a regional boundary covering the national energy mix, based on energy produced from coal. In the case of analysing an energy mix with significant energy from renewable energy, the differences between the scenarios studied would be much smaller. In subsequent studies, it is planned to continue the considerations in the field of implementing biodegradable films in the process of mass packaging. It is planned to conduct research considering the disposal scenario in order to verify whether it has a significant impact on the training of the process using different types of films.

The LCA analysis allowed for a comprehensive inventory of input and output data in the life cycle of the process of mass packaging of bottles in heat-shrinkable film. It allowed for the identification of a variant that would contribute to reducing its negative effects on the environment. The results of the LCA analysis can be used as a tool for making decisions related to changes in energy management in each company – to reduce the harmfulness of this stage and the entire process (Rocca, 2023; Salvi, 2023). To reduce the energy consumption of the process of mass packaging of bottles in heat-shrinkable film, it is necessary to strive to increase the efficiency of individual elements of packaging machines, including mechanical systems.

5. Conclusions

The study analyses the environmental impact of the mass packaging process depending on the type of shrink films (LDPE, recycled films, biodegradable PLA films) used in the mass packaging of bottles, in accordance with the principles of the circular economy. The results showed that recycled film had the lowest negative environmental impact in key categories such as health, ecosystems, and resources, supporting the concept of closed-loop recycling. Although biodegradable film reduces resource consumption, it requires specific conditions for effective degradation and can generate microplastics if decomposed improperly. The results presented in this study indicate that:

- the use of biodegradable film in the process of mass packaging of bottles reduces damage to resources compared to the variant using traditional film;
- in all the tested variants of the process, the use of film with the addition of recyclates is characterized by the smallest potentially negative impact in the three categories of damage;
- analysis of power supply scenarios for the mass bottle packaging process showed that powering the process with energy from a wind farm reduces the potential negative impact on the environment compared to the variant with power supply from the country's energy mix by 40-47% in all three damage categories;
- the gas supply to the film shringing stage in the mass packaging process reduces damage in all three examined categories, i.e. human health, ecosystems and resources, compared to the scenario from energy country's mix;
- the obtained results are subject to certain limitations, including incomplete access to the input data;
- the limitation in the conducted analysis is the boundaries of the studied system, which may be insufficient to encompass all potential interactions and impact beyond the directly studied process. The adopted range of system boundaries may omit some important aspects of the impact on the environment, which may distort the picture of the overall impact of biodegradable films in the context of mass packaging of bottles;
- the research should be continued to reduce the harmfulness of the process through further analysis of the implementation of modern heat-shrinkable films as well as ecological power supply of the process.

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COOPETITION DURING THE PANDEMIC: DYNAMICS OF COOPETITVE RELATIONSHIPS UNDER UNCERTAINTY

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Purpose: The paper aims to examine the dynamics of coopetitive relationships in a high level of environmental uncertainty caused by COVID-19 pandemic. We focus on three research questions: Does uncertainty influence coopetitive practices? What are the primary cooperation areas between competitors under uncertainty? Are the changes in coopetitive behaviour permanent or temporary?
Design/methodology/approach: A qualitative, cross-case study design (n = 18) was used to explore this topic. We conducted semi-structured in-depth interviews with key informants (PAPI technique).
Findings: Our findings suggest that pandemic-induced uncertainty had a neutral to positive effect on coopetitive behaviour. Most companies either maintained or increased their collaboration levels, often significantly. The main cooperative areas encouraged by the pandemic included open information exchange, joint lobbying efforts on legal issues, and subcontracting work among competitors. The durability of these changes is uncertain as many firms reverted to pre-pandemic cooperation levels. On the other hand, some managers reported the development of a collaborative rather than confrontational mindset what suggests potential for sustained coopetition.
Research limitations/implications: This study is limited by its qualitative, case-study approach, which constrains generalisability and may include respondent subjectivity. Additionally, the research focused on a single country, meaning multinational studies are needed to verify universal applicability, as coopetitive behaviours can vary by national context.
Originality/value: The main contribution of this paper is the identification of the main areas of coopetition and the examination of its dynamics and durability in the highly unpredictable environment during the pandemic. The study referred to pandemics and its consequences, however, the research results could be applicable to other highly uncertain environments, e.g. wars, natural disasters, political upheaval and other environmental shocks.
Keywords: coopetition, cooperation, uncertainty, relationship development.
Category of the paper: Research paper.

1. Introduction

The growing body of research on coopetition resulted in the development of many theoretical concepts and empirical evidence in the field (e.g. Bengtsson, Kock, 2014; Czakon, Mucha-Kuś et al., 2014; Fernandez, Chiambaretto, 2016; Gnyawali et al., 2016; Padula, Dagnino, 2007; Raza-Ullah et al., 2014; Ritala et al., 2017; Luo, 2007; Tidström, 2014). Systematic literature reviews have demonstrated a significant increase in the number of papers focusing on various aspects of coopetition, including its nature, forms, and challenges (Bengtsson et al., 2013; Czakon et al., 2014; Czakon, Rogalski, 2014; Della Corte, 2018; Tidström, 2014). Additionally, considerable attention has been given to drivers and outcomes of coopetition (Dorn et al., 2016; Gnyawali, Park, 2009; Ritala, Hurmelinna-Laukkanen, 2013).

Previous studies demonstrated the evidence of coopetition in different environments and sectors, including both more stable industries and also sectors of high speed and high change, e.g. automotive, airlines, tourism, construction, aerospace, IT, etc., allowing researchers to identify various forms or types of coopetition (Akpinar, Vincze, 2016; Chiambaretto, Dumez, 2016; Chim-Miki, Batista-Canino, 2017; Dorn et al., 2016; Klimas, 2014; Munten et al., 2021; Soltani et al., 2017). However, the pandemic and post-pandemic times were unique in terms of uncertainty and market turbulence, environmental shocks, law restrictions, and resource shortage (Crick et al., 2023). In this context, the pandemic-triggered coopetition seems to be a unique phenomenon and this topic constitutes an interesting research gap.

The purpose of the study is to examine coopetitive relationships' dynamics in a high level of environmental uncertainty resulting from the COVID-19 pandemic and the post-pandemic period. Thus, in our study, we focus on the general environment and external drivers of the development of dyadic coopetitve relationships between market rivals (inter-organisational level). Consequently, the following research questions have been formulated:

RQ1. Did the pandemic, along with its consequences (e.g. lockdowns, restrictions), contribute to coopetition between market rivals?

RQ2. What were the main areas of cooperation between rivals during the pandemic? Were they unique?

RQ3. How did coopetitive relationships change during the pandemic and post-pandemic times? What was the durability of coopetitive relationships?

To achieve the formulated goal and answer the research questions, we conducted empirical research using a qualitative approach. Due to the exploratory nature of the study, a cross-case study research design (n = 18) with semi-structured individual in-depth interviews (IDIs) with key informants was employed. The PAPI technique was used to gather empirical data. Interviews were coded and analysed following a multi-stage procedure (Creswell, 2008), and the researchers' triangulation technique was used to avoid subjectivity and individual bias.

The main contribution of this paper is the identification of the main areas of cooperation within coopetitive relationships and the examination of their dynamics in the highly unpredictable environment during the pandemic. The study referred to pandemics, however, the research results and conclusions could be applicable to other highly uncertain environments, e.g. war and related restrictions, natural disasters, and other environmental shocks.

The paper is organised as follows. In the first section, the literature on coopetition was critically reviewed focusing on its nature, areas of cooperation, as well as dynamics of coopetitive relationships. The second section presents the research design and methods used. In the next sections, the results of the empirical study on pandemic-triggered coopetition were presented and discussed, respectively. Finally, in the conclusion section, a summary of findings, research limitations and directions for further research have been highlighted.

2. Theoretical background

2.1. Coopetition – nature, drivers, and outcomes

Coopetition has been defined as the simultaneous pursuit of cooperation and competition between firms (Brandenburger, Nalebuff, 1996) or a relationship simultaneously containing elements of both cooperation and competition (Bengtsson, Kock, 1999). Bengtsson et al. (2010) underline that the companies involved in coopetition are cooperating and competing at the same time but in different activities or fields. This approach corresponds to the strategy of spatial separation in terms of dealing with paradoxes (Poole, Van de Ven, 1989; Smith, Lewis, 2011). Simultaneously, the literature acknowledges that the coopetition strategy is a much more complex and multifaceted phenomenon (Chin, Chan, Lam, 2008). It is viewed as a unique relational approach that goes beyond pure competition or collaboration and allows combining the advantages of both strategies (Chen, Miller, 2015; Lado et al., 1997). Consequently, coopetition has been depicted as a paradoxical approach (Gnyawali et al., 2016; Raza-Ullah et al., 2014) contradicting the idea of the traditional competitive strategy.

Prior literature provides a diverse list of drivers and antecedents of coopetition. For example, Dorn et al. (2016) differentiate three groups of antecedents: market conditions (e.g. environmental aspects, regulators, and laws), dyadic aspects comprising relationship-specific factors, and also individual aspects that determine willingness, likelihood, and capability to develop coopetitive relationships with rivals. Additionally, various industry-related factors, such as short product life cycles, technological convergence, and high R&D costs, can push rival firms to engage in collaboration (Luo, 2007; Gnyawali, Park, 2009).

Coopetition can be identified on different levels, i.e. inter-organisational (network, dyadic), intra-organisational, team-level, and individual (Dorn et al., 2016), however, most studies on coopetition in the management literature focus on the inter-organisational level (Czakon, Mucha-Kuś, 2014; Devece et al., 2019), and our research contributes to the same stream of literature.

