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REDAKTOR NACZELNY – Dr hab. inż. Barbara KULESZ, prof. PŚ
REDAKTOR DZIAŁU – Prof. dr hab. inż. Radosław WOLNIAK

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**WYDAWNICTWO POLITECHNIKI ŚLĄSKIEJ
ul. Akademicka 5, 44-100 Gliwice
tel. (32) 237-13-81, faks (32) 237-15-02
www.wydawnictwopolitechniki.pl**

**Sprzedaż i Marketing
tel. (32) 237-18-48
wydawnictwo_mark@polsl.pl**

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FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Presented papers contain result of researches conducted by various universities. The number consists of 38 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: customer experience; brand management; economics; Industry 4.0; public management; production management; environmental management; finances; sustainable development; safety management; strategic management; the implementation of AI in management; human resources management; leadership; Smart City; change management and marketing.

Radosław Wolniak

GAMIFIED CUSTOMER EXPERIENCE IN MOBILE APPLICATIONS: INSIGHTS FROM CONTENT AND SENTIMENT ANALYSIS

Magdalena BRZOZOWSKA-WOŚ

Gdańsk University of Technology; magdalena.brzozowska-wos@zie.pg.edu.pl, ORCID: 0000-0002-8433-0685

Purpose: This paper investigates the role of gamification in shaping user engagement, satisfaction, and loyalty in mobile applications. Using the Żappka app, a leading gamified loyalty platform in Poland, as a case study, it explores how users perceive and respond to game-based features across digital environments.

Design/methodology/approach: The study employs a qualitative case study methodology, analysing 1900 user-generated comments collected between January 2023 and June 2025 from five platforms: Google Play, App Store, Facebook, Instagram, and TikTok. The dataset was manually curated, thematically coded using TAGuette, and evaluated for sentiment using MonkeyLearn and interaction-based signals (e.g., reactions, likes). The analysis was grounded in Self-Determination Theory and supported by principles of content analysis.

Findings: Gamified elements, such as personalized missions, points, and surprise rewards, consistently elicited positive emotional responses, enhanced perceived value, and increased interaction frequency. Negative sentiment clustered around app instability, reward errors, and customer support issues. User feedback varied by platform, with app stores highlighting functional concerns, while social media revealed emotional and relational dynamics.

Research limitations and implications: The findings are context-specific, as they are based on a single national market and a single loyalty application. Future research should extend the analysis to other sectors, markets, and include behavioral or longitudinal data to examine changes over time.

Practical implications: The results demonstrate that clearly structured and emotionally rewarding gamification can strengthen user engagement and brand trust. The Żappka case offers actionable guidance on integrating gamification into app UX design, customer communication, and loyalty strategy.

Social implications: User-generated feedback on gamified platforms reflects a shift toward participatory, co-created brand experiences. The study highlights how digital consumers actively shape service quality and brand perception through discourse and emotional signaling.

Originality/value: By combining sentiment and thematic analysis across app stores and social media, this research offers a holistic, user-centered perspective on gamification in real-world digital ecosystems. It contributes to the literature on loyalty programs, UX, and digital co-creation by mapping how users experience, evaluate, and communicate gamified features.

Keywords: gamification, user engagement, mobile loyalty app, customer experience, user-generated content, digital retail.

Category of the paper: Research paper.

1. Introduction

In recent years, the evolution of mobile technologies and data-driven personalization has led to a transformation in how brands engage with consumers. Loyalty applications, once limited to point collection and basic discounts, now serve as interactive ecosystems that integrate user experience (UX), real-time feedback, and gamification. This shift reflects a growing emphasis on relational loyalty, where emotional engagement and the co-creation of long-term value become key competitive advantages (Morgan, Hunt, 1994; Hwang, Choi, 2020).

At the heart of this transformation lies gamification, defined as the use of game design elements in non-game contexts to influence behaviour and increase motivation (Deterding et al., 2011). When aligned with users' psychological needs, gamification significantly enhances engagement, satisfaction, and loyalty (Hamari, Koivisto, Sarsa, 2014). This effect is often explained through Self-Determination Theory (SDT), which posits that motivation improves when systems support autonomy, competence, and relatedness (Deci, Ryan, 2013). For example, progress bars and levels foster a sense of competence. Personalized missions support autonomy. Social challenges or leaderboards strengthen feelings of relatedness (Sailer et al., 2017; Tondello et al., 2016).

Empirical studies further support these mechanisms. Mekler et al. (2017) demonstrated that points and badges increase motivation primarily when they align with meaningful tasks. Paschmann et al. (2025) showed that reward-based gamification outperforms traditional price promotions in mobile apps. Ramdhani and Hussein (2024) found that gamification mediates loyalty through increased brand awareness.

Despite growing academic interest in gamification, much of the existing research focuses on experimental designs or survey data, rather than on actual game implementations. There is limited understanding of how users spontaneously describe and evaluate gamified features in natural digital environments. Platforms such as TikTok, Instagram, or Facebook offer valuable insights into user behaviour, emotional reactions, and brand interactions through public discourse and user-generated content (Li et al., 2022; Naeem, Okafor, 2019).

This study aims to address this gap by analysing the Żappka mobile application, a gamified loyalty app developed by the Żabka retail chain in Poland. Żappka incorporates a wide array of gamification features—point systems (Żappsy), narrative missions, interface personalization, and surprise rewards—making it one of the most advanced retail apps in Central and Eastern Europe. Its extensive user base and strong presence across social media platforms make it a compelling subject for examining the real-world applications of gamification.

The goal of this paper is to investigate how gamified features in Żappka affect user engagement and customer experience. Using a qualitative case study approach, this analysis examines 1496 user comments retrieved from Google Play, App Store, Facebook, Instagram,

and TikTok, posted between January 2023 and June 2025. The comments were analysed using content and sentiment analysis techniques. The study draws upon Self-Determination Theory and Relationship Marketing Theory as its interpretive frameworks.

The paper is structured as follows. It begins with a theoretical overview of gamification and motivational psychology, followed by a case description of the Žappka mobile application. The following section outlines the research methodology, including data sources, sampling strategies, and analytical procedures. A presentation of the key findings from the sentiment and content analysis follows this. The discussion section interprets these results in light of existing literature. The article then addresses limitations and proposes directions for future research. It concludes with a summary of key insights and practical implications.

2. Literature Review

Gamification has become a widely adopted strategy across digital platforms, particularly in the retail and mobile application sectors. It draws upon psychological theories to increase user engagement, motivation, and loyalty. Among the most influential theoretical frameworks is the Self-Determination Theory (SDT), which identifies autonomy, competence, and relatedness as fundamental psychological needs (Deci, Ryan, 2000; Ryan, Deci, 2000). When these needs are satisfied, individuals are more likely to exhibit sustained motivation and commitment.

Huotari and Hamari (2017) offer a foundational definition of gamification, describing it as “a process of enhancing a service with affordances for gameful experiences to support users’ overall value creation”. Their approach shifts the focus from isolated game elements to the broader experiential and service-oriented outcomes of gamification. This perspective is instrumental in the context of mobile applications, where user engagement is driven not only by external rewards but also by immersive and meaningful experiences.

In marketing and customer engagement, gamification has been shown to influence both short-term behaviors (e.g., increased app visits) and long-term loyalty outcomes (Hamari, Koivisto, 2015; Mekler et al., 2017). Hamari, Koivisto, and Sarsa (2014) provide strong empirical support for the effectiveness of gamification across multiple domains in their comprehensive literature review. Werbach and Hunter (2012) also emphasize how basic game mechanics, such as points, levels, and feedback loops, can create compelling value propositions for both users and businesses.

Recent empirical work by Paschmann et al. (2025) further refines our understanding of mobile gamification, showing that specific design choices can significantly impact user engagement metrics. Their findings highlight how integrating gamification within loyalty apps can influence both emotional connection and transactional behavior.

Research by Sailer et al. (2017) highlights the correlation between specific game elements, such as points, badges, leaderboards, and missions, and the satisfaction of psychological needs. For example, badges can reinforce competence, while missions can foster autonomy and independence. These design elements, when aligned with psychological foundations, contribute to a more meaningful and motivating user experience.

Table 1 below synthesizes core gamification elements and their associated psychological mechanisms and marketing outcomes. These elements were selected based on their prominence in the academic literature, relevance to mobile loyalty programs, and empirical support for their motivational effects. The framework not only provides theoretical clarity but also operational guidance for the study's empirical phase. It informs the thematic and sentiment analysis by linking observable user reactions to the psychological and strategic functions of each gamified feature.

Table 1.

Core Gamification Elements, Psychological Foundations, and Marketing Outcomes

Gamification Element	Psychological Basis (SDT / Motivation)	Expected Marketing Outcome	Sources
Points & Levels	Competence	Increased engagement and repeat usage	Werbach, Hunter (2012); Hamari et al. (2014)
Badges & Rewards	Competence, Extrinsic Motivation	Short-term satisfaction and motivation	Mekler et al. (2017); Paschmann et al. (2025)
Leaderboards	Relatedness, Competition	Competitive drive, peer comparison, and brand attachment	Tondello et al. (2016); Koivisto, Hamari (2019)
Narrative & Challenges	Autonomy, Flow	Deep immersion, emotional resonance	Deterding et al. (2011); Sailer et al. (2017)
Personalized Recommendations	Autonomy, Relevance	Perceived value and user satisfaction	Xu et al. (2015); Hwang, Choi (2020)
Feedback / Progress Indicators	Competence	Visible growth, motivation through clarity	Hamari et al. (2014); Högberg et al. (2019)
Social Sharing / Community	Relatedness	Word-of-mouth, social bonding, viral app growth	Ramdhani, Hussein (2024); Pagano, Maalej (2013)

Source: own elaboration.

This theoretical foundation helps to contextualize the empirical analysis of the Żappka app. By linking design features to established motivational theories and behavioral outcomes, the study provides a framework for interpreting user responses to gamified features across digital and social platforms.

3. Case Description: The Żappka Mobile Application

Żappka is the proprietary mobile application of Żabka, one of Poland's largest convenience store chains, with over 9000 locations nationwide (Żabka Group, 2023). Introduced in 2019, the app rapidly became a central component of the brand's digital transformation strategy, reaching over 10 million downloads by 2024 (Google Play, n.d.; App Store, n.d.). It is consistently ranked among the top retail apps in the Polish market (Android.com.pl, 2024).

From its inception, the Żappka app was designed not only as a functional tool for managing purchases and loyalty but also as an engagement-driven platform that reflects gamification principles. Its core functionalities include digital receipts, personalized offers via the "Żappka Post" feature (Żabka Polska, 2020), product search, store locator, and a loyalty system built around Żapps points accumulated through purchases and interactions. These points can be exchanged for discounts or exclusive rewards.

A key gamified feature is the "Misja Żappka" (Mission Żappka) module, which assigns users voluntary tasks such as "Buy two drinks this week" or "Try a vegetarian product." Completion of these missions yields bonus Żapps and access to new reward tiers (Tabletowo.pl, 2024). The missions are dynamic and time-sensitive, resetting weekly to encourage regular interaction and behavioral reinforcement.

Additional mechanisms include progressive levels, visualized through status tiers and progress bars, which signal advancement and offer symbolic recognition. Visual and audio feedback, such as animations, confetti bursts, and sound cues, accompany task completion. These elements foster a sense of competence and achievement, aligning closely with the motivational needs described in Self-Determination Theory (Deci, Ryan, 2013).

Further gamified components include badges for milestones, daily log-in bonuses, and personalized "Żappka Post" offers that simulate surprise-and-delight dynamics. Push notifications are used to maintain engagement, often framed in playful, friendly language consistent with the brand's youthful tone (Żabka Polska, n.d.-a). Interface design features bold visuals, avatars, and micro interactions that reinforce game-like cues (Wiadomości Handlowe, 2024).

Żappka's ecosystem extends beyond the app. The brand maintains an active omnichannel presence on TikTok, Instagram, Facebook, and YouTube, where it promotes challenges, influencer content, and user-generated memes (Żabka Polska, n.d.-b; Żabka Polska, n.d.-c). These platforms act as extensions of the app's gamified environment, cultivating emotional bonds and social engagement. For instance, viral TikTok posts often reference Żappka missions or joke about status levels, indicating cultural resonance beyond functional use.

Importantly, the Żappka app is also essential for accessing Żabka Nano stores – automated, staffless convenience locations that require app-based entry and digital payment. These stores extend the gamified customer journey into the physical retail environment while enhancing brand identity as an innovator in retail technology (Nano.Żabka.pl, 2025).

This case was selected due to several distinctive features: (1) Żappka's comprehensive integration of gamification into both app design and brand communication, (2) the availability of diverse, spontaneous user-generated content (UGC) across digital platforms, and (3) its relevance as an example of digital retail innovation in Central and Eastern Europe. Moreover, Żappka's gamification strategy reflects both extrinsic incentives (rewards, discounts) and intrinsic motivators (autonomy, mastery, relatedness), offering a fertile ground for examining how gamified loyalty programs are received and interpreted by users in real-world settings.

4. Methodology

This paper adopts a qualitative case study approach to investigate user perceptions of gamified features in the Żappka mobile application and their impact on customer experience. The study relies on natural language data, specifically user-generated content (UGC), which reflects real-time opinions, emotions, and expectations.

The dataset includes 1900 user comments collected between January 2023 and June 2025 from five platforms: Google Play and App Store (400), Facebook (200), Instagram (600), and TikTok (800). These channels were selected due to their popularity and complementary communication dynamics. App store reviews tend to focus on technical and functional aspects, while social media platforms offer more emotional and interactive feedback. The combination supports data triangulation, enhancing the reliability of findings.

For app store reviews, 200 comments were randomly selected from each platform (Google Play and App Store), using a simple random sampling method within the defined time frame (January 2023 – June 2025). Sampling was limited to Polish-language reviews only. Despite the significant difference in total review volume between platforms (approximately 188,000 reviews on Google Play vs. 64,000 on the App Store as of June 2025), the sample was intentionally balanced (50% per platform).

This proportional decision was informed by prior studies in software engineering and app store mining (Pagano, Maalej, 2013; Martin et al., 2017), which demonstrate that smaller, balanced qualitative samples can still yield meaningful comparative insights. Equal distribution also helped control for overrepresentation bias and facilitated thematic symmetry across platforms, which was essential for sentiment analysis and theory-driven coding.

After initial retrieval, all user comments were manually screened and filtered for relevance. From the original 400 app store reviews, 260 were retained after removing duplicates, blank entries, off-topic remarks, and content lacking evaluative language. A similar data-cleaning process was applied to social media content. The resulting corpus was then organized thematically and prepared for two-stage analysis.

The selection criteria across all platforms included originality, relevance to app usage, and references to gamification-related elements (e.g., points, missions, rewards, challenges). Duplicated posts, brand-generated content, emoji-only comments, spam, and advertisements were excluded to ensure thematic consistency. All comments were manually collected from public sources and exported into a comma-separated values (CSV) format for cleaning and organization.

In the first stage, comments were coded using TAGuette, a qualitative data annotation tool. Coding followed principles of inductive content analysis (Krippendorff, 2018), supplemented by the thematic analysis framework outlined by Braun and Clarke (2006). This involved open coding, category generation, and axial mapping. Emerging codes were aligned with key constructs from Self-Determination Theory (Deci, Ryan, 2013), especially autonomy, competence, and relatedness, as well as Relationship Marketing Theory (Morgan, Hunt, 1994), which emphasizes trust, value co-creation, and emotional engagement.

In the second stage, sentiment analysis was conducted using MonkeyLearn, a no-code machine learning platform for text classification. Comments were automatically labelled as positive, neutral, or negative. Where the classification algorithm showed low confidence or ambiguity, results were manually reviewed and reclassified to maintain interpretive accuracy.

For social media data, platform-specific filtering and sampling protocols were applied:

- On Facebook, 177 comments were selected from public threads on the Żabka Polska page. In addition to textual analysis, reaction types (e.g., "like", "heart", "angry") were interpreted as auxiliary sentiment cues, especially for ambiguous or emotionally implicit statements.
- On Instagram, 204 comments were chosen from over 600 responses to official posts and story interactions. Since Instagram does not support comment reactions, the number of likes per comment served as a proxy for resonance and peer approval.
- On TikTok, 772 comments were selected from the brand's 30 most popular videos. Like counts were again used as indicators of resonance. Thematic areas included tutorial responses, feature feedback, and brand–user interaction (e.g., public replies and Q&A formats).

A single researcher conducted all coding and interpretation. To enhance analytical rigor, the process was carefully documented through memoing, iterative coding, and refinement of the codebook. Although no formal inter-rater reliability analysis was conducted, emphasis was placed on internal consistency, methodological transparency, and the traceability of interpretive decisions.

No personal data was processed. All comments were public, anonymized, and analysed under ethical guidelines for non-intrusive digital research (Townsend, Wallace, 2016), while adhering to each platform's terms of service.

5. Results of the Analysis

This section presents the key findings from the thematic and sentiment analysis of user-generated content related to the Żappka mobile application. The analysis was conducted in two stages: first, a content and sentiment analysis of app store reviews (Google Play and App Store), and second, an evaluation of user feedback posted on Żabka’s social media platforms, including Facebook, Instagram, and TikTok. Each phase of the analysis revealed dominant themes related to user engagement, perceived value, and the outcomes of gamification.

5.1. Content and Sentiment Analysis of App Store Reviews (Google Play & App Store)

The dataset comprised public reviews from the Google Play and App Store platforms posted between January 2023 and June 2025. Although 400 user reviews were initially selected – 200 from each platform using simple random sampling – only 260 were retained for final analysis after filtering out duplicates, blank entries, and comments unrelated to gamification, UX/UI, or loyalty features. This selection ensured relevance and analytical focus while maintaining a balanced platform.

The retained comments were organized in .csv format and served as input for a two-stage analysis. Thematic coding was conducted using TAGuette, an open-source tool for qualitative data annotation. Sentiment classification was performed using MonkeyLearn, a machine learning platform trained to identify polarity (positive, neutral, negative) in short textual content.

Previous studies show that app store reviews are valuable for assessing UX quality and identifying user needs (Pagano, Maalej, 2013; Martin et al., 2017). The thematic focus of this study included app performance, UX/UI quality, loyalty rewards, and gamification features.

Table 2.

Summary of Żappka App User Reviews (January 2023–June 2025)

Thematic Category	Number of Comments	Sentiment (Positive / Neutral / Negative)	Example Quotes (Source)
App Performance Stability	84	22 / 10 / 52	“App freezes constantly.” (Google Play); “Can’t log in for a week.” (App Store)
UX/UI and Feature Access	63	38 / 12 / 13	“After update, it’s more intuitive.” (Google Play); “Layout improved!” (App Store)
Coupons and Discounts	71	50 / 13 / 8	“Love the discounts – save a lot!” (App Store); “Great personalized offers.” (Google Play)
Gamification and Missions	42	36 / 3 / 3	“Missions motivate shopping – great idea.” (Google Play)

Note: only comments relevant to key thematic categories were included in the table.

Source: own elaboration based on Google Play (n.d.); App Store (n.d.).

Analysis of the comments concerning gamification and engagement revealed that many users perceived the Żappka Missions as motivating and enjoyable. Statements such as “Thanks to the missions, I check Żappka more often and try new products” and “Collecting Żappsy is

now a fun daily habit” indicated that gamified tasks encouraged frequent interaction with the app and enhanced the overall brand experience. These findings align with Self-Determination Theory (Deci, Ryan, 2013), particularly the dimension of competence, as missions enable users to complete achievable tasks and receive meaningful feedback, thereby fostering a sense of mastery.

In contrast, some users expressed dissatisfaction with the reward system, particularly when technical failures disrupted the expected benefits. Complaints such as “Scam! Points didn’t register – lost my coupon” or “After the update, all my points disappeared” reflected a loss of trust, especially when the system failed to deliver on promised incentives. These instances highlight the fragile balance between motivation and frustration, underscoring the importance of stable and transparent point redemption mechanisms. From an SDT perspective, the violation of autonomy (lack of control) and competence (inability to achieve rewards) may lead to disengagement.

Regarding UX and interface design, the majority of user feedback was positive, particularly following updates that enhanced layout and navigation. Users appreciated the app’s visual clarity, calling it “clean and modern” and noting that Zappka is “one of the few apps I enjoy using”. However, specific comments reflected frustration with forced updates or delayed loading times at checkout, which interrupted the shopping experience.

Sentiment toward customer support was mixed. Some users noted responsive service and quick bug resolution (“After reporting a bug, the app was updated within days”). In contrast, others criticized the lack of reply or inefficient handling of point-related issues (“Wrote via the form, but no reply – how do I recover points?”). These mixed sentiments suggest that consistency in service delivery remains a key determinant of overall satisfaction. A lack of supportive interaction may threaten users’ sense of relatedness, another core SDT component.

The findings confirm the potential of gamified elements in driving engagement, but also emphasize the need for clarity, reliability, and a seamless user experience. Misunderstandings regarding mission rules and reward mechanics – evident in statements such as “The mission system is confusing, I don’t understand how points are earned” – suggest a need for better onboarding or in-app explanations.

As shown in Table 2, the most negative feedback (over 60%) pertained to app stability and technical issues. The highest share of positive feedback (70%) related to coupons and discounts, reflecting intense satisfaction with loyalty functions. UX and gamification features also received favorable reviews, particularly for their clarity and motivational impact. The results serve as a foundation for comparing perceptions gathered through social media platforms in the next phase of the analysis.

These findings provide a foundation for the next phase of analysis, which involves user feedback from social media platforms (Facebook, Instagram, TikTok), enabling a cross-channel sentiment comparison.

5.2. Content and Sentiment Analysis of Facebook Feedback

The analysis was conducted based on classic content analysis methodology (Krippendorff, 2018) and digital user research practices (Li et al., 2022; Naeem, Okafor, 2019). User comments from the official Żabka Polska Facebook profile (Żabka Polska, n.d.-a) were analyzed using open coding, sentiment tagging, and interpretation of reaction types. Data was drawn from public posts and their comment threads published between January 2023 and June 2025. From an initial corpus of 50 posts containing over 900 user comments, approximately 200 were identified as referring to the Żappka mobile application. Of these, 177 comments were retained for in-depth coding and analysis. Entries that were off-topic, duplicates, or provided no evaluative content were excluded to maintain analytical consistency.

Open coding and sentiment categorization (positive, neutral, negative) were applied to the retained comments. In addition, Facebook reaction types – such as "like", "heart", "angry face", "sad face", and "wow face" – were used as supplementary indicators of sentiment, particularly in brief or ambiguous posts.

Many users expressed strong enthusiasm toward promotions and missions such as Żappsy, special challenges, or surprise rewards. For example, celebratory reactions followed in-app campaign announcements: one user shared, “Today I got a free hot dog with a coupon :D”, which received over 100 heart reactions and several dozen likes. Others praised recurring events, writing, “It’s worth checking daily – there are always new missions”, or appreciated seasonal gamified experiences, such as “Fun pumpkin challenge – more events like this, please!” which drew numerous affirmative reactions. Surprise bonuses were also positively received, with comments such as, “I like that there are surprise bonuses – yesterday I got 500 Żappsy!”

Neutral and informative comments were also common, with users sharing discoveries or seeking clarification. For instance, some users wrote, “Didn’t know I could transfer points – thanks for the info!” or asked, “How can I recover points that weren’t credited?” These posts reflected both curiosity and knowledge exchange among users.

In contrast, negative sentiments often centered around technical difficulties, reward loss, and dissatisfaction with customer support. Users described problems such as: “After the update, the app won’t launch – how am I supposed to use the coupons?” which received multiple sad and angry face reactions. Others criticized the reward system: “My points disappeared after a purchase – Żappka scammed me”. Complaints about ineffective support were also frequent: “Why ask us to use the form if no one replies?” These expressions reflected mounting frustration when communication remained unaddressed.

In some cases, Żappka Support replied publicly to resolve issues. For example, in response to scanning problems, the brand commented: “We’re sorry to hear that. Please get in touch with us via the in-app form – we’ll investigate”. When a user’s account was blocked after activating a promotion, Żappka responded: “Please message us privately with more details – we’ll try to

help quickly”. While such messages demonstrated an effort to address concerns, several users criticized the frequent use of identical replies, questioning their sincerity: “Why do you copy-paste the same reply every time, when the problem keeps happening?”

Table 3.

Distribution of Sentiment and Reaction Types in Facebook Comments

Thematic Category	Number of Comments	Sentiment (Positive / Neutral / Negative)	Most Common Facebook Reactions
Positive coupon experiences	48	44 / 2 / 2	Heart, Like
Technical issues and updates	42	5 / 3 / 34	Sad face, Angry face
Point transfer feature	27	19 / 2 / 6	Heart, Wow face, Angry face
Criticism of support/messaging	34	4 / 6 / 24	Angry face, Sad face
Special campaign appreciation	26	23 / 1 / 2	Heart, Wow face, Like

Source: own elaboration based on Żabka Polska (n.d.-a).

As shown in Table 3, sentiment distribution on Facebook revealed divergent user experiences depending on the topic. The most positive responses were associated with coupon-related posts, which elicited gratitude and engagement. These comments typically received high volumes of heart and like reactions.

In contrast, discussions around technical malfunctions and customer service elicited predominantly negative sentiment, with angry and sad face reactions prevailing. These patterns reflect the emotional weight of functionality breakdowns, particularly when they disrupt point redemption or access to coupons.

Comments concerning the point transfer feature were mostly favorable but included instances of confusion or dissatisfaction, as evidenced by mixed reactions (e.g., heart and wow faces alongside angry faces). Posts criticizing customer support and communication practices were met with emotional disappointment and skepticism, highlighting an area for potential improvement.

Content related to special campaigns (e.g., seasonal missions, bonus events) consistently elicited positive reactions, reinforcing the role of gamified promotions in driving emotional engagement. The wide range of responses demonstrates how Facebook functions as both a feedback channel and a barometer of collective sentiment, enabling brands to monitor user emotions in real-time.

Overall, the Facebook discourse revealed a dynamic spectrum of sentiment, from enthusiasm to frustration. Users not only shared feedback but also interacted with one another, making this platform a meaningful source of community insight. While public replies from the Żabka team supported brand presence, overreliance on templated messages was viewed critically.

These findings can be interpreted through the lens of Self-Determination Theory (Deci, Ryan, 2013), particularly in terms of the psychological needs of competence, autonomy, and relatedness. Gamified content, such as missions and challenges, addressed users' need for competence through achievable goals. Comments praising point transfers and surprise bonuses indicated satisfaction with autonomy and perceived control over their work. Conversely, unresolved technical or support issues were seen as threats to relatedness, as users sought more authentic and reciprocal engagement from the brand.

5.3. Content and Sentiment Analysis of Instagram Feedback

User comment analysis from the official @zabkapolska Instagram profile (Żabka Polska, n.d.-b) was conducted analogously to the Facebook analysis, drawing on data published between January 2023 and June 2025. A total of over 30 posts were reviewed, yielding more than 600 user comments related to the Żappka mobile application, including its features, interface updates, and brand interactions.

From this initial dataset, 204 comments were retained for in-depth analysis. Entries were excluded based on redundancy, irrelevance, or lack of substantive reference to app-related functions or experiences. The selected comments were imported into a spreadsheet and analyzed using open coding and manual sentiment tagging (positive, neutral, or negative).

Unlike Facebook, Instagram does not support direct reaction types per comment. Therefore, the number of likes each comment received was used as a proxy indicator of community resonance and perceived relevance.

The analysis revealed four dominant thematic areas in the Instagram discourse. First, many users reacted positively to the redesign of the app, emphasizing improved layout clarity and ease of navigation. Statements like “The new layout looks cleaner, and it is much easier to find promotions now” (20 likes) suggest that interface improvements contributed to enhanced usability and satisfaction. These comments reflect the SDT principle of competence, as users felt more confident in exploring app features.

A second theme centered around Q&A interactions in Instagram Stories, through which users discovered new functionalities, most notably, the point transfer option. Feedback such as “Thanks for the help! I didn't know I could transfer points” (15 likes) highlighted the informational value of interactive brand communication and its role in reinforcing users' sense of autonomy.

While less frequent, critical comments addressed technical errors or issues with customer support. For example, complaints like “I'm having trouble with coupons after the update” (5 likes) reflected frustration with app instability. Although these comments were in the minority, they underscore the importance of reliability in preserving user trust.

Finally, many users expressed enthusiasm for new in-app services, such as integration with Dietly, praising time-saving benefits and functional expansion. Statements like “Diets in the app? Awesome – saving time and money” (17 likes) point to the perceived practical value of

these additions. Such reactions are consistent with extrinsic motivation under SDT, where external rewards (e.g., convenience, financial savings) promote continued engagement.

Table 4.

Summary of Instagram Comment Categories and Sentiment

Thematic Category	Number of Comments	Avg. Likes	Sentiment (Positive / Neutral / Negative)	Sample Comment
App Redesign	65	15	55 / 5 / 5	"The new layout looks cleaner, and I can browse deals faster."
Q&A-related Comments	40	12	34 / 4 / 2	"Thanks for the help! Didn't know I could transfer points."
Criticism of App Performance	48	7	6 / 4 / 38	"I'm having issues with coupons after the update."
Reception of New Features	51	14	46 / 3 / 2	"Daily in the app? Awesome – saving time and money."

Source: own elaboration based on Żabka Polska (n.d.-b).

As shown in Table 4, the Instagram feedback reflected predominantly positive sentiment across most thematic areas. The redesign of the app received particularly favorable feedback, with 85% of related comments expressing approval. These reactions emphasized visual clarity and improved navigation, supporting the idea that thoughtful interface updates contribute to perceived ease of use.

Comments related to story-based Q&A content also revealed strong engagement. Users appreciated the direct and helpful tone of communication and often expressed gratitude for discovering previously overlooked app features.

In contrast, negative feedback, though less frequent, focused on technical instability and limited responsiveness from support. These comments tended to receive lower average engagement, suggesting that critical voices, while present, were not broadly amplified by the community.

Comment-level engagement metrics (e.g., like counts) offered valuable supplementary insight into the resonance and visibility of user sentiment. The analysis confirms that Instagram serves as both a promotional and support-oriented platform. It shows that visual communication, responsiveness, and feature education play an essential role in maintaining positive perceptions of the Żabka app.