Research findings support a positive correlation between coopetition and various positive outcomes. It has been shown to contribute to performance enhancement, market share expansion, the development of new technologies and products (Gnyawali, Park, 2009; Robert et al., 2009; Meade, Hyman, Blank, 2009; Ritala, 2012), and enhanced effectiveness in organisational activities like marketing, logistics, and management control (Chiambaretto et al., 2016; Wilhelm, 2011; Grafton, Mundy, 2017). Moreover, coopetition plays a vital role in establishing new markets and industries by facilitating the development of shared technological infrastructures, platforms, and standards (Christ, Slowak, 2009; Ondrus et al., 2015; Ritala et al., 2009).

2.2. Areas of cooperation between rivals

Coopetition literature names numerous areas of cooperation between rivals (Morris et al., 2007; Rudny, 2015), e.g. new product development (e.g. high-tech industry; engineering projects), conducting projects that exceed the capabilities of a single company (e.g. construction industry; aviation), building a common resource base (e.g. tourism sector; healthcare), building a bargaining power (e.g. purchasing groups), cost and risk sharing (e.g. automotive industry), common marketing activities (e.g. retail; hotels and restaurants), knowledge exchange and technology transfer (creative sectors; start-ups). Additionally, market rivals can cooperate in the areas that are not strictly related to the market-product framework and their core business, for example, engaging in various CSR activities: charity actions, sponsoring, or social events (Rossman et al., 2018).

2.3. Dynamics of coopetitve relationships

Many studies have shown coopetition as a dynamic phenomenon (Bengtsson et al., 2010; Bengtsson, Raza-Ullah, 2016; Padula, Dagnino, 2007). Coopetitive relationships evolve as coopetitors reconfigure their relational interdependencies over time (Kylänen, Rusko, 2011; Rajala, Tidström, 2017), but their development differs from cooperative inter-organisational relationships (Chen et al., 2019). In consequence, both early models of the relationship life-cycle (e.g. Dwyer et al., 1987; Ford, 1980; Ring, Van de Ven, 1994; Wilson, 1995) and also later concepts of relationship development (e.g. Ferreira et al., 2017; Plewa et al., 2013) seem to be insufficient to describe the development and changes of complex and paradoxical coopetitive relationships. Dorn et al. (2016) examined different level-dependent evolution patterns of coopetition and differentiated four main phases: (1) antecedents for coopetition, (2) initiation, (3) managing and shaping, and (4) evaluation phase. Moreover, coopetition

includes multiple tensions (Czakon, 2014) and may lead to conflicting roles, opportunistic behaviours, and knowledge leakage. As a result, it is seen as an unstable and fragile relationship (Akpinar, Vincze, 2016; Fernandez et al., 2014; Tidström et al., 2018).

3. Research design and methods

Due to the exploratory nature of the research, the study follows a qualitative approach based on a cross-case study research design. The purposefully selected research sample contained 18 large and medium-sized companies with domestic capital and independence in developing and implementing strategies (branches of foreign corporations and state-owned companies were excluded from the study). Due to the guidelines for selecting research objects for the cross-case study, the purposefully selected sample included companies from various industries (Gerring, 2007). The main characteristics of the studied companies and interviewees are presented in Table 1.

Table 1.
Characteristics of the studied companies and interviewees

ID	Industry and profile	Position, gender and age
R1	Waste management	CEO, F_50
R2	Funeral industry	Owner/CEO, M_44
R3	Coworking, office and conference room rental	Managing Director/Board Member, F_40
R4	Leather goods and clothing - production and sales	CEO, M_44
R5	Pharmaceutical production	Operations manager, M_N/A
R6	Construction - developer	CEO, M_49
R7	New technologies - production and sales	Owner, F_40
R8	Organic food - production and sales	CEO, M_49
R9	Beauty/cosmetics - production and sales	Owner, M_51
R10	Business services - cleanliness, security, other	CEO, founder, M_62
R11	Delicatessen production, deliveries to chain stores	CEO, M_37
R12	Financial, B2B	President, M_44
R13	Loyalty programs, cooperation with stores and petrol stations	Leadership team member, M_44
R14	Financial - supplier of services and equipment	Key account manager, M_40
R15	Construction - wholesale of materials	Vice president, M_40
R16	Electric/construction - wholesale chain	Founder and co-owner, M_69
R17	Energy technologies, photovoltaics	Managing director, M_N/A
R18	Construction - production of concrete materials	President and co-owner, F_41

Source: authors' own.

The primary data collection technique was individual semi-structured in-depth interviews (IDIs). The interlocutors treated as key informants were company owners and top managers with a dominant influence on the company's strategy (the fact was confirmed in a telephone screening survey preceding the interview). The research was conducted using the PAPI technique in the form of face-to-face meetings or using remote communication tools (Zoom), in 2022. The average duration of the interview was approximately 60 minutes.

The interviews were recorded and transcribed, then coded and analysed following a multi-stage procedure (Creswell, 2009). In the process of coding the interviews, codes were developed using a mixed approach, i.e. theory-driven combined with data-driven (Eriksson, Kovalainen, 2016). Each interview was analysed and coded independently by three members of the research team due to the researchers' triangulation technique.

This procedure was developed as part of the research project "Dualisms and Paradoxes in Strategic Management", carried out in 2021-2022 by a research team from the Department of Strategic Management at Wroclaw University of Economics and Business, of which the Authors were the members. Then, the interview data was reused and re-coded for the purpose of the analysis on the topic of coopetition under uncertainty.

4. Research findings

Analysis of the research results was guided by the purpose of the study, which was to examine the dynamics of coopetitive relationships in a high level of environmental uncertainty resulting from the COVID-19 pandemic and the post-pandemic period. The following research questions became a framework for the presentation of the findings:

RQ1. Did the pandemic and its consequences (e.g. lockdowns, restrictions) contribute to coopetition between market rivals?

RQ2. What were the main areas of cooperation between rivals during the pandemic?

RQ3. How did coopetitive relationships change during the pandemic and post-pandemic times? What was the durability of coopetitive relationships?

4.1. Pre-pandemic experiences with coopetition

The researched companies entered the pandemic with varied previous experiences and mindsets regarding coopetition. It was important to establish a baseline in order to recognise the changes brought about by the turbulence and uncertainty of the pandemic. The starting point turned out to be a wide variety of practices and attitudes, from no coopetition at all to coopetition within limited areas to coopetition as a leading business model.

Companies entering the pandemic with **no previous history of cooperation with competitors** usually attributed it to the specifics of the industry or a moment in the company's life cycle. *The industry is very competitive, and you don't cooperate with this competition on a daily basis* [R14]. *(There is) no cooperation. The nature of the industry is such that we are clearly in competition with each other* [R6]. *We are definitely in the competition model (...) As a company (...), we treat ourselves as market leaders, and we do not need to look for elements that would allow us to obtain added value through cooperation with the competition. It would not be a win & win situation, we try to create the market and get ahead of the competition* [R12].

Other companies on the verge of the pandemic described some **limited experiences with coopetition**. The main fields of such cooperation included participation in industry and employers' associations, joint legal actions and PR projects. Particularly membership in industry organisations was emphasized: *I am a great supporter of activating employers' organisations, establishing think tanks (...) I always participate as the chairman of the chamber's council, I am a member of the Polish Employers' Federation, (...) I was twice the vice-president of employers of the Republic of Poland (...) I believe that despite the small influence of employers on reality caused by the approach of successive governments or the culture of our nation (...) cooperation with competitors is, in my opinion, very effective* [R10].

Such organisations were primarily perceived as instrumental in achieving representation and lobbying influences. *The industry discusses its issues, identifying what should be reported to the regulator* [R14]. *We have industry organisations and they are for shared legal interests as the industry is decidedly overregulated* [R1]. *If we need regulations that are clearly essential for survival, we also come together very easily. Then we achieve representativeness, (...) we prepare expertise jointly, create various budgets to develop a legislative solution (...) at a high level—one that can be presented to parliament* [R10]. Joint actions in the common interest of the industry may also refer to the industry's public image: *In terms of PR, in the debt management industry, we had a project on how to change the image of debt collection companies, which are often seen as bad actors taking money from consumers and businesses. (...) Ultimately, 20 companies were involved in this project, sharing information, business models, and prospects for market development. This information was collected, and a comprehensive report was prepared (...), which was communicated to various organisations and ministries. Thanks to this, the image of the industry (...) changed somewhat* [12].

The third type of coopetitive experiences included **business cooperation with competitors**. Three types of business relationships were described:

- Subcontracting work or providing services to competitors: *If we are not able to produce something ourselves due to our production capabilities, (...) then we turn to, let's call them, befriended competitors to whom we outsource or subcontract these activities and the ability to produce for our client* [R5]. *Now we have changed our strategy to more cooperation with competitors, we also provide services to competitors* [R2].
- Deliberate business model based on coopetition: *We have 7 thousand products, of which 700 are under our brands, and 6300 are in the so-called distribution. We distribute our competitors' products, and they distribute ours* [R8].
- Joint R&D: *We are looking for various advantages, entering into partnerships with companies (...) to find a better and cheaper service for the customer; we are looking for new methods* [R1].

Concluding, our findings confirmed that the development of coopetition is strongly industry and context-dependent.