Applying Self-Determination Theory (SDT) to this dataset helps clarify the motivational dynamics at play. Competence was supported through improved usability and clarity. Interactive Q&A exchanges and precise control over app functions reinforced autonomy. Extrinsic motivation was evident in comments that valued functional rewards, such as time savings or added convenience, underscoring the multidimensional nature of app engagement on Instagram.

In summary, the findings from the Instagram analysis confirm that this platform serves not only as a marketing channel but also as a valuable source of feedback. While the format limits reaction types compared to Facebook or TikTok, likes remain a meaningful proxy for

community endorsement. Instagram thus continues to offer helpful insight into user experience, emotional tone, and brand interaction surrounding the Żappka app.

5.4. Content and Sentiment Analysis of TikTok Feedback

An analysis of posts published on the official @zabkapolska TikTok profile (Żabka Polska, n.d.-c) covered the 30 most popular videos uploaded between January 2023 and June 2025. The dataset included a range of content types, including technical tutorials, interface announcements, promotional campaigns, and brand communications related to Żappka app features.

Although over 800 user comments were initially retrieved, 772 were retained for final analysis after excluding duplicates, spam, or off-topic replies. Each comment was imported into a spreadsheet, thematically coded, and categorized by sentiment (positive, neutral, negative). As TikTok does not support reaction types under comments, the number of likes per comment was used as a proxy indicator of engagement and resonance.

Technical tutorial videos – such as “Troubleshooting the Żappka App” – generated particularly high engagement, with 199 comments that showed a predominantly positive tone. Users appreciated the clarity and practical value of these tutorials. Comments like “Worked after reinstalling – thanks!” and “Really helpful tutorial” received significant support (53 and 41 likes, respectively). These reactions suggest that educational content enhances brand credibility and user trust, reinforcing the SDT concept of competence by helping users feel effective in managing app issues.

Similarly, videos introducing the app redesign prompted both praise and constructive critique. While many users applauded the improved visuals – e.g., “Looks clean and stylish” or “It’s more professional now” – others noted issues, such as “The icons are too small” or “Finding coupons is harder”. These mixed responses illustrate that interface changes, although positively intended, may enhance or hinder users’ sense of autonomy, depending on usability and accessibility.

TikToks featuring merchandise or new service rollouts (e.g., integration with Jush or Dietly) were also well received. Reactions such as “Cool hoodie – I’m in!” or “Dietly in the app? Awesome – saving time and money” demonstrate that utility-based innovations can enhance brand loyalty, particularly when tied to tangible benefits. Such comments reflect extrinsic motivation within the SDT framework, where functional value encourages ongoing engagement.

A unique aspect of TikTok discourse was the platform’s real-time interaction model. Żappka’s strategy of responding to user comments – either directly in threads or through dedicated Q&A videos – was often praised. For example, “They read and respond to comments – props to the social media team!” illustrates how reciprocal communication fosters a sense of connection. These moments fulfill users’ need for relatedness, the third core SDT dimension, by making them feel seen, heard, and acknowledged.

Table 5.*Summary of TikTok Comment Categories and Sentiment*

Thematic Category	Number of Comments	Avg. Likes	Sentiment (Positive / Neutral / Negative)	Sample Comment
Technical Tutorials	199	34	155 / 30 / 14	“Worked after reinstalling – thanks!”
App Redesign	276	31	180 / 60 / 36	“Menu is fine, but the icons are too small.”
Merch and Promotions	41	26	30 / 6 / 5	“Diets in the app? Awesome – saving time.”
Interactivity & Feedback	256	38	180 / 50 / 26	“They actually read and respond to comments!”

Source: own elaboration based on Żabka Polska (n.d.-c).

As shown in Table 5, TikTok feedback was largely positive, especially for educational content and brand interaction. Tutorials were the most highly endorsed category, confirming the platform’s potential for value-driven engagement.

While the app redesign drew positive attention for aesthetics, some usability concerns reveal the importance of continuous UX iteration. Negative sentiment was modest overall but focused on technical or navigation barriers.

TikTok’s short-form, interactive format also enabled brand responsiveness. User appreciation for two-way communication suggests that platform authenticity and responsiveness are potent tools for fostering emotional connection and loyalty.

Overall, TikTok emerged as a key medium in Żappka’s multichannel strategy—not only as a marketing space but also as a real-time feedback loop. The lack of comment-level reactions was effectively offset by using like counts to assess public response.

When viewed through the lens of Self-Determination Theory (SDT), the platform’s success lies in its support of all three motivational pillars: competence (via problem-solving content), autonomy (through interface personalization), and relatedness (via dialogue and user acknowledgment). TikTok thus functions as both a community space and a barometer of digital brand perception.

5.5. Summary of Key Findings

Across the five content sources – Google Play, App Store, Facebook, Instagram, and TikTok – user-generated feedback revealed consistent patterns in perceived value and engagement with Żappka’s gamified features. Positive sentiment was strongly associated with ease of navigation, rewarding loyalty mechanisms (such as coupons, Żappsy, and missions), and engaging challenges, reflecting the fulfilment of competence and autonomy as proposed by Self-Determination Theory (SDT). These expressions appeared across all platforms, underscoring the effectiveness of gamification in fostering user satisfaction and habitual app usage.

Conversely, negative sentiment was concentrated around technical instabilities, failed point registrations, and perceived inefficiencies in customer support. These issues not only disrupted the intended reward experience but also undermined trust and user–brand connection, thereby threatening the relatedness dimension of SDT. Comments expressing frustration over app crashes, log-in problems, or unresolved complaints were particularly prominent in app store reviews and Facebook threads.

Social media content reinforced and extended these findings. On Facebook and Instagram, users actively engaged in clarification exchanges and peer-to-peer advice, using comments and reactions to express sentiment and flag recurring issues. On TikTok, positive engagement clustered around tutorial content, new feature rollouts, and brand responsiveness via Q&A replies, illustrating how short-form, humanized content deepened emotional connection and strengthened brand perception.

The combination of app store and social media data validated the multi-platform approach as a robust strategy for capturing diversified user perspectives. While app store reviews provided focused functional feedback, social media comments enriched the analysis by reflecting emotional tone, brand trust, and real-time engagement dynamics. This convergence of findings offers actionable insights for app design, loyalty program development, and customer communication strategies.

The analysis of user-generated feedback collected from 1900 entries (later narrowed down to 1413 relevant comments) revealed several critical insights regarding user perceptions of gamified loyalty features. Gamified missions, point accumulation, and personalized rewards were consistently linked to high emotional engagement and positive sentiment across platforms. Conversely, technical instability, coupon-related errors, and inconsistent customer support emerged as dominant drivers of dissatisfaction, particularly in app store reviews and Facebook discussions.

The redesigned interface was generally well-received, particularly on visually oriented platforms like Instagram and TikTok. TikTok also stood out as a key channel for community interaction, with users responding favourably to Q&A formats and brand replies in comment sections. These patterns confirm that user engagement extends beyond app use and into platform-mediated dialogue, where emotional and social dynamics shape the brand experience.

From a theoretical perspective, the findings reinforce and extend Self-Determination Theory (SDT). Gamified features such as missions and visual progress cues supported users' needs for competence (e.g., completing challenges), autonomy (e.g., choosing rewards), and relatedness (e.g., social acknowledgment via comments or reactions) (Ryan, Deci, 2000; Sailer et al., 2017). Furthermore, the study contributes to research on user-generated content (UGC) by illustrating how users not only evaluate brand experiences but actively co-create them through digital discourse (Li et al., 2022; Naeem, Okafor, 2019).

From a practical standpoint, the results confirm that gamification, when intuitively integrated and effectively communicated, can serve as a strategic tool for building emotional loyalty. Features such as Zappsy, missions, and loyalty challenges were frequently mentioned in positive reviews, often described as fun, motivating, or rewarding. However, the findings also stress that gamification cannot compensate for core functional shortcomings. Negative feedback about login errors, point loss, or lack of customer response suggests that the motivational potential of gamification depends on trust and stability in app infrastructure (Hamari et al., 2014; Pagano, Maalej, 2013).

User feedback additionally functioned as a critical input for iterative app development. Reviews and comments provided concrete suggestions, identified pain points, and helped prioritize improvements to app usability, performance, and clarity. This underscores the need for brands to actively monitor and respond to UGC, not merely for reputation management, but as a form of agile, user-informed design (Martin et al., 2017).

In the broader context of digital experience design, the study supports the view of gamification as a strategic design philosophy (Deterding et al., 2011; Huotari, Hamari, 2017). Rather than serving as surface-level incentives, gamified mechanisms can enrich brand ecosystems by embedding narrative, reward feedback, and personalization into everyday interactions. Applications like Zappka demonstrate that gamification can enhance perceived credibility, increase retention, and contribute to the co-creation of long-term value.

Socially, gamification also enhances brand humanization and emotional presence, particularly on platforms like TikTok and Instagram, where humour, responsiveness, and co-creation are expected. Participating in user narratives, acknowledging feedback, and reacting with authenticity fosters deeper engagement and relational loyalty beyond transactional interactions.

Finally, while this study is grounded in a national retail context, its findings have broader applicability. Gamification models adapted to user motivation profiles can be effectively implemented in adjacent service industries, such as hospitality, education, fitness, and banking (Koivisto, Hamari, 2019; Xu et al., 2015), provided they align with the behavioural dynamics and platform expectations within those sectors.

6. Discussion and Implications

The analysis of 1900 user-generated entries across five digital platforms revealed several critical insights. Gamified missions and personalized rewards were consistently associated with high emotional engagement and positive user sentiment. Conversely, issues such as app instability, coupon errors, and inadequate customer support were frequently cited in negative comments, particularly in app store and Facebook feedback. The interface redesign received

generally favorable responses, particularly on visually driven platforms like Instagram and TikTok. Additionally, content on TikTok highlighted user appreciation for interactive formats, including Q&A sessions and comment responses.

This study highlights the multidimensional impact of gamification in loyalty applications, particularly its role in shaping user engagement, satisfaction, and brand perception. From a theoretical perspective, the findings reinforce and extend established frameworks such as Self-Determination Theory, where elements like missions and badges respond to users' intrinsic motivations for competence, autonomy, and relatedness (Ryan, Deci, 2000; Sailer et al., 2017). Moreover, this research contributes to the field of user-generated content by showcasing how users not only react to brand experiences but actively co-create them through discourse on digital platforms (Li et al., 2022; Naeem, Okafor, 2019).

Practically, the study confirms that gamification, when integrated and communicated in a meaningful way, can serve as an effective strategy for enhancing customer relationships. Gamified features such as missions, reward points, and visual progress cues were often mentioned in positive contexts and appeared to strengthen emotional engagement with the app (Hamari et al., 2014; Werbach, Hunter, 2012). This suggests that such mechanisms, particularly when combined with transparent communication and responsive customer support, establish a cycle of motivation and trust that fosters loyalty over time.

The analysis also reveals that user feedback plays a crucial role in the iterative improvement of digital applications. Comments highlighting both appreciation and frustration guide developers toward refining interface design, clarifying features, and addressing technical flaws. This responsiveness enhances the brand's credibility and fosters deeper user trust (Pagano, Maalej, 2013; Martin et al., 2017).

In the broader context of digital marketing, gamification has emerged not merely as an engagement tool but as a strategic design philosophy integrated into value creation. It enhances digital touchpoints with narrative, feedback, and reward mechanisms that turn mundane interactions into meaningful experiences (Deterding et al., 2011; Huotari, Hamari, 2017). This study demonstrates that gamified applications, such as Żappka, not only maintain user attention but can also influence perceived brand credibility and customer lifetime value. As consumers increasingly expect interactivity and personalization, gamification becomes a central component of modern customer experience strategies across digital ecosystems.

Socially, the ability of gamification to foster community interaction, primarily through humorous, relatable, and responsive content on platforms like TikTok and Instagram, underscores its power not only as a design element but as a communication strategy. By participating in user narratives and acknowledging feedback, brands like Żappka can humanize their digital presence and cultivate ongoing engagement.

These insights are further contextualized in the following section, which outlines the study's methodological limitations and directions for future research.

7. Limitations and Future Research Directions

Despite its contributions, this study is subject to several limitations. First, the dataset focuses on a single Polish loyalty app, which may limit the generalizability of the findings across cultures or sectors. Second, the content analyzed was publicly available and may not reflect the views of all user segments. Third, while sentiment analysis was manually validated, the use of machine-assisted tools still carries the risk of contextual misinterpretation, particularly in cases involving sarcasm, regional idioms, or implicit meaning.

Additionally, there are methodological constraints related to platform-specific biases. For instance, visibility algorithms on TikTok or Instagram may disproportionately amplify certain types of content, affecting the representativeness of retrieved comments. The reliance on engagement metrics (likes, emoji reactions) as sentiment indicators, while informative, may also overlook more nuanced interpretations. For example, a comment receiving many likes might reflect agreement with the topic discussed in the post rather than the sentiment of the comment itself. Similarly, emoji-based reactions (e.g., “like”, “heart”, “angry”) carry varying meanings across users and contexts, limiting interpretive precision.

There is also the challenge of representativeness in qualitative sampling. Although efforts were made to balance the data between platforms (e.g., equal samples from Google Play and the App Store), the total number of app reviews differed significantly (approximately 188,000 on Google Play vs. 64,000 on the App Store), potentially introducing overrepresentation or underrepresentation of specific experiences. While proportional sampling was intentionally adjusted for symmetry, future studies may consider applying stratified or weighted sampling strategies to reflect population-level distributions more accurately.

Future research could expand this inquiry by incorporating user demographics or behavioral data to explore differentiated responses to gamified features. Comparative studies across national markets or loyalty programs in other industries (e.g., hospitality, education, public services) could help identify transferable principles and cultural specificities. Longitudinal research would further support understanding of how sentiment and engagement evolve, particularly in response to changes in app features or reward structures. Finally, mixed-method approaches that combine qualitative analysis with quantitative metrics (e.g., retention rates, purchase frequency, mission completion) would enable more robust conclusions about the effectiveness of gamification in driving loyalty and value co-creation.

8. Summary

This study explored user perceptions of gamified features in the Żappka mobile application, a prominent example of loyalty-based digital innovation in Central Europe. Drawing from 1,496 user-generated comments posted between January 2023 and June 2025 across five platforms – Google Play, App Store, Facebook, Instagram, and TikTok – it applied qualitative content analysis and sentiment tagging to uncover behavioral and emotional responses.

Findings confirmed that gamified elements, such as missions, points, badges, and visual progress indicators, play a central role in shaping the user experience. Positive feedback consistently emphasized the ease of use, motivational value of challenges, and satisfaction with loyalty rewards – these patterns aligned with Self-Determination Theory, particularly in terms of the satisfaction of competence and autonomy. Negative sentiment was predominantly linked to technical errors and inconsistent customer service, indicating barriers to user trust and relatedness.

By analyzing discourse across app stores and social media, the study showed how digital platforms function not only as feedback channels but also as spaces for co-creating brand narratives. Comments revealed both enthusiasm and frustration, offering actionable insights for iterative app development and customer communication strategies. TikTok, for instance, has proven especially effective in fostering emotional connections through relatable content and responsive engagement.