4.2. Pandemic's impact on the scope of coopetition

We anticipated that the pandemic would trigger changes in coopetitive behaviour and mindsets. Indeed, the conditions created by the pandemic influenced the way many companies felt about the need for cooperation. The impact on the scope of coopetition was, however, multifold and surprising. In our sample, we observed three different responses to the pandemic, regarding the scope of coopetition:

- Increased coopetition.
- Decreased coopetition.
- No change in coopetitive behavior.

Many companies experienced **increased cooperation** during the pandemic. The respondents' language brought up the associations with the need for uniting in the face of a catastrophe or a war. The companies felt they were *creating a common front* [R10] against the *common enemy: the pandemic, (...) the government and landlords* [R4], being *very alert, not to miss anything* [R13], and acting out of the *defensive instinct (...) in a tragic situation* [R4]. In this context, the pandemic's triggering effect was evident, acting like a magnifying glass or an accelerator: *The pandemic was kind of a turbocharger for the cooperation* [R10], when *both of them (cooperation and competition) intensified* [R14] and *everything felt a bit more saturated* [R14]. The respondents admitted that *uncertainty encourages cooperation* [R10] and *the pandemic definitely caused most companies to integrate (...) (as they) had similar problems from the perspective of running a business* [R4]. As a result – *the increase in collaboration during the pandemic was significant and the industry debated* [14].

Increased cooperation, however, was not always the outcome. Uncertainty and threats to the company's survival also created a cornering effect. Instead of cooperation and integration – some companies observed the opposite - a shift toward **more aggressive competitive behaviour**. *Everyone is much more alert now to avoid missing out on anything, much more than before the pandemic* [R13]. *A lot of imitation appeared in the industry. If someone did something, most others started copying it to avoid falling behind. (...) Scrutinising (what others are doing) and copying things—imitation has intensified. There was no cooperation or sharing here. (...) This intensified greatly, while in normal times, companies had their own ideas. Everyone was afraid that they might miss something due to the risk and market uncertainty* [R13].

Interestingly enough, in both of the above approaches – the goal was to stay up to date with how others are dealing with uncertainty and look for inspiration for out-of-the-box solutions. Except in the case of increased coopetitive behaviour, it was accompanied by positive sentiment and a sense of community and unity (joint front, joint enemy, win-win), whereas in the case of increased aggressive competition – the sentiment was threat, fear and zero-sum game perception of the situation.

Not in all the cases, however, did the pandemic bring a change in coopetitive dynamics. Many of the interviewees reported a lack of influence of the pandemic either on the so far coopetitive or non-coopetitive strategies. In the case of very competitive young industries, the pandemic **didn't change the no-cooperation** approach: *We had model A (competition) and still have model A. (...) Regardless of the pandemic or war, the industry is very young and is under intense pressure for competition* [R18]. *No (cooperation). The nature of the industry is such that we clearly compete with each other* [R6]. *No (changes during the pandemic). There is some level of cooperation, but we don't discuss product matters; it's a very competitive, dispersed business (...) and the pandemic didn't change that* [R15].

On the other hand – in the case of some companies who had built their business model on cooperation with competitors – the pandemic didn't influence its scope, and such companies **continued their coopetitive practices**: *The pandemic did not change anything, companies that wanted to cooperate with us - continued to cooperate, those that did not want to - did not. The pandemic had no impact* [R2].

4.3. The main areas of cooperation with rivals during the pandemic

Our interviewees pointed out the three most important areas of cooperation practised during the pandemic:

- Open information exchange and debate
- Lobbying, legal matters, and communication with the government
- Business cooperation in the form of subcontracting or subletting

The most dynamic area of cooperation, particularly specific to the pandemic times, was **open information exchange**. This seemed to be the area with the biggest change compared to the pre-pandemic period. A sudden disruption in business and legal conditions, combined with high uncertainty about how the situation was going to develop, served as a strong motivator to openly communicate with competitors and jointly look for new solutions or discuss the consequences for the industry: *In the initial six months of uncertainty and stress, everyone wanted to see what was happening with others; there was quite a lot of honesty and openness in comparing situations, asking, 'How are things going for you?' We compared results, I spoke openly, and I received similar information from others* [R4]. *We had many discussions, and sometimes I participated in two meetings at once because there was a new legal project they wanted to discuss. I won't deny that there were more friendly phone calls from the industry, asking what we were doing, how we were operating, how clients were behaving* [R12]. The casual exchange of information was also accompanied by the active seeking of new ways of functioning and new business models: *From the first weeks of the lockdown, when turnover drastically dropped, we had to engage in unconventional thinking and look for various solutions. We travelled around, talked with the competition, and managed to establish some (new) agreements* [R11].

Another prevalent area of cooperation with rivals during the pandemic was **lobbying and joint representation of the industry's legal interests** with the government. The intensity of cooperation in this area increased significantly and became a necessity, not an option, especially at the beginning of the pandemic, when new conditions and regulations were shaping. *The first steps we took at the beginning (...) - we decided it would be good to unite, to be a voice that could engage with our government and with landlords. We created an association that brought together over 150 Polish companies* [R4]. *The industry had to consolidate to ensure that the government wouldn't do anything to hinder its operation. For instance, the industry argued that it was crucial for the economy and that it could not be entirely shut down in terms of office operations. The industry sought more rights for itself compared to other sectors* [R14]. This kind of approach was necessary to secure the industry's interests and to have its voice heard. *In this uncertainty, protective measures need to be simply effective, which happens when an industry that represents a certain type of service (...) thinks together, collectively, establishing a roughly unified policy and direction* [R10].

Subcontracting work or seeking opportunities to become a subcontractor was another way in which the companies cooperated in the pandemic. Significant disturbances in orders and the supply chain, combined with staff fluctuations resulting from lockdowns and illness, disrupted the usual organisational balance. Many organisations experienced orders shortages, while others were understaffed, which opened new cooperation possibilities. *Today, we opened ourselves up to making products for others, something we hadn't done before. We had the idea, but (now) we had no choice; we had to find customers* [R9]. This kind of collaboration, however, turned out to be more difficult as it demanded trust. In industries with trust issues – even impossible: *I tried to collaborate with one of the competitors by borrowing their employees, but I only ended up scaring them. I received feedback that they wouldn't go in that direction. They were simply afraid that I would take over their employees. The idea was that I had orders, and they didn't at that time, so I proposed that since I was short-staffed but not permanently, I'd gladly borrow their employees for six months or three months, during the period when I had increased demand. But it turned out I only frightened the competition. It seemed normal to me; I didn't see anything wrong with it. (...) I tried it this one time, and it didn't work out* [R5].

4.4. Dynamics of the pandemic and post-pandemic coopetitive relationships

The uncertainty associated with the pandemic proved to be a disrupting factor in terms of coopetitive behaviour. For most of our interviewees, it either increased their willingness to collaborate with competitors or maintained their pre-pandemic level of cooperation. Certain areas of collaboration became particularly characteristic, such as the open exchange of information between competitors regarding their perspectives and responses to the situation, as well as joint lobbying efforts to advocate for the industry's interests in the legal turmoil.

The dynamics of these changes, however, raise further questions. Will closer cooperation also be sustainable after the pandemic, or was it merely an opportunistic behaviour? Did the pragmatics of collaboration in the face of danger succeed in increasing mutual trust and fostering a climate of openness also post-pandemic?

The research indicates that for many companies, the end of the pandemic meant a return to previous practices regarding coopetition. However, it's also noticeable that there is a certain level of "warming-up" of the relationships that prevailed beyond the pandemic. *In the initial six months of uncertainty and stress (...), there was quite a lot of honesty and openness in comparing situations, asking, 'How are things going for you?'* (…). *Once we moved past that period, it really changed back. But we still talk, we keep in touch—maybe not as much as before* [R4]. *During the pandemic, cooperation grew significantly; the industry was engaging in discussions. We met and checked in with each other, but I think things have now returned to how they were before* [R14]. *Nothing has really changed here; there are areas where we collaborate, but it's weaker. We're friendly, sometimes meet somewhere, and maybe it will change someday* [R15]. The above examples, even though reporting the weakening of the pandemic-time collaboration, also express a certain positive sentiment that prevailed ("we keep in touch", "we are friendly", "we meet somewhere").

For some managers, the experience of coopetition during the pandemic was transformative on a personal level and had a profound impact on how they perceive the right and wrong of inter-organisational relations. *As a person, I'm definitely bolder now; when I negotiate or talk with someone, I speak with complete honesty from the start. (...) it's a much better way to live. (...) I believe that building relationships and creating networks helps restore a sense of community* [R9]. *The pandemic (...) somewhat forced this second style (collaboration), but it feels closer to me now. After all, you can sometimes create something valuable with competitors (...). I'm looking for opportunities to explore new ways of working together* [R11]. *Yes, I'm convinced this is the right path for development. The pandemic acted as a turbo boost for this collaboration, but we continue on this path, learning as we go, thinking more deeply (...). The idea is for each part to collaborate with every other part, and it's the same in the marketplace* [R10]. The language the managers used may suggest that collaborative experiences from the pandemic encouraged their transition to a different, possibly more mature, values-driven approach to inter-organisational relations (Laloux, 2016; Greiner, 1972) and that such change may be sustainable.

5. Discussion and conclusions

The COVID-19 pandemic was an example of high uncertainty disruption to organisations' operations. It brought a sudden change of conditions in which businesses functioned both on macro, industry, organisational and personal levels. In our research, we wanted to find out if high uncertainty influences an organisation's readiness to cooperate with competitors and, if so – what are the main areas of cooperation and whether such changes are permanent.

Eighteen companies that we interviewed entered the pandemic with varied previous experiences of coopetition – from none to limited to incorporated into the business model. Our research showed that the uncertainty of the pandemic had a neutral to a positive impact on coopetitive behaviour, and the vast majority of companies either sustained the collaboration level or increased it, sometimes significantly. The scope of this cooperation was largely industry-dependent, with industry dynamics and stage in the life-cycle being the main contributing factors. This confirms previous studies showing coopetition as industry-dependent (Chim-Miki, Batista-Canino, 2017; Gnyawali, Park, 2009; Dorn et al., 2016; Klimas, Czakon, 2018).

The change in the coopetitive behaviour extended from "increased coopetition" to "no change in coopetitive strategies" to "decreased (or constricted) coopetition" in rare cases when the uncertainty provoked more aggressive competitive practices. We observed varied responses, with the prevalence of positive or neutral-positive impact on inter-organisational relationships. The main areas of cooperation with competitors triggered by the uncertainty of the pandemic were: the open exchange of information, joint lobbying efforts in legal matters and activities aimed at subcontracting and outsourcing of work to and from competitors. Particularly the open exchange of information between competitors on how they respond to the pandemic brought new value to coopetitive practice and could be considered the most characteristic of this uncertain situation. This, together with the lobbying efforts, could be considered less advanced levels of coopetitive behaviour and are characteristic of the beginning stages of cooperation, i.e. awareness or pre-relationship phases, in traditional relationship life-cycle models (Dwyer et al., 1987; Ford, 1980). This is an indication of future collaboration possibilities once the initial trust and rapport are built.

When it comes to the permanence of the changes in coopetitive behaviour, once the pandemic was finished, many of the interviewees reported a return to the previous level of cooperation with competitors; however, the sentiment seems to have changed. Some of the managers declared warm-up of their relationships with competitors, including increased contact, communication, and friendliness. Also, for some of the managers, the experience of collaboration during the pandemic had a personal transformative effect, leading to the appreciation of cooperation as a good path to follow and to the development of a collaborative rather than confrontational mindset (Colpaert et al., 2015; Iriyama et al., 2016) - possibly

moving the managers on the continuum of cooperative-competitive strategic thinking style (Tang, 1999). This opens an interesting line of future research on how uncertainty changes not only organisations but also individual strategists and the way they think and make decisions.

The permanence of the coopetitive practices that were observed during the pandemic is uncertain, which is in line with other studies presenting coopetitive relationships as dynamic and prone to change in any context (see e.g. Bengtsson, Raza-Ullah, 2016; Kylänen, Rusko, 2011; Tidström et al., 2018). The prevalence of positive connotations with collaboration for some managers, and the personal impact it had on others, indicate a possible increased level of trust between the actors and a higher likelihood of future coopetition.

The study contributes to the inter-organisational relationship literature in several ways. Firstly, it shows the uncertain time of the pandemic as a trigger of coopetition for organisations. This, however, remains an industry and context-dependent phenomenon. Secondly, it describes the development of coopetitive relationships during the turbulent time of the COVID-19 pandemic by identifying the main areas of cooperation and examining their dynamics in a highly unpredictable environment. What is important, the research results and conclusions drawn from studying the pandemic may be applicable to other highly uncertain environments, e.g., war, natural disasters, political upheaval and other environmental shocks.

The work has research limitations concerning e.g. limited generalisability, case selection, and subjectivity of the interviewees. However, the study was exploratory in nature, and the in-depth examination of interfirm coopetitive relationships allowed us not only to identify motives, areas of cooperation between market rivals, and the dynamics of coopetitive relationships at the organisational level, but also examine the mindset changes on the individual level. This direction seems to be appealing in terms of future studies on coopetition.

Our research was limited to one country, and according to previous studies, coopetition can vary depending on the country context (Czakon, Mucha-Kuś, Rogalski, 2014; Dorn et al., 2016). In our case, some cultural factors, e.g. low level of social trust, may play a vital role in the development of coopetitive relationships between market rivals, which suggests extending research into a multinational context.

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COOPERATIVE BANKS IN THE CONTEXT OF SERVICING LOCAL COMMUNITIES IN POLAND

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Purpose: The aim of the studies was to identify the characteristics of local government units in Poland that chose to have their primary bank accounts conducted by cooperative banks.
Design/methodology/approach: The studies encompassed communes from six voivodeships displaying significant differences in the conditions and traditions of cooperative banking development (annexations) and population density. A total of 1,116 communes were analyzed. The main data sources for the analysis and inference were the official websites of the analyzed units, Statistics Poland's Local Data Bank, and the online map platform Google Maps. Structure indicators, descriptive statistics methods, and the Classification and Regression Tree (C&RT) method were used to analyze the empirical material.
Findings: The analyses enabled the identification of the characteristics of the communes served by the cooperative banking sector. The findings confirmed the dominant role of the cooperative sector in communes with the smallest populations and local budgets. A significant determinant of communes' reliance on cooperative banking services was the percentage of inhabitants employed in agriculture. Communes with a higher proportion of agricultural workers more frequently had their budgets serviced by cooperative banks.
Research limitations/implications: The conducted research allowed for a deeper understanding of the analysed research problem relating to the factors that determine the choice of the organisational form of a bank serving a commune.
Practical implications: The results obtained are important for the management staff of cooperative banks. Having information about the factors that determine the choice of a bank serving the municipal budget, they can design financial products that meet the expectations of this customer segment.
Social implications: Socially, they contribute to strengthening the positive image of the cooperative banking sector among various stakeholders (consumers, agricultural producers, municipal authorities).

Originality/value: The results obtained in the conducted research enrich the existing scientific achievements of management and quality sciences as well as economics concerning the identification of the current features of communes that determine the choice of the type of bank (cooperative bank/commercial bank) by the commune.
Keywords: bank cooperative, banking services, commune, commune budget.
Category of the paper: Research paper**.**

1. Introduction

Cooperative banking in Poland has a long and rich tradition, with the first cooperative banks established on Polish soil as early as the second half of the 19th century. Their purpose, similar to those in Western Europe, was to provide financial services and engage in social activities, mainly for the benefit of their members and the local communities in which they operated (Greve, 2002). During the period of annexations, these aims included fighting against usury and exploitation, as well as efforts to maintain and increase Polish estate by promoting entrepreneurship in agriculture, Polish crafts, and trade (Orzeszko, 1998; Paluch et al., 2022).

In the interwar period, much like during the annexations, credit cooperatives provided services to various population groups, with members from diverse backgrounds (farmers, clerks, merchants, workers). Beyond economic activities, credit cooperatives were also engaged in various endeavors to promote educational and civilizational progress in the communities where they operated (Szambelańczyk, 1997).

During the command economy period, Polish credit cooperatives underwent forced transformations to integrate them with the entities and principles of the socialist economy (Szambelańczyk, 2006). When evaluating the post-war development of banking cooperatives in Poland, it should be noted that despite these measures, the sector of cooperative banks remained a permanent feature of the Polish banking system and experienced systematic, albeit sometimes hindered, development. Local cooperative banks provided credit funds to improve the efficiency of agricultural farms and offered financial services to other players in the food economy operating in their areas (Orzeszko, 1998; Golik, 2002).

After 1989, the cooperative banking sector underwent a massive transformation accompanied by organizational changes. Following a sudden revival of their activity at the beginning of the political transformation and a subsequent systemic crisis (which saw the number of banking cooperatives decrease by nearly two-thirds), the cooperative banking system regained its position at the start of the 21st century and became competitive (Szambelańczyk, 2006). The advantage of cooperative banks over commercial entities lay mostly in their deep understanding of the needs of the communities they served. However, today's customer expectations, especially those of younger generations, combined with technological changes and new distribution channels for financial services implemented by commercial banks, pose

new challenges to cooperative banks. As most cooperative banks are unable to handle these challenges on their own, strong associating banks have a vital role to play in this segment of the Polish banking sector.

Cooperative banks continue to play a significant role in local communities today. They make up the largest network of banks in Poland. According to data from the National Association of Cooperative Banks, at the end of 2023, there were 492 cooperative banks operating in Poland. Of these, 10 were stand-alone banks, while the remaining were members of two associations: Bank Polskiej Spółdzielczości SA (307 entities) and Spółdzielcza Grupa Bankowa SA (175 entities) (Lista…, 2024). Present-day cooperative banks have offices in both large cities and small communes, providing access to financial services for enterprises and individuals even in the smallest towns across the country, thus fostering financial inclusivity (Lal, 2019). Numerous studies show that banks operating according to cooperative principles are often the only financial institutions within a dozen or several dozen kilometers (Płonka et al., 2023; Szafrańska, 2023). They are becoming particularly significant for local communities as commercial banks systematically reduce the number of their branches and focus more on developing electronic distribution channels for financial services (in the second half of 2023 alone, the number of bank branches in Poland decreased by 63, or 1.25%).

Cooperative banks serve a range of functions in the areas where they operate: a stimulating function by offering credits to fund various purposes, a structural function (e.g., transformations in the agrarian structure due to preferential credits), and a social function (forging ties among members, i.e. bank customers, enhancing credibility, and promoting a positive image) (Giagnocavo et al., 2012; Jones et al., 2016). Another function is advisory, which involves promoting innovation, entrepreneurship, and cooperation in developing investment business plans. Other significant functions include the educational function, which promotes financial literacy, and the servicing function, which involves providing financial services to individual customers, farmers, entrepreneurs, and local government units (Jiménez-Hernández et al., 2018).