The research contributes to gamification literature by demonstrating how user discourse in public, unmoderated digital environments reflects real-world evaluations of engagement design. It also supports the strategic relevance of combining gamification with responsive communication to enhance loyalty and long-term value creation.

Overall, the findings validate the role of gamification as a multidimensional engagement tool that integrates psychological, emotional, and social dynamics. As digital touchpoints continue to evolve, such mechanisms may offer scalable models for enhancing customer experience across sectors, provided they remain transparent, user-centered, and responsive to feedback.

References

1. Android.com.pl (2024). *Żabka prezentuje odświeżoną aplikację mobilną. Żappka pełna ofert i korzyści*. Retrieved from: https://android.com.pl/aplikacje/519357-aplikacja-zabka-funkcje-promocje/?utm_source=chatgpt.com, 20.03.2025.
2. App Store (n.d.). *Żappka – zakupy, promocje, Żabka*. Retrieved from: <https://apps.apple.com/pl/app/%C5%BCappka-zakupy-promocje-%C5%BCabka/id1444267322?l=pl>, 26.06.2025.
3. Bittner, J.V., Shipper, J. (2014). Motivational effects and age differences of gamification in product advertising. *Journal of consumer marketing*, 31(5), 391-400. <https://doi.org/10.1108/JCM-04-2014-0945>.
4. Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>.
5. Deci, E.L., Ryan, R.M. (2013). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media (Original work published 1985).
6. Deterding, S., Dixon, D., Khaled, R., Nacke, L. (2011, September). *From game design elements to gamefulness: defining gamification*. Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments, pp. 9-15. <https://doi.org/10.1145/2181037.2181040>.
7. Gazeta Ubezpieczeniowa (2025). *Ubezpieczenia turystyczne od KioskPolis.pl w aplikacji Żabki*. Retrieved from: <https://gu.com.pl/ubezpieczenia-turystyczne-od-kioskpolis-pl-w-aplikacji-zabki/>, 16.03.2025.
8. Google Play (n.d.). *żappka: zakupy, promocje Żabka*. Retrieved from: <https://play.google.com/store/apps/details?hl=pl&id=pl.zabka.apb2c>, 28.06.2025.
9. Hamari, J., Koivisto, J. (2015). Why do people use gamification services? *International Journal of Information Management*, 35(4), 419-431. <https://doi.org/10.1016/j.ijinfomgt.2015.04.006>.
10. Hamari, J., Koivisto, J., Sarsa, H. (2014). *Does gamification work? – A literature review of empirical studies on gamification*. 47th Hawaii International Conference on System Sciences, 3025-3034. <https://doi.org/10.1109/HICSS.2014.377>.
11. Högberg, J., Hamari, J., Wästlund, E. (2019). Gameful Experience Questionnaire (GAMEFULQUEST): An instrument for measuring the perceived playfulness of gamification. *User Modeling and User-Adapted Interaction*, 29(3), 619-660. <https://doi.org/10.1007/s11257-019-09223-w>.
12. Huotari, K., Hamari, J. (2017). A definition for gamification: anchoring gamification in the service marketing literature. *Electronic markets*, 27(1), 21-31. <https://doi.org/10.1007/s12525-015-0212-z>.

13. Hwang, J., Choi, L. (2020). Having fun while receiving rewards?: Exploration of gamification in loyalty programs for consumer loyalty. *Journal of business research*, 106, 365-376. <https://doi.org/10.1016/j.jbusres.2019.01.031>.
14. ITReseller (2022). *Nagrody SAP Innovation Awards 2022 rozdane. Firma SAP podczas SAP NOW – Droga do sukcesu przyznała aż osiem nagród liderom transformacji cyfrowej w Polsce*. Retrieved from: <https://itreseller.pl/nagrody-sap-innovation-awards-2022-rozdane-firma-sap-podczas-sap-now-droga-do-sukcesu-przyznala-az-osiem-nagrod-liderom-transformacji-cyfrowej-w-polsce/>, July 2025.
15. Koivisto, J., Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, 45, 191-210. <https://doi.org/10.1016/j.ijinfomgt.2018.10.013>
16. Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). Sage Publications.
17. Li, S., Liu, F., Zhang, Y., Zhu, B., Zhu, H., Yu, Z. (2022). Text mining of user-generated content (UGC) for business applications in e-commerce: A systematic review. *Mathematics*, 10(19), 3554. <https://doi.org/10.3390/math10193554>.
18. Lincoln, Y.S., Guba, E.G. (1985). *Naturalistic inquiry*. Sage Publications.
19. Martin, W., Sarro, F., Jia, Y., Zhang, Y., Harman, M. (2017). A survey of app store analysis for software engineering. *IEEE Transactions on Software Engineering*, 43(9), 817-847. <https://doi.org/10.1109/TSE.2016.2630689>.
20. Mekler, E.D., Brühlmann, F., Tuch, A.N., Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, 71, 525-534. <https://doi.org/10.1016/j.chb.2015.08.048>.
21. Morgan, R.M., Hunt, S.D. (1994). The commitment-trust theory of relationship marketing. *Journal of Marketing*, 58(3), 20-38. <https://doi.org/10.1177/002224299405800302>.
22. Naeem, M., Okafor, S. (2019). User-generated content and consumer brand engagement. In: G. Bowen, W. Ozuem (Eds.), *Leveraging computer-mediated marketing environments* (pp. 193-220). IGI Global. <https://doi.org/10.4018/978-1-5225-7344-9.ch009>.
23. Nano.Żabka.pl (2025). *Żabka Nano – sklep bezobsługowy*. Retrieved from: <https://nano.zabka.pl>, 25.05.2025.
24. Pagano, D., Maalej, W. (2013, July). *User feedback in the Appstore: An empirical study*. 21st IEEE international requirements engineering conference (RE), pp. 125-134. <https://doi.org/10.1109/RE.2013.6636712>.
25. Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N., Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), 533-544. <https://doi.org/10.1007/s10488-013-0528-y>

26. Paschmann, J.W., Bruno, H.A., van Heerde, H.J., Völckner, F., Klein, K. (2025). Driving Mobile App User Engagement Through Gamification. *Journal of Marketing Research*, 62(2), 249-273. <https://doi.org/10.1177/00222437241275927>
27. Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods* (3rd ed.). Sage Publications.
28. Ramdhani, N., Hussein, A.S. (2024). The Impact of Gamification on Loyalty, Mediated by Consumer Engagement and Brand Awareness. *International Journal of Research in Business & Social Science*, 13(5), 96-107. <https://doi.org/10.20525/ijrbs.v13i5.3495>.
29. Ryan, R.M., Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, 55(1), 68-78. <https://psycnet.apa.org/doi/10.1037/0003-066X.55.1.68>.
30. Sailer, M., Hense, J., Mayr, S.K., Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, 69, 371-380. <https://doi.org/10.1016/j.chb.2016.12.033>.
31. Tabletowo.pl (2024). *Żabka wyłączy historię Żappsów i Żappka Post*. Retrieved from: <https://www.tabletowo.pl/zabka-nowy-regulamin-koniec-zappka-pay/>, 25.05.2025.
32. Tondello, G.F., Wehbe, R.R., Diamond, L., Busch, M., Marczewski, A., Nacke, L.E. (2016, October). The gamification user types hexad scale. *Proceedings of the 2016 annual symposium on computer-human interaction in play*, pp. 229-243. <https://doi.org/10.1145/2967934.2968082>.
33. Townsend, L., Wallace, C. (2016). *Social media research: A guide to ethics*. University of Aberdeen. Retrieved from: https://www.gla.ac.uk/media/Media_487729_smxx.pdf, 20.05.2025.
34. Werbach, K., Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.
35. Wiadomości Handlowe (2024). *Żabka udostępnia nową wersję aplikacji Żappka. Wśród nowości: integracja z innymi biznesami grupy i... wymiana żappsów na monety Allegro*. Retrieved from: <https://www.wiadomoscihandlowe.pl/retailtech-i-nowe-technologie/zabka-udostepnia-nowa-wersje-aplikacji-zappka-wsrod-nowosci-integracja-z-innymi-biznesami-grupy-i-wymiana-zappsow-na-monety-allegro-2520712>, 20.05.2025.
36. Wirtualnemedi.pl (2022). *Nowa funkcjonalność: przelewanie Żappsów*. Retrieved from: <https://www.wirtualnemedi.pl/artykul/zabka-zappszy-aplikacja-zappka-punkty-transfer-jak-pobrac>, 20.05.2025.
37. Xu, C., Peak, D., Prybutok, V. (2015). A customer value, satisfaction, and loyalty perspective of mobile application recommendations. *Decision Support Systems*, 79, 171-183. <https://doi.org/10.1016/j.dss.2015.08.008>.
38. Yin, R.K. (2017). *Case study research and applications: Design and methods*. Sage Publications.

39. Żabka Group (2023). *Żabka with three awards in the competition Market of the Year 2023. Tomasz Blicharski named "The Visionary of Retail Business"*. Retrieved from: <https://zabkagroup.com/zabka-with-three-awards-in-the-competition-market-of-the-year-2023-tomasz-blicharski-named-the-visionary-of-retail-business/>, 20.05.2025.
40. Żabka Polska (2020). *Żappka Post – nowa usługa w aplikacji mobilnej Żabki pozwala śledzić zamówioną przesyłkę i ułatwia jej odbiór*. Retrieved from: <https://www.zabka.pl/zappka-post-nowa-usluga-w-aplikacji-mobilnej-zabki-pozwala-sledzic-zamowiona-przesylke-i-ulatwia-jej-odbior/>, 20.05.2025.
41. Żabka Polska (n.d.-a). *[Instagram profile]*. Instagram. <https://www.instagram.com/zabkapolska/>, 10.06.2025.
42. Żabka Polska (n.d.-b). *[Facebook profile]*. Facebook. https://www.facebook.com/zabkapolska/?locale=pl_PL, 15.06.2025.
43. Żabka Polska (n.d.-c). *[TikTok Profile]*. TikTok. <https://www.tiktok.com/@zabkapolska>, 28.06.2025.

PURPOSE IN LIFE AND BRAND ADVOCACY: A SEQUENTIAL MEDIATION APPROACH

Magdalena BRZOWSKA-WOŚ

Gdańsk University of Technology; magwos@pg.edu.pl, ORCID: 0000-0002-8433-0685

Purpose: This paper investigates how a sense of purpose in life (PIL) shapes consumer–brand relationships, focusing on the mechanisms through which existential motivation influences emotional brand engagement (EBE), brand satisfaction (BS), and brand advocacy (AD). The study addresses a gap in the literature on value-driven consumer behaviour by examining a sequential mediation model.

Design/methodology/approach: A cross-sectional survey was conducted among 850 Polish consumers using validated psychometric scales. Structural equation modelling (SEM) with MIMIC specification was used to test a four-construct model comprising PIL, EBE, BS, and AD. Age, gender, and income were included as control variables. A bias-corrected bootstrap method was applied to test the hypothesised sequential mediation pathway.

Findings: All direct relationships were statistically significant and in the expected direction. Purpose in life positively influenced emotional brand engagement, which in turn predicted brand satisfaction and subsequent advocacy. The indirect path from PIL to AD through EBE and BS was also significant, while the direct path was not, confirming full sequential mediation. Age was a significant positive predictor of PIL; gender and income were not.

Research limitations/implications: The study's cross-sectional design limits causal inference. Future research should include longitudinal or experimental methods to validate directionality. Additionally, broader cultural contexts could enrich generalisability.

Practical implications: Brands that align with consumers' deeper life purpose can foster emotional attachment and behavioural advocacy. Marketing managers should consider the existential relevance of their campaigns when designing purpose-driven initiatives.

Social implications: Purpose-driven branding may contribute to consumer well-being by enabling individuals to express their identity and find meaning. Such approaches can support responsible and value-consistent consumption.

Originality/value: This study integrates psychological constructs of life purpose with branding theory, offering empirical evidence for a sequential mechanism linking existential motivation to advocacy. It extends the literature on meaningful consumption and consumer identity.

Keywords: Purpose in life; Brand engagement; Brand satisfaction; Brand advocacy; Sequential mediation.

Category of the paper: Research paper.

1. Introduction

In recent years, consumers have shown a growing tendency to engage with brands that align with their values, identities, and worldviews. This shift from transactional to value-driven consumption is reflected not only in brand preferences but also in affective and behavioural responses such as engagement, satisfaction, and advocacy (Ahuvia, 2005; Holt, 2002). Many individuals now seek brands that resonate with their life goals and deeper existential motivations, suggesting that psychological meaning plays a growing role in consumer–brand relationships (Gupta, Pansari, Kumar, 2024; Iniesta-Bonillo, Sánchez-Fernández, Jiménez-Castillo, 2025).

This trend is evident in the online retail sector, where certain brands position themselves around themes such as sustainability, well-being, or personal growth. Through mission statements, symbolic messaging, and emotionally charged storytelling, such brands aim to foster meaningful consumer engagement (Ko, Costello, Taylor, 2019; Escalas, Bettman, 2005). In contrast, many mainstream retailers emphasize functional value – affordability, speed, and convenience, which may not address consumers’ deeper psychological needs related to meaning and self-definition.

These contrasting strategies highlight a theoretical gap: what psychological mechanisms drive brand relationships grounded in purpose and meaning? While prior research has explored constructs such as brand personality, identity congruence, and trust (Hollebeek, Glynn, Brodie, 2014; Oliver, 1999), the role of existential motivation remains underexplored. One such motivator is purpose in life (PIL) – a key dimension of psychological well-being defined as the extent to which individuals perceive their lives as meaningful, intentional, and goal-directed (Ryff, 1989; Schulenberg, Schnetzer, Buchanan, 2011).

Although PIL has been widely studied with well-being, ethical action, and prosocial behaviour (Kasser, 2016; Schnell, Hoof, 2012), its relevance to consumer psychology and brand research remains limited. This study addresses that gap by examining how PIL shapes affective and behavioural outcomes in brand relationships. Specifically, it examines a sequential process in which PIL enhances emotional brand engagement (EBE), which in turn increases brand satisfaction (BS), ultimately leading to brand advocacy (AD).

The proposed conceptual model is theoretically grounded in Self-Determination Theory (Deci & Ryan, 2000), which emphasizes meaning and self-congruence as drivers of motivation, and the Stimulus–Organism–Response (SOR) framework (Mehrabian, Russell, 1974), which posits that internal states mediate the link between external stimuli and behavioural outcomes.

The model is tested using structural equation modelling (SEM), incorporating a sequential mediation path (PIL → EBE → BS → AD). To account for potential demographic influences on PIL, the analysis employs a MIMIC (Multiple Indicators Multiple Causes) specification,

which allows observed variables such as age, gender, and income to predict variation in the latent construct (Jöreskog, Goldberger, 1975; Kline, 2016; Brown, 2015).

This article contributes to branding literature by introducing existential motivation, specifically, purpose in life, as a meaningful antecedent of consumer–brand engagement. It offers a new conceptual pathway, integrates diverse theoretical perspectives, and highlights the psychological underpinnings of advocacy in value-driven consumption. It begins by outlining the theoretical background, introducing the key constructs and conceptual relationships that underpin the proposed model. The subsequent section presents the methodology used to examine these relationships, including the research design, data collection procedures, and statistical analysis techniques. The presentation of empirical results, including the validation of the measurement model and the testing of structural hypotheses, follows this. The discussion then interprets the findings in light of existing literature, highlighting theoretical contributions, managerial implications, and the broader relevance of purpose-driven branding. Finally, the article concludes by acknowledging limitations and suggesting directions for future research.

2. Theoretical Background

2.1. Overview of Theoretical Constructs and Model Logic

The conceptual foundation of this study draws upon two complementary theoretical frameworks—Self-Determination Theory (SDT) (Deci, Ryan, 2000) and the Stimulus–Organism–Response (SOR) model (Mehrabian, Russell, 1974), to explain how existential motivation informs consumer–brand relationships.

According to SDT, individuals are intrinsically motivated to seek autonomy, competence, and relatedness. The pursuit of purpose in life (PIL) is one manifestation of these needs, reflecting a psychological orientation toward meaning, coherence, and intentionality (Ryff, 1989; Schulenberg, Schnetzer, Buchanan, 2011). When people perceive their lives as purposeful, they are more likely to form authentic, emotionally meaningful connections with external entities – brands included – particularly those aligned with their values and identities (Ahuvia, 2005; Malär et al., 2011).

The SOR framework complements this view by providing a dynamic mechanism: external stimuli (S), such as value-congruent branding, elicit internal responses (O) – in this case, emotional engagement and satisfaction – which, in turn, drive behavioral outcomes (R), such as brand advocacy. In this context, PIL is conceptualized as an internalized psychological stimulus that activates emotional and evaluative states, ultimately shaping brand-related behaviour (Eroglu et al., 2001; Hollebeek et al., 2014).

The proposed model consists of four key constructs. Purpose in life (PIL) is defined as the extent to which individuals perceive their lives as meaningful and goal-directed (Ryff, 1989). It serves as a motivational driver that informs consumer preferences and value-based brand engagement. Emotional brand engagement (EBE) captures affective states such as enthusiasm, attachment, and absorption (Hollebeek et al., 2014). Brand satisfaction (BS) reflects the consumer's evaluative response to a brand's performance, both functionally, symbolically, and emotionally (Oliver, 1999). Brand advocacy (AD) refers to proactive behaviors such as recommending or defending the brand (Zeithaml et al., 1996; Kumar et al., 2010).

These constructs are integrated into a sequential mediation model: $PIL \rightarrow EBE \rightarrow BS \rightarrow AD$. This framework reflects a psychologically grounded, temporally plausible chain, where purpose-driven consumers first form emotional connections with brands, which then deepen satisfaction and lead to advocacy. This approach aligns with recent recommendations to use sequential mediation to reflect layered psychological processes (Hayes, 2018; Zhao, Lynch, Chen, 2010).

Moreover, prior research suggests that PIL may vary with demographic characteristics. Age is often positively associated with life purpose, possibly due to the accumulation of experiences and the integration of identity that occurs over the lifespan (Hill, Turiano, 2014). Gender differences have also been observed, with women and men deriving purpose from different life domains (Martela, Steger, 2016). Socioeconomic indicators, such as income and education, have similarly been linked to differences in psychological well-being and existential orientation (Ryff, 1989).

To account for these individual differences, this study employs a MIMIC (Multiple Indicators Multiple Causes) model within both the CFA and SEM frameworks. This allows for the inclusion of observed covariates (age, gender, and household income) as predictors of PIL. Integrating these variables enhances the validity and explanatory power of the model (Jöreskog, Goldberger, 1975; Kline, 2016), allowing for a more nuanced understanding of how purpose in life is shaped and how it functions within the branding context.

2.2. Purpose in Life and Emotional Brand Engagement

The search for purpose is a basic psychological drive that supports well-being and motivates behaviour aligned with personal meaning (Deci, Ryan, 2000; Ryff, 1989). Individuals who perceive their lives as purposeful often seek brands that resonate with their identity, values, and long-term goals (Ahuvia, 2005; Escalas, Bettman, 2005). Such alignment may foster a stronger emotional connection with brands.

Emotional brand engagement (EBE) refers to a consumer's affective involvement with a brand, typically expressed through enthusiasm, emotional attachment, and deep involvement (Hollebeek et al., 2014). This emotional bond is likely to be strengthened when consumers see the brand as symbolically or personally meaningful.

Recent studies support this logic. Pereira et al. (2024) demonstrated that value-based brand communication has a significant impact on emotional responses. Similarly, Acar et al. (2024) found that when consumers perceive a high degree of fit between their lifestyle and a brand's identity, emotional engagement increases.

Based on this evidence, the study proposes the following hypothesis:

H1: Purpose in life (PIL) positively influences emotional brand engagement (EBE).

2.3. Emotional Brand Engagement and Brand Satisfaction

Emotional brand engagement (EBE) plays a vital role in shaping consumers' evaluations of their brand experience. When individuals experience strong emotional ties to a brand, they tend to appraise their interactions with it more positively, even in the face of minor shortcomings or service inconsistencies (Hollebeek et al., 2014). This affective connection enhances trust, loyalty, and perceived value, all of which contribute to satisfaction.

Research has shown that emotional engagement can amplify both hedonic and symbolic benefits, thus deepening satisfaction. For example, Dessart et al. (2016) found that emotional engagement mediates the link between brand expression and customer experience outcomes. Likewise, Sparks and McCann (2023) reported that emotionally engaged consumers are more likely to perceive brand–self congruence as fulfilling, which in turn translates into greater satisfaction with the brand.

In essence, EBE enhances the emotional quality of the brand relationship, thereby strengthening post-purchase evaluations. This suggests the following hypothesis:

H2: Emotional brand engagement (EBE) positively influences brand satisfaction (BS).

2.4. Brand Satisfaction and Brand Advocacy

Brand advocacy refers to consumers' voluntary behaviours aimed at supporting, recommending, or defending a brand within their social circles (Zeithaml et al., 1996). Such behaviors often extend beyond repeat purchasing to include positive word-of-mouth, online reviews, or sharing brand-related content. Among the key antecedents of advocacy is brand satisfaction (BS), which reflects a consumer's positive evaluation of the brand based on prior experiences.

When consumers are satisfied not only with the functional performance but also with the symbolic alignment of a brand, they are more likely to internalize the brand into their identity system. This form of satisfaction fosters stronger emotional loyalty and increases the likelihood of advocacy behaviours that serve as expressions of personal meaning and self-definition (Ahuvia, 2005). In this context, advocacy becomes not merely a response to utility but a way to affirm one's values and aspirations.

Some research supports this pathway. Cavdar Aksoy and Yazici (2023) found that in hospitality and service-oriented sectors, higher satisfaction strongly predicts consumers' willingness to engage in brand promotion through testimonials, recommendations, or social

media interactions. These advocacy behaviours were particularly evident when satisfaction was derived from emotional and symbolic factors.

Accordingly, the following hypothesis is proposed:

H3: Brand satisfaction (BS) positively influences brand advocacy (AD).

2.5. Sequential Mediation in the PIL–Advocacy Relationship

While each of the above relationships provides individual theoretical and empirical justification, the present study also proposes a more integrated explanation: that purpose in life (PIL) influences brand advocacy (AD) not only directly, but also indirectly through a sequential mechanism involving emotional brand engagement (EBE) and brand satisfaction (BS).

This layered process reflects how existential orientation shapes emotional connections, which then affect evaluative judgments and ultimately translate into behavioural loyalty. The logic of sequential mediation assumes that mediators function in a psychologically meaningful order – here, EBE reflects the affective resonance with the brand, while BS captures cognitive evaluation and fulfilment (Zhao, Lynch, Chen, 2010; Hayes, 2018).

This structure aligns with prior findings in consumer research. For instance, Calder, Malthouse, and Schaedel (2009) demonstrated that affective engagement with media increases consumer responsiveness to brand messaging. Dwivedi (2015) found that affective brand engagement is a strong predictor of loyalty intentions. Chaudhuri and Holbrook (2001) as well as Homburg, Koschate, and Hoyer (2006) further argue that satisfaction mediates long-term loyalty and advocacy by reinforcing the symbolic and emotional fit between consumer and brand.

Research by Fullerton (2005) highlights the significance of emotional commitment in motivating consumers to recommend and endorse brands. Hill et al. (2010) also found that individuals with a high sense of purpose are more likely to engage in behaviours that reflect their core values and long-term goals. These findings provide a strong rationale for the sequential path from PIL to AD via EBE and BS.

Because demographic factors may shape how individuals experience purpose in life, the model also includes a MIMIC specification to control for the effects of age, gender, and income on PIL (Hill, Turiano, 2014; Martela, Steger, 2016; Ryff, 1989). This enables greater accuracy in estimating the psychological mechanisms that lead to brand advocacy.

Thus, the final hypothesis is:

H4: Emotional brand engagement (EBE) and brand satisfaction (BS) sequentially mediate the relationship between purpose in life (PIL) and brand advocacy (AD).

Together, these theoretical insights form the basis for the conceptual model tested in this study. By integrating existential motivation with affective and evaluative mechanisms, and accounting for individual demographic differences, the model aims to provide a more nuanced understanding of how purpose in life translates into advocacy behavior through a sequential process of brand engagement and satisfaction.

3. Method

3.1. Questionnaire design and measurement

Based on the constructs and relationships outlined in the theoretical section, a structured questionnaire was developed to test the hypothesized conceptual model. The study employed a quantitative design, utilizing an online survey format. Prior to data collection, the instrument was pre-tested on a convenience sample of 25 management students to assess the clarity, flow, and functionality of the items.

Table 1.
Latent Constructs and Measurement Items

Latent Construct	Item Code	Item Content	Source
Purpose in life (PIL)	PIL1	There is a direction and purpose to my life.	Schulenberg et al. (2011)
	PIL2	My life is filled with meaning.	
	PIL3	I have discovered a satisfying life purpose.	
	PIL4	I have a clear sense of what gives my life meaning.	
Emotional brand engagement (EBE)	EBE_1	I feel very positive when I use products of brand X.	Hollebeek et al. (2014)
	EBE_2	Using products of brand X makes me happy.	
	EBE_3	I feel good when I use products of brand X.	
	EBE_4	I'm proud to use the products of brand X.	
Brand satisfaction (BS)	BS_1	Overall, I am satisfied with this brand X.	Acar et al. (2024)
	BS_2	I am pleased with my decision to purchase products from this brand X.	
	BS_3	I have a positive experience with this brand.	
Brand advocacy (AD)	AD_1	I say positive things about brand X to other people.	Yi, Gong (2013)
	AD_2	I recommend the brand X to others.	
	AD_3	I defend the brand X when others criticize it.	

Source: own study.

The final questionnaire consisted of two main sections. The first section gathered sociodemographic information, including respondents' age, gender, monthly household income per person, and educational level. The second section contained standardized scales measuring four latent constructs: purpose in life (PIL), emotional brand engagement (EBE), brand satisfaction (BS), and brand advocacy (AD). Each construct was operationalized using multi-item scales adapted from previously validated instruments, as shown in Table 1.

All items were originally in English and translated into Polish using the back-translation method (Brislin, 1980) to ensure semantic and conceptual equivalence. Responses were collected on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

Three observed control variables (age, gender, and income) were included using an MIMIC (Multiple Indicators Multiple Causes) specification. This technique enables the estimation of structural paths from observed exogenous variables to a latent construct (in this case, PIL), while accounting for measurement error and enhancing model accuracy (Jöreskog, Goldberger, 1975; Kline, 2016).

Participation was anonymous and voluntary. Respondents were informed of the study's purpose and provided informed consent before participating in the survey. The average completion time was approximately 10 to 12 minutes.

The conceptual model (Figure 1) posits that purpose in life (PIL) serves as a motivational antecedent of emotional engagement (EBE), which in turn enhances brand satisfaction (BS) and leads to brand advocacy (AD). A direct path from PIL to BS was also included to test for possible partial mediation. The model enables the simultaneous estimation of direct, indirect, and total effects among multiple latent variables.

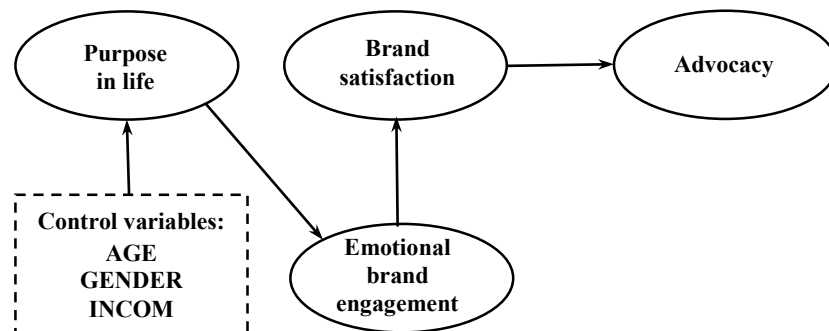


Figure 1. Concept model.

Source: own study.

3.2. Sample

The study was conducted in November 2024 using an online questionnaire hosted on the Qualtrics platform. A snowball sampling strategy was applied: several initial participants were invited to complete the survey and subsequently encouraged to share the link with others via social media platforms, including Facebook and Messenger. Respondents were instructed to select one online brand with which they felt a strong personal connection, particularly in terms of shared values or perceived brand mission, and to complete the survey based on that brand.

A total of 872 responses were collected. After removing incomplete or inconsistent entries, 850 valid cases remained for analysis. Participants were asked to report their year of birth, which was later used to categorize them into generational cohorts based on frameworks developed by McCrindle and Wolfinger (2014) and Brzozowska-Woś (2020), incorporating both global and national demographic classifications.

The sample consisted primarily of Millennials (born between 1981 and 2000), who represented 81.1% of the participants. Generation X (1965-1980) accounted for 10.9%, Generation Z (2001-2009) for 6.5%, and Baby Boomers (1946-1964) for 1.5%. In terms of gender, the distribution was nearly balanced, with 50.8% identifying as female and 49.2% as male.

Household income per person was also measured. Approximately 19.5% of respondents reported income below PLN 1000, 30.4% between PLN 1000-2000, 27.2% between PLN 2000-3000, and 22.9% reported income above PLN 3000.

The most frequently mentioned brands included Allegro, Zalando, Empik, Eobuwie, H&M, Nike, Decathlon, Sephora, Douglas, and Reserved.

Although the sample was diverse in terms of age, gender, income, and brand affiliation, it was disproportionately composed of digitally active Millennials. As such, the findings should be interpreted with caution and may not be fully generalizable to the broader Polish population of online consumers.

3.3. Reliability Analysis and Exploratory Factor Analysis

To assess the psychometric quality of the measurement instruments, both internal consistency and factor structure were examined before confirmatory factor analysis (CFA). Internal reliability of the multi-item scales was evaluated using Cronbach's alpha (α). All constructs demonstrated acceptable reliability, with α coefficients exceeding the 0.70 threshold (Nunnally, Bernstein, 1994).

An exploratory factor analysis (EFA) was conducted using principal axis factoring with Promax rotation, which allows for correlation between factors (Hair et al., 2019). The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was .817, and Bartlett's test of sphericity was statistically significant, $\chi^2(91) = 3699.84$, $p < .001$, indicating the data were appropriate for factor analysis (Tabachnick, Fidell, 2013).