Many researchers note a certain specificity in the functioning of cooperative banks. In most European countries, a relational banking model, or a similar model, can be distinguished in cooperative banking. Compared to the transactional model, this type of banking is characterized by a higher proportion of deposits from and credits granted to individuals and farmers, higher quality credit portfolios, and positive customer ratings for service quality (Kata, 2009; Beck et al., 2014; Ayadi et al., 2016; Fiordelisi et al., 2023). Some researchers even classify cooperative banks as niche banks that satisfy the financial needs of a specific demographic group (Lang et al., 2016). Often, these banks operate in areas with less developed financial infrastructure, thus contributing to the reduction of financial exclusion (Kata, 2009).

To create conditions that enable cooperative banks to effectively fulfill their functions for the benefit of local communities, it is essential to identify the characteristics of the communes that choose to have their primary accounts serviced by these banks. This perspective has not yet been explored. However, it is crucial, particularly in the context of addressing various local issues such as improving the financial situation of households, stimulating entrepreneurial activity within the local community, reducing unemployment in the local market, developing and upgrading infrastructure, protecting the environment, and implementing projects aimed at economic and social revival.

The analysis of the collected material should provide answers to the following research questions:

1. Does the number of inhabitants of a commune determine the type of bank that provides budget services to the commune in Poland?
2. Does the number of people employed in agriculture in a given commune affect the type of bank (cooperative/commercial) that maintains the basic account for the local government unit?

The article begins with an introduction in which the choice of the topic is justified. The next part of the study is a literature study on the subject. Then, data sources and research methods were presented. The next section presents the research results and discussion. Finally, the conclusions resulting from the analysis are presented.

2. Literature review

Local government units, while fulfilling their statutory tasks, must rely on an intermediary that provides comprehensive financial services to them. These services are not limited to cashier service but also include, among other things, credit and deposit products, servicing the issuance of local government securities, and professional advice in handling the financial resources and municipal assets of the local government unit.

Currently, municipal banks, which were owned by local government units and established specifically to provide financial services to them, no longer operate in Poland. Local government units now choose financial intermediaries from among the operational branches of commercial banks or cooperative banks willing to cooperate. It should be noted that cooperative banks currently dominate in servicing local government units, particularly smaller ones in rural areas.

Cooperative banks hold a unique position in the financial services market, functioning both as banks and cooperatives. Consequently, they are classified as social enterprises, combining two key attributes: entrepreneurship and social character (Siudek, 2011). To operate effectively as banks, they must place significant emphasis on the type and quality of their financial services and how they provide them. To survive and grow, they must strive to achieve business objectives that may not always align with their mission, while simultaneously pursuing social objectives. These social objectives include forging lasting relationships with their members and customers and promoting local development. Achieving this balance is challenging, given the constant pressure on cooperative banks to prioritize commercial activity over their social mission (Alken, 2005).

It should be emphasized that the position of cooperative banks in the markets they serve depends not only on their economic and social relationships with local government units but also on their usefulness to potential non-institutional customers—those whom they are mission-driven to serve (Wierzbicki, 2016).

Cooperative banks conducting business activities must remember that a bank's success is measured not only by its ability to attract customers but also by maintaining long-term cooperation with them through high-quality services. This long-term cooperation, especially with local government units, should not be based solely on financial aspects. Both local government units and cooperative banks should prioritize the local community, aiming to conduct activities that promote local development. For cooperative banks, such activities should go beyond allocating part of their profits to support various local initiatives, such as cultural and sporting events or initiatives promoting local economic development. By undertaking these tasks, cooperative banks not only demonstrate their commitment to the local community but also strengthen their positive image within the area. It is important to emphasize that by providing services to residents of small towns, who often have limited access to comprehensive financial services, cooperative banks help reduce financial exclusion among local community members. In engaging in these activities, typically in environments with relatively low revenue potential, cooperative banks prioritize the interests of the local community over profitability. Local government units should consider this when choosing a financial institution to serve them. Beyond financial costs, they should also consider the history of cooperation, the level of trust in individual banks, and the benefits that selecting a particular institution will bring to the local communities. Ensuring the presence of socially responsible and robust local banks, typically cooperative banks, is crucial. These banks, with their many years of service to the local community, understanding of its needs, and knowledge of its financial possibilities, can offer a range of financial services that meet the community's expectations at reasonable prices (Giagnocavo et al., 2012).

According to Z.R. Wierzbicki (2016), local government units and cooperative banks should aim to form alliances to foster mutual development, as well as the development of local communities and enterprises within their sphere of influence. In practice, cooperation between a cooperative bank and a local government unit should extend beyond typical bank-customer relationships and the financial services specific to this type of customer.

At this point, it is worth noting that all cooperative banks are obliged to act in a manner that preserves the good image of the entire cooperative banking sector. The bankruptcy of several cooperative banks, particularly Podkarpacki Bank Spółdzielczy (which serviced 35 local government units), has led to local government units being more cautious in their dealings with cooperative banks.

It should also be highlighted that local government units cannot ignore the fact that cooperative banks' individual customers, i.e., their stakeholders, primarily consider the following factors when selecting a bank: convenient location, quality of customer service, and social activity (Nowacka, 2018). Cooperative banks place more emphasis on social activity compared to commercial banks.

Many cooperative banks conduct their activities within the bounds of the local market, i.e., the commune, poviat, or, at best, the entire voivodeship. Conducting business activity across the whole country requires initial capital at the level of the minimum capital of commercial banks (Ustawa…, 2000). However, it should be stressed that many cooperative banks that meet the statutory capital requirements are organizationally unable to conduct such activities. Moreover, by operating nationwide, a cooperative bank loses its local character, and its relationships with customers change. On the other hand, when operating in a small area, these banks have limited capabilities to attract more customers. However, they have the opportunity to get to know their potential customers much better and adapt their offerings to individual needs. This approach does not allow them to maximize profits but enables them to continue their activities, establish lasting relationships with customers, and fulfill the social objectives included in their mission statements.

Thus, the local character of cooperative banks can be largely shaped by existing legal regulations and the banks' compliance with the principle of regionalization. One can therefore assume that this character is related to territoriality, defined as the ability and inalienable right to operate within one's own territory while retaining full legal and economic independence (Siudek, 2007).

It should be stressed that, contrary to claims by some authors, the local character of cooperative banks does not only involve servicing a specific area where the organization of local community life centers around a single urban center (Jakubowska, 2009; Żółtowski, 2011). The local character of a bank should also be viewed through the prism of its engagement with the local community it serves and its ability to meet the individual needs of its customers (Kata, 2009).

Traditionally, the customers of cooperative banks mainly consist of their members, representatives of the local community, farmers, small and medium-sized enterprises (SMEs), local institutions, and local government units.

Cooperative banks place great importance on cooperating with local government units and related entities such as healthcare institutions, public utility enterprises, and schools, which are typically reliable customers. Their financial activities are strictly governed by existing legal regulations (Ustawa…, 1990, 2009), ensuring stability, predictability, openness, and transparency. Through long-term cooperation with these institutional customers, cooperative banks not only secure stable revenues but also contribute to achieving social goals aligned with the bank's mission. Moreover, servicing such institutions enables cooperative banks to enhance their position in the local financial market and expand their customer base to include employees and customers of these institutions. When serving members of the local community, cooperative banks must recognize that their most valuable assets, alongside financial resources, are loyal customers with whom they have established long-term relationships.

The view expressed by W.L. Jaworski (2002), two decades ago, that in the competitive arena, only those cooperative banks with strong support from local (commune) governments and the local community can survive in the market, still holds true. To achieve this, cooperative banks must adhere to the regional principle, focusing on becoming banks for communes and poviats. Their role should be to retain funds accumulated by these local entities for local development and prevent their transfer to other regions of the country or abroad (Jaworski, 2005).

However, it should be stressed that for cooperation between a cooperative bank and a local government unit to be beneficial for both parties, the bank needs to have a product offer tailored to the needs of the local government unit. It should also be capable of ensuring comprehensive and effective fulfillment of the unit's financial requirements and granting it the status of a strategic customer of the bank (Korenik, D., Korenik, S., 2007).

The topic of cooperation between cooperative banks and local government units represents an important issue that has not been thoroughly studied. In the literature, isolated studies can be found, but these do not encompass the majority of cooperative banks operating in the market. An example of such research is that conducted by J. Przybylska and A. Jakubowska.

J. Przybylska (2008) conducted a study among 140 cooperative banks, each of which serviced local government units. The findings revealed that 92.2% of the serviced local government units were communes (with 57.8% being rural communes), 7.6% were poviats, and 0.71% were cities with poviat rights. It is noteworthy that 21.4% of the analyzed banks serviced one local government unit, 17.8% serviced two local government units, and 16.4% serviced three local government units. The bank servicing the most units had 20 local government clients.

In a survey conducted by A. Jakubowska (2015) regarding the cooperation between selected banks operating in the Silesian Voivodeship and local government units, 89.47% of cooperative banks and 36.67% of commercial banks reported engaging in such cooperation. It should be noted that cooperative banks reported cooperating with rural and urban-rural communes, whereas commercial banks reported cooperating with urban communes with over 40 thousand residents and cities with poviat rights with up to 100 thousand residents.

The fact that a cooperative bank services one or multiple local government units indicates significant differences in the sizes of cooperative banks. Small cooperative banks, which offer mainly basic deposit-credit products and cashier services, aim to cooperate only with local government units from their immediate area (communes, poviats). In contrast, large cooperative banks are inherently universal banks; they compete with commercial banks by offering a broader range of services and aim to service many local government units across a larger area (multiple poviats or a voivodeship). It should also be emphasized that only strong cooperative banks are capable of adapting to evolving forms of customer service, including modern product offerings and technological solutions.