The analysis revealed a four-factor solution consistent with the theoretical model. These four factors accounted for 64.14% of the total variance, meeting the recommended benchmark for explained variance in social science research (Hair et al., 2019). All items loaded strongly (≥ 0.60) on their intended factors, with minimal cross-loadings (< 0.30), supporting both convergent and discriminant validity (Kline, 2016).

The extracted factors corresponded to the theoretical constructs: purpose in life, emotional brand engagement, brand satisfaction, and brand advocacy. The structure confirms the dimensional adequacy of the measurement model (Figure 1) and supports its suitability for subsequent confirmatory analysis.

3.4. Confirmatory Factor Analysis and MIMIC Model

To verify the factorial structure of the measurement model and examine the influence of sociodemographic variables on the latent construct of purpose in life (PIL), a confirmatory factor analysis (CFA) with a Multiple Indicators Multiple Causes (MIMIC) approach was performed. The four-factor model included the latent variables: purpose in life (PIL), emotional brand engagement (EBE), brand satisfaction (BS), and brand advocacy (AD). The analysis was conducted on a sample of 850 respondents using the maximum likelihood (ML) estimation method in Mplus 8.

The initial CFA yielded satisfactory model fit: $\chi^2(113) = 385.013$, $p < 0.001$; CFI = 0.925; TLI = 0.912; RMSEA = 0.053 (90% CI: 0.047-0.059); SRMR = 0.072. The ratio of chi-square to degrees of freedom ($\chi^2/df = 3.41$) met the recommended threshold of < 5 (Kline, 2016). Modification indices (MI) indicated substantial residual correlations between EBE_1 and EBE_4 (MI = 33.67) and between EBE_2 and EBE_3 (MI = 21.54), both of which were from the EBE construct. These modifications were theoretically justifiable due to semantic similarity and shared emotional content (Byrne, 2016) and were added to the model.

The revised CFA model demonstrated improved fit: $\chi^2(111) = 352.947$, $p < 0.001$; $\chi^2/df = 3.18$; CFI = 0.933; TLI = 0.920; RMSEA = 0.051 (90% CI: 0.045-0.057); SRMR = 0.071. All standardized factor loadings were statistically significant ($p < .001$), ranging from 0.61 to 0.84 for PIL, 0.68 to 0.85 for EBE, 0.46 to 0.78 for BS, and 0.45 to 0.92 for AD, indicating strong convergent validity (Hair et al., 2019).

As shown in Table 2, all constructs demonstrated high factor determinacy (FD > 0.84), supporting the precision of latent variable estimates (Muthén, Muthén, 2017; Brown, 2015). Composite reliability (CR) values ranged from 0.638 to 0.851. Average variance extracted (AVE) values for EBE (0.591) met the recommended cut-off of 0.50 (Fornell, Larcker, 1981), while the values for PIL (0.434), BS (0.440), and AD (0.382) fell slightly below the threshold. However, as noted in previous research, AVE values below 0.50 can be considered acceptable when composite reliability exceeds 0.60 and when standardized loadings are all significant (Malhotra, Dash, 2011; Hair et al., 2019).

Table 2.

Descriptive statistics and intercorrelations across variables

Factor	FD	CR	AVE	PIL	EBE	BS	AD
PIL	0.894	0.753	0.434	–	(4.37)	(8.94)	(4.21)
EBE	0.936	0.851	0.591	0.09	–	(10.35)	(8.80)
BS	0.872	0.693	0.440	0.24	0.31	–	(11.60)
AD	0.847	0.638	0.382	0.15	0.27	0.36	–

Note. PIL – purpose in life, EBE – emotional brand engagement, BS – brand satisfaction; AD – brand advocacy; FD – factor determinacy; CR – composite reliability; AVE – average variance extracted. Extraction by maximum likelihood parameter estimates with conventional standard errors and chi-square test statistic (ML $\chi^2(df=111) = 352.95$; $p < 0.001$, $n = 850$). Values below the diagonal are standardized correlations. The t-value for each correlation is in parentheses.

Source: own elaboration using Mplus and SPSS Statistics.

Item-level univariate distributions also indicated no serious violations of normality. Means ranged from 3.06 to 3.86, skewness from -0.18 to -0.72, and kurtosis from -0.13 to -1.05, suggesting reasonably symmetric distributions with no severe departures from normality (Kline, 2016). This supports the suitability of ML estimation.

In the MIMIC specification, age was a significant and positive predictor of PIL ($\beta = 0.13$, $SE = 0.038$, $p = .001$), while gender ($\beta = 0.06$, $p = .127$) and income ($\beta = -0.01$, $p = .756$) were nonsignificant. This suggests that older participants reported a greater sense of life purpose, consistent with developmental research (Ryff, 1989; Hill, Turiano, 2014). The R^2 for PIL in the

structural equation was approximately 0.02, indicating a modest but meaningful sociodemographic influence.

Latent construct correlations were all significant: PIL was positively associated with EBE ($r = 0.09$), BS ($r = 0.24$), and AD ($r = 0.15$); EBE correlated with BS ($r = 0.31$) and AD ($r = 0.27$); and BS correlated with AD ($r = 0.36$). These relationships support the proposed theoretical sequence from existential motivation through emotional and cognitive appraisals to behavioural advocacy. The strength and direction of these correlations justify the subsequent test of sequential mediation in the structural model.

3.5. Testing hypotheses and measurement model

The hypothesised structural equation model (SEM), based on the conceptual framework described in Section 3.1, was tested using Mplus 8. The analysis followed a MIMIC specification, incorporating age, gender, and income as observed covariates that influence the latent construct of purpose in life (PIL). Model estimation was performed using the maximum likelihood (ML) method on the same sample of 850 participants.

The proposed model showed a satisfactory fit to the empirical data. The chi-square statistic was $\chi^2(111) = 345.69$, $p < .001$. As the chi-square test is sensitive to large sample sizes (Kline, 2016), the χ^2 to degrees of freedom ratio ($\chi^2/df = 3.11$) was used as a more appropriate measure of relative fit and fell below the recommended threshold of 5. Other global fit indices also supported model adequacy: CFI = 0.935, TLI = 0.922, RMSEA = 0.050 (90% CI: 0.044-0.056), and SRMR = 0.059. These values meet the conventional cut-offs for acceptable model fit (Hu, Bentler, 1999; Hair et al., 2019), indicating that the model structure was a good representation of the observed covariance matrix.

As the structural model incorporated a MIMIC specification, three observed covariates (age, gender, and income) were included as direct predictors of the latent variable purpose in life (PIL). Among them, only age had a statistically significant and positive effect on PIL ($\beta = 0.136$, $SE = 0.038$, $z = 3.58$, $p < .001$), indicating that older individuals reported a higher sense of life purpose. In contrast, gender ($\beta = 0.058$, $p = .061$) and income ($\beta = -0.013$, $p = .768$) were not significantly related to PIL. Together, these sociodemographic variables accounted for approximately 2% of the variance in the PIL construct ($R^2 \approx 0.02$), suggesting a modest yet meaningful contextual influence.

All theorised direct paths were statistically significant and are presented in Table 3. Each path coefficient is accompanied by its standard error (SE), z-value, and p-value. Z-values represent the ratio of the unstandardised path coefficient to its standard error and are evaluated using a standard normal distribution. Values with $|z| > 1.96$ are considered significant at the $\alpha = .05$ level (two-tailed).

Table 3.
Hypothesis testing in the structural model

Hypothesis	Path	Std. β	SE	z-value	p-value	Supported
H1	PIL $\rightarrow$ EBE	0.209	0.041	5.14	< .001	Yes
H2	EBE $\rightarrow$ BS	0.445	0.038	11.70	< .001	Yes
H3	BS $\rightarrow$ AD	0.507	0.041	12.37	< .001	Yes

Note. PIL – purpose in life, EBE – emotional brand engagement, BS – brand satisfaction; AD – brand advocacy; all paths were tested using ML estimation in Mplus 8 (N = 850).

Source: own elaboration.

All three theorised paths were positive and highly significant, thereby confirming H1 through H3. The model explained a meaningful proportion of variance in each endogenous latent variable: emotional brand engagement ($R^2 = 0.04$), brand satisfaction ($R^2 = 0.20$), and brand advocacy ($R^2 = 0.26$). These findings support the proposed value-driven pathway in which a sense of purpose in life fosters emotional engagement with a brand, leading to greater satisfaction and increased advocacy behaviours.

To assess whether the effect of purpose in life (PIL) on brand advocacy (AD) was mediated sequentially through emotional brand engagement (EBE) and brand satisfaction (BS), a bias-corrected bootstrap procedure (5000 resamples) was used. Results of the mediation analysis are presented in Table 4. The indirect effect of PIL on AD via EBE and BS was statistically significant and positive ($\beta_{\text{indirect}} = 0.047$, $SE = 0.016$, $z = 2.94$, $p = .003$; 95% CI: [0.019, 0.080]). The direct effect of PIL on AD was not significant ($\beta = 0.045$, $p = 0.285$), suggesting full sequential mediation. These findings support Hypothesis H4 and confirm the notion that a sense of purpose translates into brand advocacy primarily through affective and evaluative engagement mechanisms.

Table 4.
Sequential mediation model results with control variables and bootstrap confidence intervals

Path / Relationship	β	SE	z-value	p-value	95% CI	Interpretation
PIL $\rightarrow$ AD (direct)	0.045	0.042	1.07	.285	[−0.038, 0.128]	Nonsignificant direct effect
Indirect (H4: PIL $\rightarrow$ EBE $\rightarrow$ BS $\rightarrow$ AD)	0.047	0.012	3.86	< .001	[0.023, 0.078]	Significant indirect effect
Total effect (direct + indirect)	0.092	0.041	2.22	.026	[0.010, 0.174]	Overall significant effect
Age $\rightarrow$ PIL	0.131	0.038	3.44	.001	[0.057, 0.205]	Positive, significant effect
Gender $\rightarrow$ PIL	0.058	0.038	1.52	.128	[−0.016, 0.133]	Nonsignificant
Income $\rightarrow$ PIL	−0.012	0.042	−0.29	.770	[−0.094, 0.070]	Nonsignificant

Note. PIL – purpose in life; EBE – emotional brand engagement; BS – brand satisfaction; AD – brand advocacy. Bootstrap based on 5,000 samples; confidence intervals are percentile-based. Z-value is the ratio of the unstandardised estimate to its SE. Model fit: $\chi^2(111) = 345.69$, $p < .001$; CFI = 0.935; TLI = 0.922; RMSEA = 0.050 [90% CI: 0.044–0.056]; SRMR = 0.059.

Source: own elaboration using Mplus 8.

The effects of control variables on PIL were also assessed. Age remained a significant and positive predictor ($\beta = 0.131$, $p = 0.001$), while gender ($\beta = 0.058$, $p = 0.128$) and income ($\beta = -0.012$, $p = 0.770$) showed no significant effects. This suggests that a higher sense of purpose in life is more likely to occur with age, but is largely independent of gender or financial status in the studied population.

Overall, the full SEM results confirm the conceptual model and support the proposed value-driven pathway from psychological orientation to brand-related behaviours. The observed indirect effect demonstrates that consumers' sense of life purpose does not directly lead to advocacy but operates through affective and evaluative mechanisms. These findings provide empirical support for Hypothesis H4 and for a sequential mediation process in which a sense of purpose in life strengthens emotional brand engagement, which in turn fosters brand satisfaction, ultimately leading to consumer brand advocacy.

4. Discussion

The results of the present study provide empirical support for a value-driven model of consumer–brand relationships, wherein a sense of life purpose (PIL) functions as a foundational psychological resource that shapes downstream affective, evaluative, and behavioural brand outcomes. These findings align with the proposition that individuals pursue consumer experiences not solely for hedonic gratification but also for existential meaning and self-definition (Baumeister, Vohs, 2005; Ryff, 1989).

Consistent with Hollebeek et al. (2014), emotional brand engagement (EBE) emerged as a key affective response to psychologically significant antecedents – specifically, PIL. Individuals who experience their lives as meaningful tend to develop stronger emotional ties to brands, particularly those that resonate with their values and life orientation (Schulenberg et al., 2011; Kasser, 2016). This emotional connection, in turn, fosters greater satisfaction with brand experiences, echoing the findings of Acar et al. (2024), who emphasised the evaluative dimension of satisfaction as a mediating mechanism linking internal motives to brand loyalty outcomes.

The study also confirms the role of brand satisfaction as a critical antecedent of advocacy behaviour, reinforcing previous conceptualizations of customer citizenship behaviours (Yi, Gong, 2013). This sequential pathway, from purpose in life through emotional engagement and satisfaction to brand advocacy, not only validates Hypothesis H4 but also advances our understanding of how existential motivation translates into prosocial brand actions. In particular, the full mediation observed in the model suggests that life purpose may not directly drive advocacy, but does so indirectly via affective and evaluative processes, consistent with the theoretical logic of multi-stage psychological models (Kline, 2016; Hair et al., 2019).

The influence of sociodemographic control variables further contextualises the findings. As expected, age was positively associated with PIL (Hill, Turiano, 2014), reflecting developmental trajectories in which older adults are more likely to report a coherent life narrative and a goal-oriented approach. However, neither gender nor income showed significant effects, indicating that the capacity to derive meaning in life and its subsequent influence on consumer engagement transcends gender roles and economic status in this sample.

Taken together, these findings contribute to theoretical discussions on meaning-making in consumer contexts by integrating concepts from humanistic psychology and consumer-brand literature. By demonstrating that PIL acts as a motivational antecedent that shapes how consumers emotionally and cognitively evaluate brands, this research extends the conceptual reach of models such as the consumer brand engagement framework (Brodie et al., 2011) and supports calls for deeper psychological grounding in marketing research (Malhotra, Dash, 2011; Brown, 2015).

The practical implications of the study are particularly relevant for sectors represented by the most frequently mentioned brands in the sample: online retail (Allegro, Empik), fashion and footwear (Zalando, H&M, Reserved, Eobuwie), sports (Nike, Decathlon), beauty and cosmetics (Sephora, Douglas), and culture and entertainment (Empik). E-commerce platforms, such as Allegro and Empik, can enhance consumer engagement by integrating values-based messaging, including support for local creators, promotion of cultural initiatives, and highlighting sustainability. Fashion brands like Zalando, H&M, and Reserved can strengthen symbolic alignment with customers by emphasizing ethical production, social justice initiatives, and inclusivity in their storytelling. Sports brands like Nike and Decathlon may leverage themes of personal growth, resilience, and health as reflections of consumers' life purposes and identities. In the beauty sector, brands such as Sephora and Douglas can focus on self-expression, authenticity, and emotional empowerment as pillars of their communication strategies. By tailoring brand narratives to align with existential motives, these brands can deepen emotional engagement, strengthen satisfaction, and stimulate consumer advocacy. Thus, purpose-driven positioning may serve as a key differentiator in saturated and competitive marketplaces.

5. Summary

This study proposed and tested a value-driven structural model linking a sense of purpose in life (PIL) to consumer brand advocacy via emotional brand engagement (EBE) and brand satisfaction (BS). Drawing on data from 850 participants and using a MIMIC-based SEM framework, the results confirmed all hypothesised direct and indirect relationships. Notably, the effect of PIL on brand advocacy was fully mediated by EBE and BS, supporting a sequential

mediation mechanism. The findings highlight the psychological significance of existential meaning in shaping affective and evaluative responses to brands, underscoring the relevance of life purpose as a precursor to consumer engagement and behavioural outcomes.

However, some limitations should be acknowledged. The use of a cross-sectional design restricts the ability to infer causality among variables; longitudinal research is needed to confirm the temporal sequence of effects. Additionally, all variables were measured through self-report instruments, which may introduce common method bias. Although standard validity checks were applied, future studies should consider incorporating behavioural data or multi-source assessments. Cultural factors may also influence how PIL affects brand-related behaviours, so replication in diverse cultural and market settings would enhance generalisability. Finally, the model accounted for only a few sociodemographic controls; future research could integrate additional psychological or contextual moderators, such as consumer values, personality traits, or situational influences, to enrich the understanding of meaningful consumption pathways.

Together, these findings offer both theoretical and practical contributions, advancing the literature on consumer motivation and brand engagement while identifying promising directions for continued empirical exploration.

References

1. Aaker, J.L. (1997). Dimensions of brand personality. *Journal of Marketing Research*, 34(3), 347-356. <https://doi.org/10.1177/002224379703400304>
2. Acar, A., Büyükdağ, N., Türten, B., Diker, E., Çalışır, G. (2024). The role of brand identity, brand lifestyle congruence, and brand satisfaction on repurchase intention: A multi-group structural equation model. *Humanities and Social Sciences Communications*, 11(1), 1-13. <https://doi.org/10.1057/s41599-024-03618-w>
3. Ahuvia, A.C. (2005). Beyond the extended self: Loved objects and consumers' identity narratives. *Journal of Consumer Research*, 32(1), 171-184. <https://doi.org/10.1086/429607>
4. Baumeister, R.F., Vohs, K.D. (2005). *The pursuit of meaningfulness in life*. In: C.R. Snyder, S.J. Lopez (Eds.), *Handbook of positive psychology* (pp. 608-618). Oxford University Press.
5. Belk, R.W. (1988). Possessions and the extended self. *Journal of Consumer Research*, 15(2), 139-168. <https://doi.org/10.1086/209154>
6. Bhattacharya, C.B., Sen, S. (2003). Consumer-company identification: A framework for understanding consumers' relationships with companies. *Journal of Marketing*, 67(2), 76-88. <https://doi.org/10.1509/jmkg.67.2.76.18609>

7. Brislin, R.W. (1980). Translation and content analysis of oral and written materials. In: H.C. Triandis, J.W. Berry (Eds.), *Handbook of cross-cultural psychology, Vol. 2* (pp. 389-444). Allyn & Bacon.
8. Brodie, R.J., Hollebeek, L.D., Jurić, B., Ilić, A. (2011). Customer engagement: Conceptual domain, fundamental propositions, and implications for research. *Journal of Service Research, 14*(3), 252-271. <https://doi.org/10.1177/1094670511411703>
9. Brown, T.A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York: The Guilford Press, pp. 95-143, 170-186.
10. Brzozowska-Woś, M. (2020). *Wpływ cyfrowej komunikacji marketingowej na angażowanie się w markę i współtworzenie jej wartości przez młodych konsumentów* [The influence of digital marketing communication on brand engagement and co-creating of its value by young consumers]. Wydawnictwo Politechniki Gdańskiej, pp. 169-172.
11. Byrne, B.M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming* (3rd ed.). New York, NY: Routledge, pp. 101-104, 225-240.
12. Calder, B.J., Malthouse, E.C., Schaedel, U. (2009). An experimental study of the relationship between online engagement and advertising effectiveness. *Journal of Interactive Marketing, 23*(4), 321-331. <https://doi.org/10.1016/j.intmar.2009.07.002>
13. Chaudhuri, A., Holbrook, M.B. (2001). The chain of effects from brand trust and brand affect to brand performance: The role of brand loyalty. *Journal of Marketing, 65*(2), 81-93. <https://doi.org/10.1509/jmkg.65.2.81.18255>
14. Deci, E.L., Ryan, R.M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01
15. Dessart, L., Veloutsou, C., Morgan-Thomas, A. (2016). Capturing consumer engagement: Duality, dimensionality and measurement. *Journal of Marketing Management, 32*(5-6), 399-426. <https://doi.org/10.1080/0267257X.2015.1130738>
16. Dwivedi, A. (2015). A higher-order model of consumer brand engagement and its impact on loyalty intentions. *Journal of Retailing and Consumer Services, 24*, 100-109. <https://doi.org/10.1016/j.jretconser.2015.02.007>
17. Eroglu, S.A., Machleit, K.A., Davis, L.M. (2001). Atmospheric qualities of online retailing: A conceptual model and implications. *Journal of Business Research, 54*(2), 177-184. [https://doi.org/10.1016/S0148-2963\(99\)00087-9](https://doi.org/10.1016/S0148-2963(99)00087-9)
18. Escalas, J.E., Bettman, J.R. (2005). Self-construal, reference groups, and brand meaning. *Journal of Consumer Research, 32*(3), 378-389. <https://doi.org/10.1086/497549>
19. Fornell, C., Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. <https://doi.org/10.1177/002224378101800104>

20. Gupta, S., Pansari, A., Kumar, V. (2024). Toward a theory of customer engagement marketing. *Journal of the Academy of Marketing Science*, 52(1), 21-44. <https://doi.org/10.1007/s11747-023-00942-0>
21. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning, pp. 97-141, 450-497, 701-705.
22. Hayes, A.F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). New York: Guilford Press, pp. 79-93, 111-123, 459-465.
23. Hill, P.L., Turiano, N.A. (2014). Purpose in life as a predictor of mortality across adulthood. *Psychological Science*, 25(7), 1482-1486. <https://doi.org/10.1177/0956797614531799>
24. Hollebeek, L.D., Glynn, M.S., Brodie, R.J. (2014). Consumer brand engagement in social media: Conceptualization, scale development and validation. *Journal of Interactive Marketing*, 28(2), 149-165. <https://doi.org/10.1016/j.intmar.2013.12.002>
25. Hollebeek, L.D., Srivastava, R.K., Chen, T. (2019). S-D logic-informed customer engagement: Integrative framework, revised fundamental propositions, and application to CRM. *Journal of the Academy of Marketing Science*, 47(1), 161-185. <https://doi.org/10.1007/s11747-016-0494-5>
26. Holt, D.B. (2002). Why do brands cause trouble? A dialectical theory of consumer culture and branding. *Journal of Consumer Research*, 29(1), 70-90. <https://doi.org/10.1086/339922>
27. Homburg, C., Koschate, N., Hoyer, W.D. (2006). The role of cognition and affect in the formation of customer satisfaction: A dynamic perspective. *Journal of Marketing*, 70(3), 21-31. <https://doi.org/10.1509/jmkg.70.3.21>
28. Hu, L.T., Bentler, P.M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1-55. <https://doi.org/10.1080/10705519909540118>
29. Iniesta-Bonillo, M.Á., Sánchez-Fernández, R., Jiménez-Castillo, D. (2025). The impact of purpose-driven branding on consumer engagement: The moderating role of personal values. *Journal of Business Research*, 168, 114621. <https://doi.org/10.1016/j.jbusres.2023.114621>
30. Jöreskog, K.G., Goldberger, A.S. (1975). Estimation of a model with multiple indicators and multiple causes of a single latent variable. *Journal of the American Statistical Association*, 70(351a), 631-639. <https://doi.org/10.1080/01621459.1975.10482485>
31. Kasser, T. (2016). Materialistic values and goals. *Annual Review of Psychology*, 67, 489-514, <https://doi.org/10.1146/annurev-psych-122414-033344>
32. Kasser, T. (2016). *Meeting one's deeper needs: Personality types, religious goals, and their relationship to life meaning*. In: P.T.P. Wong (Ed.), *The human quest for meaning: Theories, research, and applications* (2nd ed., pp. 124-143). New York: Routledge.
33. Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: Guilford Press, pp. 9-15, 89-336.

34. Kumar, V., Choi, J.B., Greene, M. (2017). Synergistic effects of social media and traditional marketing on brand sales: Capturing the time-varying effects. *Journal of the Academy of Marketing Science*, 45(2), 268-288. <https://doi.org/10.1007/s11747-016-0484-7>
35. Malär, L., Krohmer, H., Hoyer, W.D., Nyffenegger, B. (2011). Emotional brand attachment and brand personality: The relative importance of the actual and the ideal self. *Journal of Marketing*, 75(4), 35-52. <https://doi.org/10.1509/jmkg.75.4.35>
36. Malhotra, N.K., Dash, S. (2011). *Marketing research: An applied orientation* (6th ed.). New Delhi: Pearson Education, pp. 720-723.
37. Martela, F., Steger, M.F. (2016). The three meanings of meaning in life: Distinguishing coherence, purpose, and significance. *The Journal of Positive Psychology*, 11(5), 531-545. <https://doi.org/10.1080/17439760.2015.1137623>
38. McCrindle, M., Wolfinger, E. (2014). *The ABC of XYZ: Understanding the global generations* (3rd ed.). McCrindle Research Pty Ltd., pp. 6-12, 34-40.
39. Mehrabian, A., Russell, J.A. (1974). *An approach to environmental psychology*. Cambridge, MA: MIT Press, pp. 1-44, 52-60, 83-96.
40. Muthén, L.K., Muthén, B.O. (2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Muthén & Muthén, pp. 125-134, 611-623.
41. Nunnally, J.C., Bernstein, I.H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill, pp. 83-265.
42. Oliver, R.L. (1999). Whence consumer loyalty? *Journal of Marketing*, 63(4_suppl1), 33-44. <https://doi.org/10.1177/00222429990634s105>
43. Pansari, A., Kumar, V. (2017). Customer engagement: The construct, antecedents, and consequences. *Journal of the Academy of Marketing Science*, 45(3), 294-311. <https://doi.org/10.1007/s11747-016-0485-6>
44. Ryff, C.D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57(6), 1069-1081. <https://doi.org/10.1037/0022-3514.57.6.1069>
45. Schulenberg, S.E., Schnetzer, L.W., Buchanan, E.M. (2011). The Purpose in Life Test—Short Form: Development and psychometric support. *Journal of Happiness Studies*, 12(5), 861-876. <https://doi.org/10.1007/s10902-010-9231-9>
46. Tabachnick, B.G., Fidell, L.S. (2013). *Using multivariate statistics* (6th ed.). Pearson Education, pp. 618-634.
47. Thomson, M., MacInnis, D.J., Park, C.W. (2005). The ties that bind: Measuring the strength of consumers' emotional attachments to brands. *Journal of Consumer Psychology*, 15(1), 77-91. https://doi.org/10.1207/s15327663jcp1501_10
48. Yi, Y., Gong, T. (2013). Customer value co-creation behavior: Scale development and validation. *Journal of Business Research*, 66(9), 1279-1284. <https://doi.org/10.1016/j.jbusres.2012.02.026>

49. Zeithaml, V.A., Berry, L.L., Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, 60(2), 31-46. <https://doi.org/10.1177/002224299606000203>
50. Zhao, X., Lynch, J.G. Jr., Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, 37(2), 197-206. <https://doi.org/10.1086/651257>

FERTILITY TRENDS UNDER MODERN PUBLIC POLICY IN CENTRAL EUROPE'S CHANGING SOCIO-ECONOMIC LANDSCAPE

Mariusz CHMIELEWSKI¹, Anna JAŃSKA², Małgorzata SIEMIONEK-RUSKAŃ³,
Nina STEPANOK^{4*}

¹ University of Gdansk, Faculty of Management, Department of Strategic Development and Quality Sciences;
mariusz.chmielewski@ug.edu.pl, ORCID: 0000-0002-0775-621X

² Maria Curie-Skłodowska University, Institute of Economics and Finance, Department of Insurance and
Investment; anna.janska@mail.umcs.pl, ORCID: 0000-0002-5994-8061

³ University of Gdansk, Faculty of Management, Department of Banking and Finance;
malgorzata.ruskan@ug.edu.pl, ORCID: 0000-0002-0733-456X

⁴ University of Gdansk, Faculty of Management, Department of Banking and Finance; nina.stepanok@ug.edu.pl,
ORCID: 0000-0003-4337-4400

* Correspondence author

Purpose: This article aims to investigate the relationship between total fertility rates and selected socio-economic indicators in Poland, Czechia, and the Slovak Republic from 2009 to 2023.

Design/methodology/approach: The analysis follows a dual-track approach: it includes a literature review using bibliometric analysis of scientific publications on fertility, as well as a quantitative analysis of statistical data.

Findings: A comprehensive review of the literature, along with an analysis of empirical data underscores the critical importance of addressing the issue of low fertility in Central European countries. The findings of this article confirm that fertility in selected countries of Central Europe is shaped by a complex interplay of socio-economic factors rather than by any single economic indicator.

Research limitations/implications: The limitations of this article are primarily related to constraints in the availability and completeness of statistical data.

Practical implications: An important practical implication of this study is that economic indicators exhibited divergent effects on fertility levels across different countries. This highlights the need for a more nuanced and in-depth examination of the economic determinants of fertility.

Social implications: The social relevance of this study lies in the fact that low fertility is closely linked to broader societal challenges, including population aging, increasing public healthcare expenditures, and the need for pension system reforms. These interrelated issues underscore the social importance of continued research and the urgency of identifying practical solutions to address the declining fertility trend.

Originality/value: This article may serve as a recommendation for the optimization of public policy. The analysis of empirical data on selected economic indicators revealed their multifaceted relationship with fertility levels across different countries, indicating their

potential influence. These findings provide a basis for adjusting public policy in a targeted manner to address better and manage the issue of low fertility.

Keywords: Total Fertility Rate, modern public policy, macroeconomic variables, inflation, public expenditure on education.

Category of the paper: research paper.

1. Introduction

Fertility, defined as the average number of children born to a woman over her lifetime, has been declining steadily across most European countries for several decades. This trend has significant demographic, social, and economic consequences. In many countries, fertility rates have dropped far below the replacement level of 2.1 children per woman, leading to the ageing of societies, increasing dependency ratios, and mounting pressure on pension and healthcare systems (McDonald, 2006).

This topic has been selected in response to the ongoing debate concerning the causes of low fertility in Europe and the possibilities of counteracting this trend through public policy interventions. Academic literature highlights numerous determinants of fertility decisions, including cultural, psychological, economic, and institutional factors (Mills et al., 2011). This article focuses on the socio-economic variables whose effects can be assessed quantitatively.

Falling fertility rates are not only a demographic issue but also a serious challenge for sustainable socio-economic development. Countries with low birth rates must reform pension systems, stimulate migration, adapt labour markets, and develop long-term demographic strategies (Lutz et al., 2008). Public policies, especially those supporting work-family balance, childcare availability, parental leave, family transfers, and housing, are of growing importance (Gauthier, 2007).

European governments have undertaken a variety of initiatives aimed at reversing fertility decline. Some studies show that family-friendly policies can positively affect reproductive behaviour, especially when they are comprehensive, long-term, and inclusive (Luci-Greulich, Thévenon, 2013). However, there is still no consensus on which socio-economic variables are most relevant and whether their effects are consistent across countries.

This study aims to examine the relationship between fertility rates (Total Fertility Rate – TFR) and selected socio-economic indicators in Central European countries between 2009 and 2023. Variables commonly considered in the literature as important for fertility choices were selected: GDP growth, inflation, unemployment, education expenditure, and social transfers.