It is also worth highlighting that A. Jakubowska and A. Grabowska-Powaga, based on studies conducted among Silesian banks and local government units, found that the following factors had the biggest impact on a bank's cooperation with a local government unit: mutual trust (banks – 92.3%, local government units – 94.6%), customization of offerings (banks – 87.2%, local government units – 81.1%), willingness of the bank to negotiate (banks – 85%, local government units – 73%), quality of communication (banks – 79.5%, local government units – 89.2%), and willingness of the local government unit to negotiate (banks – 64.1%, local government units – 81.1%) (Jakubowska, Grabowska-Powaga, 2015).

The literature review indicates that while cooperation between cooperative banks and local government units significantly impacts their efficient operation, this topic has not been thoroughly examined. Therefore, comprehensive studies are needed to address this research gap.

Based on the analysis of the literature on the subject, as well as in the context of the main aim adopted in the article, the following research hypotheses were accepted for verification:

H1: Cooperative banks dominate in servicing the smallest municipalities in terms of number of inhabitants and with lowest budgets.

H2: Local government units characterized by a high share of population employed in agriculture are mainly served by cooperative banks.

3. Methods

The provision of banking services to local governments has been less explored compared to services offered to commercial enterprises. This is due to local governments' slower adoption of modern banking solutions and the legal framework within which they operate. Until recently, communes primarily utilized traditional banking products such as bank accounts, credits, acceptance of deposits, execution of withdrawals, and term deposits. However, financial institutions now offer local governments a wide range of innovative financial services, including virtual accounts, prepaid cards, assistance in issuing municipal bonds, and advice on financing structures and investment implementation models.

The market for servicing commune budgets has been developing systematically. From 1999 to 2022, the revenues of communes (excluding cities with poviat rights) increased by 431.1%, while their spending rose by 434.5%. Cities with poviat rights saw even greater increases during this period, with revenues and spending rising by 468.4% and 473.9%, respectively. Adjusted for inflation, the real total revenue of communes and cities with poviat rights increased by 166.3%, while spending increased by 168.5%. This represents a 2.7-fold increase in this market (Bank…, 2023). The dynamic growth attracts the interest of banking institutions, leading to increased competition between cooperative banks and commercial banks.

The aim of the study was to identify the characteristics of local government units that opted to have their primary accounts serviced by cooperative banks. The research was conducted in communes located in voivodeships with notable differences in terms of conditions and traditions related to the development of cooperative banking (annexations) and population density:

- high population density: Little Poland Voivodeship (former area annexed by Austria), Mozovia Voivodeship (Congress Kingdom of Poland, former area annexed by Russia),
- medium population density: Great Poland Voivodeship (former area annexed by Prussia), Subcarpathian Voivodeship (former area annexed by Austria),
- low population density: Warmia-Masuria Voivodeship (former area annexed by Prussia), Podlaskie Voivodeship (former area annexed by Russia).

In total, 1,116 communes were analyzed. The study to identify banks servicing communes, banks, and through telephone interviews (dependent variable: type of bank servicing a primary account of the local government unit). The population of banks servicing communes was classified into five groups:

- commercial banks (1),
- cooperative banks operating independently (2),
- cooperative banks affiliated with Bank Polskiej Spółdzielczości SA (3),
- cooperative banks affiliated with Spółdzielcza Grupa Bankowa SA (4),
- Bank Gospodarstwa Krajowego (5).

To identify the characteristics differentiating the analyzed communes, data from Statistics Poland's Local Data Bank (averaged for the period 2018-2021) (Bank…,2023) and Google Maps (first half of 2023) were utilized. The analysis included variables describing a commune's economic potential, location, and banking infrastructure saturation. Predictors were selected based on literature review and reduction reasoning. The economic potential was assessed using the following characteristics (notations used in modeling are indicated in brackets):

- commune size measured by the number of inhabitants (COMMUNE SIZE),
- commune's attractiveness to the bank measured by the level of total revenue (COMMUNE'S REVENUE),
- commune's wealth measured by its revenue per capita (COMMUNE'S WEALTH),
- population density (POPULATION DENSITY),
- number of unemployed individuals per 1000 people of working age (UNEMPLOYMENT LEVEL),
- number of economic entities per 1000 people of working age (INHABITANTS' ENTREPRENEURSHIP),
- number of individuals working in agriculture per 1000 people of working age (EMPLOYMENT IN AGRICULTURE),
- total migration balance for the period 2018-2021 per 1000 inhabitants (MIGRATION).

Variables describing commune type and its location:

- commune type (TYPE),
- location within voivodeship (VOIVODESHIP),
- whether the commune borders a city or includes one (BORDERS A CITY),
- distance to a city with over 100,000 inhabitants (DISTANCE FROM A BIG CITY),
- travel time to a city with over 100,000 inhabitants (LARGE CITY TRAVEL TIME).

Variables describing the local banking infrastructure:

- number of bank branches within the commune (NUMBER OF BANKS),
- whether the bank servicing the budget has an office within the commune (BUDGET SERVICING BANK),
- whether there is a cooperative bank operating within the commune (COOPERATIVE BANK),
- whether there is a commercial bank operating within the commune (COMMERCIAL BANK),

- whether there is a SKOK credit union operating with the commune (SKOK credit union),
- number of cashpoints (CASHPOINTS),
- cashpoint of a commune-servicing bank (CASHPOINT OF A SERVICING BANK).

To address the question regarding the characteristics of communes opting to have their budgets serviced by specific groups of banks, the Classification and Regression Tree (C&RT) method, a tool in Data Mining (Statistica®), was employed. This method facilitates the discovery of dependencies and patterns within large datasets (Dacko et al., 2023). An essential step in constructing the classification tree model (C&RT) was defining parameters to assess its quality and prevent excessive model complexity. During the development of the Classification and Regression Tree method (C&RT), the following assumptions were made:

- the costs of misclassifications will be equal,
- the goodness of fit will be evaluated using the Gini measurement,
- the stopping rule will prune on misclassification error,
- terminal nodes will consist of at least 10 observations,
- the quality of the obtained results will be assessed using V-fold cross-validation with V = 10.

For the purpose of the analyses, the communes were classified based on their characteristics using quartile division, with the following descriptive categories assigned to the different groups: very high, high, moderate, low.

4. Results and Discussion

The analysis of the local conditions affecting banks that service commune budgets was conducted based on various criteria: type of local government unit, commune location, budget and wealth level, number of inhabitants, population density, and the proportion of the population employed in agriculture.

The analysis of the banking infrastructure indicates that no bank was operating in 105 local government units (9.4%) participating in the study. It should be noted that while this was not an issue in urban communes, it was a marginal problem in urban-rural communes (1%). In rural communes, however, this problem was identified in 14.4% of local government units. In 97.2% of urban communes, there is at least one cooperative bank operating, and in 95.5%, there is a commercial bank branch. For urban-rural communes, these figures were 97.6% and 67.2%, respectively. The worst situation was recorded in rural communes, where cooperative banks operated in 84.3% of the analyzed local government units, while commercial bank branches operated in only 12.4% (see Table 1). This illustrates that residents of rural communes,

along with their local authorities seeking direct banking services within their area, can typically find such services available at cooperative banks. In contrast, commercial banks show more interest in providing customers access to electronic distribution channels for financial services rather than expanding their network of physical branches. Consequently, local governments in rural communes more frequently opt to cooperate with local partners such as cooperative banks for their financial service needs.

Local government units constitute a crucial customer group for cooperative banks. Servicing such customers can significantly impact both their financial standing and their perception by local residents. This is exemplified by SGB-Bank SA, which, together with 175 cooperative banks, forms the Spółdzielcza Grupa Bankowa and cooperates with 220 local government units (Banki…, 2023). Another associating bank in Poland, BPS SA, also offers banking services tailored for local governments on behalf of itself and its associated cooperative banks.

Table 1.
Banking infrastructure in communes by type

Specification (location within the commune)	**Communes by type**			
	urban	**rural**	**urban-rural**	**In total**
	number of communes			
Number of communes in the group	112	708	296	1116
Lack of bank branches	0	102	3	105
At least one cooperative bank branch	109	597	289	995
At least one commercial bank branch	107	88	199	394
Budget-servicing bank branch	107	577	278	962
Lack of a cashpoint	0	100	4	104
Cashpoint of a bank servicing commune budget	109	563	277	949

Source: own work, n = 1116.

In the analyzed group, 86.2% of local government units used financial services provided by banks with an office within the territory of the commune. It should be noted that in urban communes, 4.5% of local governments used the services of banks without an office in the commune, while in urban-rural communes, this figure was 6.1%. These local government units chose such institutions for financial services out of preference, not necessity. The situation differed in rural communes, where 18.5% of local governments used services of a bank without an office within their territory. It is important to emphasize that for 14.4% of rural communes, this was due to the lack of bank branches within their territory, whereas only 4.1% chose to do so freely for budget servicing.

The analysis revealed significant disparities in the development of banking infrastructure across the analyzed voivodeships. The most favorable situation was observed in Podlaskie Voivodeship, where every analyzed commune had at least one cooperative bank operating, and 40.7% of local government units also had a branch of a commercial bank. In over 99% of communes in this voivodeship, banking services were available from institutions with offices within their territory. A positive situation in terms of banking infrastructure was observed in

the Little Poland and Masovia Voivodeships, where only 5.5% and 7.6% of communes, respectively, lacked bank offices. However, Subcarpathian and Warmian-Masurian Voivodeships faced more challenges, with 15.6% and 19.8% of local governments respectively lacking access to banking services within their commune's territory. It is important to highlight that local authorities, regardless of voivodeship, generally prefer to collaborate with banks that have offices within their commune. Across all analyzed voivodeships, over 95% of local government units opted for local banks for budget servicing. Notably, the highest trust in local banks was observed in Subcarpathian Voivodeship, where every commune preferred cooperation with a local bank, typically a cooperative bank operating within the commune's territory.

The level of a commune's budget does not have a definitive impact on banking infrastructure. The number of commercial bank offices increases with the commune's revenue, being the lowest in communes with low revenue (7.9%) and the highest in those with very high revenue (81%). This significant difference indicates that commercial banks prioritize servicing wealthier areas, focusing primarily on maximizing profits. However, it should be noted that large commercial banks, despite not having offices in most Polish communes, are still interested in servicing local governments.

It should also be noted that wealthier communes often seek business partners outside their area to service their budgets, even when local banks are available. The highest number of such cases was observed in communes with very high (6.1%) and high (5.4%) revenue, while the fewest cases occurred in communes with moderate (3.9%) and low (2.2%) revenue. This suggests that an increase in the commune's budget may motivate authorities to look beyond their territory when selecting a bank to service their budget. Consequently, some wealthier local governments may place less emphasis on strengthening ties with local financial institutions.

The number of inhabitants significantly impacts banking infrastructure (Table 2). Communes with a "very high" population are not affected by the lack of banking establishments. Similarly, this issue only slightly affects communes with a high population (2.36%). However, it is more noticeable in communes with a low (10.8%) and moderate (10.2%) population. The number of inhabitants in communes does not have as significant an impact on the infrastructure of cooperative banks as it does on the infrastructure of commercial banks. It should be stressed that cooperative banks operate in over 89% of communes. These banks operate in 88.6% of communes with a low population and in 100% of communes with a very high population.

Table 2.
Banking infrastructure in communes by commune size measured by the number of inhabitants

Specification (location within the commune)	Communes by the number of inhabitants*			
	low	medium	high	very high
	number of communes			
Number of communes in the group	702	255	127	32
Lack of bank branches	76	26	3	0
At least one cooperative bank branch	622	221	120	32
At least one commercial bank branch	114	135	113	32
Budget-servicing bank branch	603	212	116	31
Lack of a cashpoint	83	21	0	0
Cashpoint of a bank servicing commune budget	584	215	118	32

* average number of commune inhabitants for the period 2018-2021: low (< 10,000 people), medium (10,000-20,000 people), high (20,000-50,000 people), very high (> 50,000 people)

Source: own work, n = 1116.

Meanwhile, physical branches of commercial banks are present in only 35.3% of the analyzed communes. Branches of commercial banks operate in 16.2% of communes with a low population, 52.9% of communes with a moderate population, 88.98% of communes with a high population, and 100% of communes with a very high population.

Communes with low, moderate, and high levels of entrepreneurship among inhabitants are equally likely to lack access to banking services within their territory. This problem is minimal only in communes where inhabitants exhibit a very high level of entrepreneurship. Cooperative banks do not prioritize this criterion when developing their branch networks. Branches of cooperative banks are located in 87.8% of communes with a low level of entrepreneurship and 92.1% of those with a very high level. This is arguably due to the fundamental aim of cooperative banks, which is to provide their members with access to banking services at a reasonable price, rather than focusing on profit or the development of entrepreneurship. This is not the case with commercial banks. The study found that communes with higher levels of entrepreneurship among inhabitants have a better-developed network of commercial bank branches. Such branches operate in 14.7% of communes with a low level of entrepreneurship, 15.8% of communes with a moderate level, 40.1% of communes with a high level, and 70.6% of communes with a very high level of entrepreneurship. This may be because individuals with higher levels of entrepreneurship seek financial partners capable of offering comprehensive financial services, including modern and innovative banking products, which are typically provided by commercial banks.

It cannot be stated categorically that the level of employment in agriculture has a direct impact on banking infrastructure. The study showed that in communes with low and very high levels of employment in agriculture, the inhabitants were least likely to lack access to banking services within the territory of the commune (Table 3).

Table 3.
Banking infrastructure in communes by level of employment in agriculture

Specification (location within the commune)	Communes by level of employment in agriculture*			
	low	medium	high	very high
	number of communes			
Number of communes in the group	279	279	279	279
Lack of bank branches	11	39	33	22
At least one cooperative bank branch	259	234	244	258
At least one commercial bank branch	226	87	46	35
Budget-servicing bank branch	250	225	235	252
Lack of a cashpoint	5	38	36	25
Cashpoint of a bank servicing commune budget	257	218	228	246

* level of employment in agriculture measured by the number of people working in agriculture per 1000 working-age people: low (<134.1), medium (1341-266.4), high (266.4-401.7), very high (>401.7).

Source: own work, n = 1116.

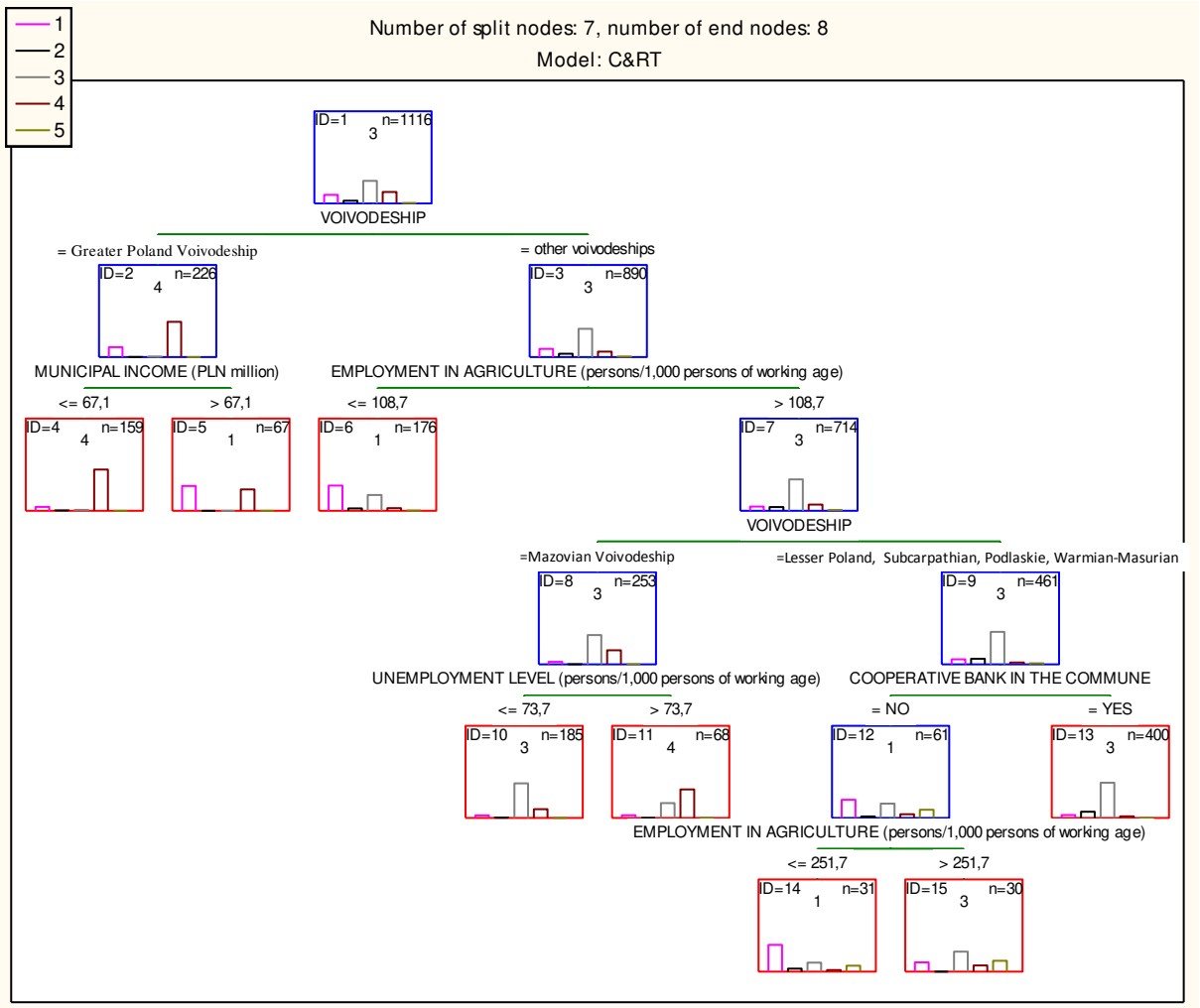
The study found that in 14% of communes with a moderate level of employment in agriculture and in 11.8% of communes with a high level of employment in agriculture, there were no bank branches. It is worth noting that although farmers are the main customers of cooperative banks, such banks mainly operated in communes with a low level of employment in agriculture (92.8%) and a very high level of employment in agriculture (92.5%). In the case of commercial banks, it was found that as the level of employment in agriculture increased, banks' interest in servicing such communes decreased. This is confirmed by the fact that commercial bank branches operated in 81% of communes with a low level of employment in agriculture, in 31.2% of communes with a moderate level of employment in agriculture, in 16.5% of communes with a high level of employment in agriculture, and in 12.5% of communes with a very high level of employment in agriculture.

To identify the characteristics that differentiate the analyzed population of communes based on the type of bank entrusted with budget servicing, interactive C&RT trees were used. The developed tree model consists of 7 splitting nodes and 8 terminal nodes (Figure 1). The proportion of misclassifications was 32%, which was considered a good and satisfactory result for exploration purposes. The first splitting criterion was location, separating the communes located in Greater Poland Voivodeship, where banks associated with Spółdzielcza Grupa Bankowa predominate. The second largest group of banks servicing commune budgets were commercial banks. The next split resulted in two terminal nodes (No. 4 and 5). This time, the tree chose the level of budget revenue as the splitting criterion, indicating that the likelihood of choosing a commercial bank for budget servicing was much higher if the commune had a higher budget. Communes with revenue not exceeding PLN 67.1 million per annum were primarily serviced by cooperative banks associated with SGB S.A.[1]

[1] Choosing a cooperative bank other than one from the group SGB S.A. was very difficult as in Greater Poland Voivodeship there are only 2 banks in the group BPS.

In other voivodeships, the primary criterion for identifying communes serviced by commercial banks was a low proportion of people working in agriculture. Communes where less than one-tenth of working-age inhabitants were employed in agriculture showed a significantly higher likelihood of choosing a commercial bank (node No. 6). This preference was predominantly observed in urban communes and suburban areas bordering large agglomerations.

In the case of 714 communes where employment in agriculture exceeded 108.7 individuals per 1000 working-age people, location again emerged as the most important criterion for differentiation. In Masovian Voivodeship, with higher unemployment levels in a commune, there was an increased likelihood of choosing a cooperative bank from the SGB group (node no. 11). Conversely, when unemployment levels were below 73.7 individuals per 1000 working-age people, cooperative banks from the BPS group were chosen more frequently (node no. 10). This trend likely stemmed from the fact that cooperative banks in communes with higher unemployment rates were often associated with SGB. In the remaining four voivodeships, the likelihood of choosing a commercial bank increased when the commune lacked an office of a cooperative bank and employment in agriculture was below 251.7 individuals per 1000 working-age people. Conversely, when a commune had a cooperative bank branch or when more than one-fourth of working-age people were employed in agriculture, the commune budget was most often serviced by a cooperative bank, typically belonging to the BPS group.



* Dependent variable bank type: 1 – commercial bank, 2 – independent cooperative bank, 3 – cooperative bank associated with BPS, 4 – cooperative bank associated with SGB, 5 – Bank Gospodarstwa Krajowego. A list of predictors was included in methodological notes.
ID - branch number.

Figure 1. Model of interactive C&RT tree for the variable: bank type.

Source: own work.

An additional feature of C&RT trees is their ability to generate a predictor importance ranking. This is significant because many predictors may not appear in the graph but are strongly connected with the choice of a bank servicing the commune budget (Table 4).

Table 4.
Selected characteristics of the predictors used in the analysis

Characteristic (predictor)	Features of the characteristic	Importance of predictors
Voivodeship	Lesser Poland Voivodesh, Mazovian Voivodeship, Subcarpathian Voivodeship, Podlaskie Voivodeship, Warmian-Masurian Voivodeship, Greater Poland Voivodeship	1.00
Employment in agriculture (people/1000 working-age people)	min.: 0 max.: 1306[2] average: 288.4	0.87
Commune size (number of inhabitants)	min.: 1447 max.: 1823365 average: 15287	0.84
Commune revenue (PLN million/year)	min.: 9,2 max.: 18816,6 average: 99.1	0.84
Population density (people/km2)	min.: 4 max.: 3987 average: 211	0.75
Cashpoint within the commune	yes or no	0.62
Commune type	city with poviat rights; urban commune; rural commune; urban-rural commune	0.58
Local entrepreneurship (number of entities with REGON/1000 working age people)	min.: 53.9 max.: 500.7 average: 143.1	0.57
Commercial bank branch in the commune	yes lub no	0.57
Commune's wealth (per capita own revenue (PLN)	min.: 862 max.: 7294 average: 2097	0.48
SKOK credit union in the commune	yes or no	0.45
Unemployment rate (unemployed individuals per 1000 working age people)	min.: 9,0 max.: 186.9 average: 50.0	0.43
Whether the commune includes a city or borders a city	yes or no	0.37
Travel time to a large city (minutes)	min.: max.: average	0.28
Cooperative bank branch in the commune	yes or no	0.21

Source: own work.

The most important predictor turned out to be commune location. Consequently, the choice of a bank to service the commune budget is often local. As mentioned earlier, 95.15% of local governments chose a bank operating within the territory of their commune when given the option. A cooperative bank's affiliation with one of the two main banking groups is often local and historically determined, leading to the formation of specific clusters. Location was followed by characteristics describing commune structure (employment in agriculture, number of inhabitants, population density). These characteristics largely determine the attractiveness of a given commune for a bank. The next characteristic in the ranking is commune revenue. Generally, it is evident that the more attractive a commune is, the higher the probability that a commercial bank will be chosen to service the budget.

Local governments of communes, along with individual customers and small to medium-sized enterprises (SMEs), constitute an important market segment for cooperative banks (Kraemer-Eis et al., 2014). This is attributed to their sheer number and the significant financial resources that flow through the accounts of the banking institutions servicing them, which are utilized by communes to fulfill their own tasks as well as those commissioned to them.

[2] During the agricultural census, non-working age people may have been classified as working in agriculture.

The study identified characteristics that differentiate communes in terms of the legal form of bank chosen to service their budget: commune location and the number of people employed in agriculture. Cooperative banks more frequently serviced basic accounts for communes located far from large urban centers, less affluent communes, and those with a high proportion of people employed in agriculture, typically urban-rural and rural communes. These findings confirm previous research indicating that these types of communes are the primary customers of cooperative banks in the segment of local government units (Przybylska, 2008).

One reason for this is that cooperative banks in Poland, due to historical factors, are primarily situated in small and medium-sized cities as well as rural areas. During the centrally controlled economy period, farmers and rural residents could only access services provided by cooperative banks (Kulawik, 2002). Moreover, according to the legislation of that time, cooperative banks were exclusively authorized to provide financial services to agriculture, rural populations, and cooperative associations (e.g., farmers' cooperative associations) (Juszczyk, 2023).

The situation changed during the initial period of the market economy. Commercial banks, previously predominantly located in urban areas, expanded their operations to rural areas and began servicing agricultural populations, thus competing with cooperative banks. However, they later shifted their strategy to concentrate on expanding their branch networks in cities. This trend of commercial banks withdrawing from rural areas also occurred in other countries undergoing systemic transformations. According to G. Van Empel (2001), this was due to the high costs associated with establishing bank branches in rural areas and the lack of expertise among commercial bank staff to serve rural customers effectively. Additionally, as highlighted by R. Kata (2011), large commercial banks showed little interest in adapting to local specificities. Consequently, modern cooperative banks have expanded their services beyond their traditional focus on the agricultural sector, now offering a diverse range of services that include banking products for local government units.

An important predictor was the size of the commune, measured by the number of inhabitants. The analysis indicates that as the number of inhabitants increases, the proportion of communes serviced by commercial banks also rises. Among communes with the lowest number of inhabitants, cooperative banks serviced 90% of local government units, whereas in communes with the highest number of inhabitants (cities), the proportion serviced by cooperative banks dropped to under 50%. The study shows that commercial banks provided basic servicing of commune budgets in the analyzed capital cities of voivodeships. Although cooperative banks operate within these metropolises, their equity capital levels do not enable them to meet the financial needs of large communes, such as providing overdraft facilities where the credit amount exceeds the value of the cooperative bank’s equity capital. These limitations, stemming from the necessity to manage banking risks, present barriers to the expansion of cooperative banks in Europe as well (Groeneveld, 2015). Other studies confirm

that the level of equity capital and the value of assets determine a bank's business model (Borgioli et al., 2013).

5. Conclusions

The cooperative banking sector, which has operated in a competitive environment for many years, is seeking an appropriate business model. Given certain historically determined limitations, it strives to find a suitable market niche and tailor its banking products accordingly. Facing strong competition from commercial counterparts, cooperative banks focus on market segments that remain unfilled or have not attracted commercial banks due to their business strategies.

Significant differences in economic development across Poland result in variations in commune size, banking market size, and socio-economic characteristics of local governments. Commercial banking has primarily developed in urbanized, densely populated areas with intensive economic activity.

In contrast, cooperative banks, rooted in rural environments, naturally target customers in these areas. The present study confirmed the dominance of the cooperative banking sector, particularly in communes with the smallest populations and lowest budgets. The presented research results therefore allow the acceptance of the first hypothesis (H1).

The second hypothesis (H2) was also accepted. An important factor determining the use of cooperative banks by communes was the proportion of the population employed in agriculture. Communes with higher agricultural populations more frequently chose cooperative banks for budget servicing.

Due to capital requirements related to risk management, cooperative banks, with their small balance sheets, face significant barriers to competing, particularly in extending credits to large economic units. Consequently, they are often pushed out by better-capitalized commercial banks, mainly in larger cities where major enterprises are headquartered. Rural areas and smaller towns constitute a banking market segment where cooperative banks find it easier to break through and expand.

The cooperative banking sector should leverage its strong local roots to strengthen its market position in rural areas and capitalize on opportunities related to servicing communes and local development processes. EU structural funds, which support previously disadvantaged and peripheral areas, offer significant growth and expansion opportunities for these banks. Increased operations will inevitably lead to bank mergers and further concentration in this sector. This should be viewed not as a threat to the status quo but as a chance to maintain competitiveness, survive, and develop.

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