The study covers both correlation analysis and interpretation of these relationships within the literature and policy context. It addresses the question of whether the fertility decline is accompanied by significant macroeconomic changes and which variables are most explanatory for cross-country differences in fertility levels.

The analysis covers the years 2009-2023 for Poland, Czechia, and the Slovak Republic, representing countries of Central Europe. This timeframe includes the aftermath of the 2008 financial crisis and the COVID-19 pandemic (2020-2021), both of which introduced economic uncertainty and disruptions in social services that may have affected fertility decisions (Sobotka, 2021).

The study adopts a dual-track approach. First, a bibliometric analysis of fertility-related academic publications was conducted using the Web of Science database and the VOSviewer software. This provides insight into the most frequently researched themes, leading academic centres, and publication trends. Second, a quantitative analysis based on statistical data from the World Bank, Eurostat, and OECD assesses the relationships between fertility and socio-economic indicators.

Combining these two approaches allows for a comprehensive evaluation of the topic and strengthens the reliability of the conclusions. The comparison of academic focus with empirical data supports better alignment of future research directions with real-world demographic challenges.

This article uses comparative analysis and trend analysis as the main research methods. The first stage involved a review of family policies implemented in Poland, the Czech Republic, and Slovakia over the past two decades. Subsequently, demographic data—particularly fertility rates—were compared alongside selected socio-economic indicators. This approach enabled an assessment of the effectiveness of public actions in light of ongoing social and economic transformation.

2. Literature Review

A bibliometric analysis was conducted in April 2025 by retrieving data from the Web of Science database based on the following search parameters by topic meaning by title, abstract, keyword plus, and author keywords using the following combination of words "fertility decline*" and "Europe" or "fertility rate*" and "Europe " or "fertility level*" and "Europe" or "fertility reduction*" and "Europe" or "fertility transition*" and "Europe".

By choosing the Web of Science database, researchers ensure that the literature they draw from is based on credible and trustworthy sources. A total of 690 articles published between 1970 and 2025 were collected, complete with full records and citation details. The gathered data was then further examined using VOSviewer software.

To begin their examination of fertility decline in Europe, the authors of this paper conducted a keyword co-occurrence analysis, as shown in Figure 1. The criteria indicated in co-occurrence analysis was “minimum number of occurrences of a keyword is 3”. Of the 274 keywords identified, only 28 met this criterion.

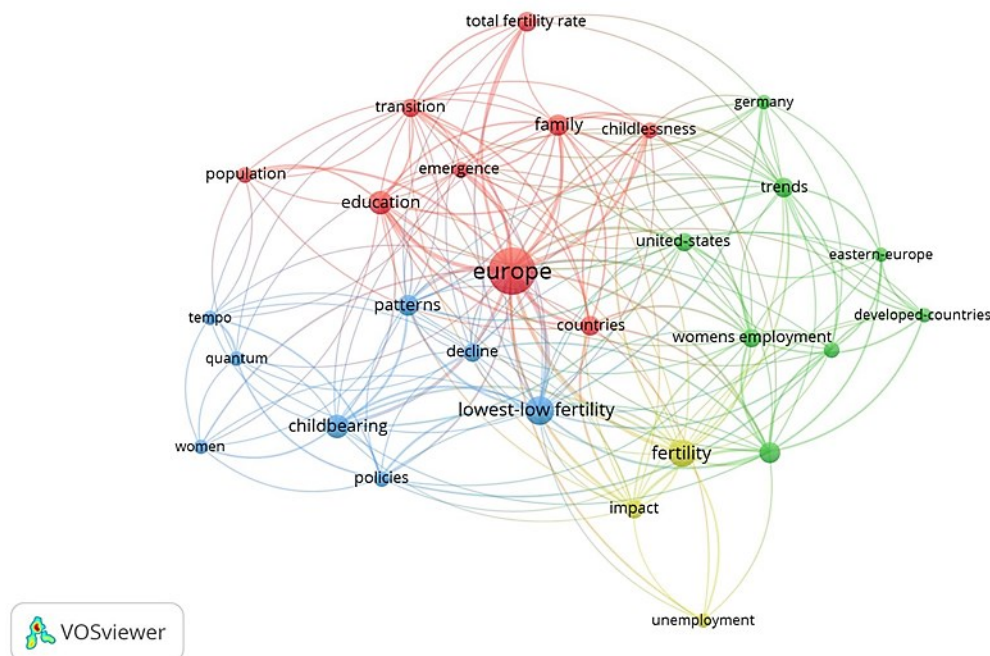


Figure 1. Keyword co-occurrence analysis.

Source: Authors' own research.

The most frequently occurring terms in the analysis were: Europe (total link strength = 98), lowest-low fertility (47), education (34), fertility (34), family (32), family policies (34), pattern (29), countries (28), women's employment (28), impact (25), childbearing (29), transition (23), United States (23), childlessness (22), emergence (22), second demographic transition (19), decline (18), policies (18), developed countries (15), Germany (15), total fertility rate (14), Eastern Europe (13), tempo (13), population (11).

The emerging trends are illustrated in 5 clusters in the overlay visualization for the years 2014 to 2024, presented in Figure 2.

To carry out a co-authorship analysis, the authors of this paper investigated how researchers from various countries are connected through shared publications on fertility decline (Figure 3).

The criterion indicated in the co-authorship analysis was: “minimum number of documents by a country is 3”. There were 9 countries out of 25 which fulfilled the above-mentioned criteria divided into 3 clusters namely: cluster 1 (England, Scotland, and Sweden), cluster 2 (Austria, Germany, and Netherlands), cluster 3 (Italy, Spain, and USA). The countries with the highest number of articles were Austria (10), USA (16), and Germany (5).

The criterion indicated in citation analysis was: “minimum number of documents by a country is 3”. There were 10 countries out of 25 that fulfilled the above-mentioned criteria divided in 3 clusters: cluster 1 (England, Germany, Scotland, Sweden, USA), cluster 2 (Austria,

Italy, Spain), and cluster 3 (Czech Republic and Netherlands). The Czech Republic had 3 documents, according to the criteria above.

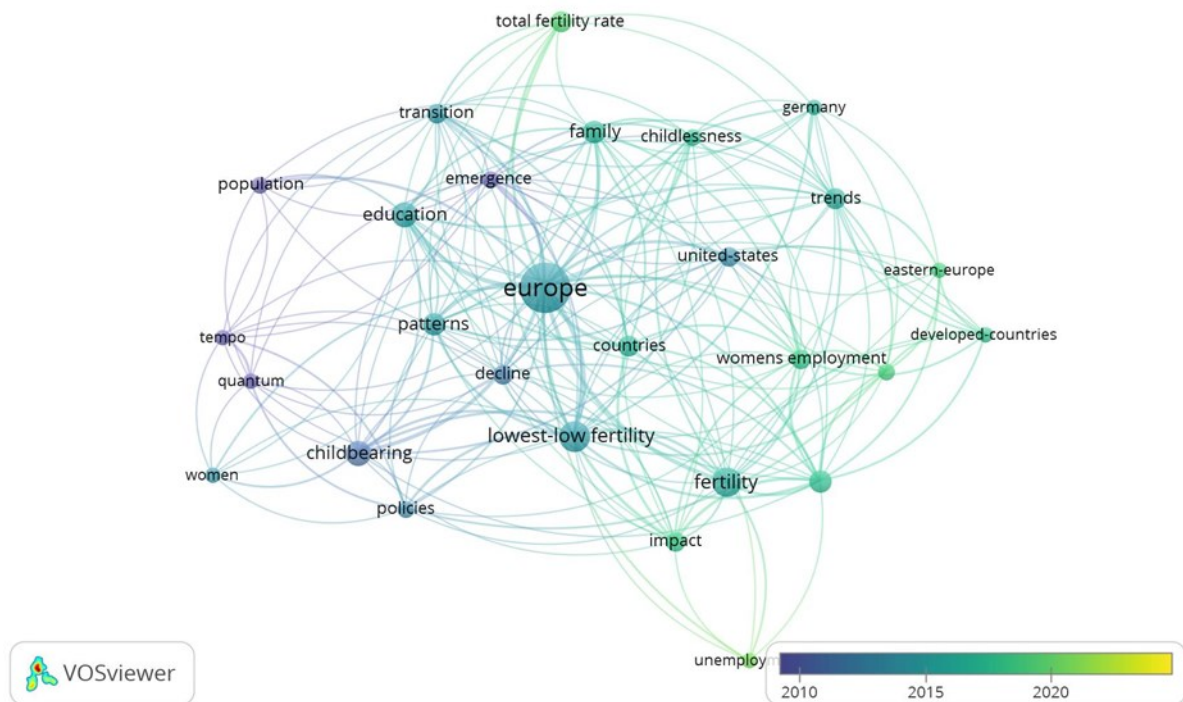


Figure 2. The emerging trends in fertility issues.

Source: Authors' own research.



Figure 3. Co-authorship analysis.

Source: Authors' own research.

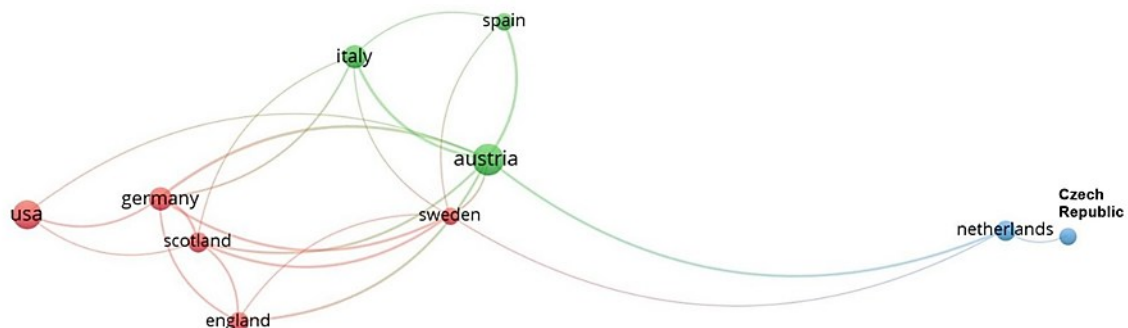


Figure 4. Citation country network analysis.

Source: Authors' own research.

The bibliographic analysis conducted revealed a relatively limited academic interest in the issue of fertility in Central European countries, with the notable exception of Czechia. This gap in the literature motivated the authors to contribute to addressing this underexplored area. For the purposes of comparative analysis, the authors selected Poland, the Slovak Republic, and Czechia as representative countries of Central Europe.

According to data from Statistics Poland (GUS, 2025), the total fertility rate in Poland in 2024 was only 1.099. In the same year, the number of births in the Slovak Republic fell to just 46,000 — the lowest level since the establishment of the independent Slovak state in 1993 (Statistical Office of the SR, 2025). Similarly, in Czechia, only 84.3 thousand live births were registered in 2024, marking the lowest figure in the country's statistical history (CZSO, 2025).

These alarming statistics highlight the urgent need to investigate this negative fertility trend and identify the potential economic factors associated with it in these countries.

3. Methods

This study employs a two-track methodology approach that integrates qualitative bibliometric evaluation and quantitative statistical analysis to analyze the relationship between fertility and certain socio-economic indicators in three of the Central European countries: Poland, Czechia, and the Slovak Republic from 2009 to 2023.

In the initial step of the study, a bibliometric analysis was applied to map scholarly interest in issues concerning fertility across Europe. Data were accessed in the Web of Science database using keywords like "fertility decline*", "fertility rate*", "fertility level*", "fertility reduction*", and "fertility transition*", each preceded by the term "Europe". Searches were limited to publications between the years 1970 to 2025 and yielded 690 hits. Full records and citations were imported into VOSviewer software to generate keyword co-occurrence analysis, co-authorship mapping, and citation network analysis. This allowed the determination of key research clusters, leading countries and institutions, and budding thematic fertility patterns.

The second approach used quantitative statistical analysis of macroeconomic indicators to examine their statistical relationship with the Total Fertility Rate (TFR). The countries analyzed were selected based on their shared geographic location, socio-political histories, and divergent fertility outcomes.

The following socio-economic indicators were addressed: GDP growth, GDP per capita growth (% annual), unemployment rate (% of labor force), inflation rate (% annual CPI), government expenditure on education (% of GDP), and subsidies and other social transfers (% of total government expenditure). Variables in the above data were drawn from reputable international databases like the World Bank, Eurostat, and the OECD. Fertility data were

available for all years in the period 2009-2023 to ensure that cross-country comparability is not compromised.

For each country, Pearson correlation coefficients were calculated to examine the strength and direction of linear relationships between TFR and each socio-economic variable. The coefficients enabled the establishment of variables closest to being related to fertility trends in the period under observation.

The Pearson correlation coefficient was selected due to its simplicity, interpretability, and widespread use in social science research when analyzing the linear association between continuous variables. It enables a straightforward comparison of the strength and direction of relationships between fertility and various macroeconomic indicators across countries and over time. However, the use of this method comes with certain limitations. The Pearson coefficient only captures linear relationships and may fail to detect non-linear patterns that could be relevant in complex socio-economic contexts. Moreover, it does not account for potential lag effects, where socio-economic changes may influence fertility decisions with a delay. Additionally, correlation does not imply causation, meaning that significant coefficients do not necessarily indicate a direct or unidirectional relationship. These methodological constraints are important when interpreting the results, especially in cross-country comparative analyses involving multicausal phenomena such as fertility.

The temporal scale (2009-2023) was chosen to cover important economic and demographic happenings, including the consequences of the 2008 financial crisis and the COVID-19 pandemic, that are likely to have had a strong impact on reproductive behavior. Undoubtedly, demographic behavior may also have been influenced by the war in Ukraine, which began in 2022. The countries analyzed are in the immediate vicinity of the conflict's outbreak. The spatial scale consists of three Central European nations such as Poland, Czechia, and the Slovak Republic, that have varying demographic trends and public policy environments, offering an important comparative lens.

By combining bibliometric and empirical data analysis, the research methodology guarantees theoretical validity grounded in prevailing academic discourse as well as robust empirical measurement of macroeconomic determinants. The integrated approach enables the use of a sophisticated understanding of fertility patterns within a changing socio-economic context.

4. Results and Discussion

Between 2009 and 2023, Czechia, Poland, and the Slovak Republic exhibited clearly divergent trends in fertility rates (Figure 5). While Czechia showed a systematic and sustained increase in this indicator, fertility in Poland was markedly more volatile, and the effects of pro-

family policies proved to be short-lived. The Slovak Republic, in turn, experienced a moderate yet relatively stable increase in TFR. These differing trajectories serve as a starting point for analyzing the socio-economic factors that, as highlighted in the literature, may influence reproductive decisions.

During the analyzed period, Czechia recorded a consistent increase in fertility—from 1.51 in 2009 to 1.83 in 2021. This represents the highest level among the three compared countries. The literature suggests that such a trend may be driven by favorable institutional conditions, including access to childcare, low unemployment, economic stability, and a high level of trust in public institutions (Kocourková et al., 2023; Brabec, 2022; Matysiak et al., 2021). The Czech model of family policy, based on long-term support and substantial investment in education, appears to foster decisions to have children.

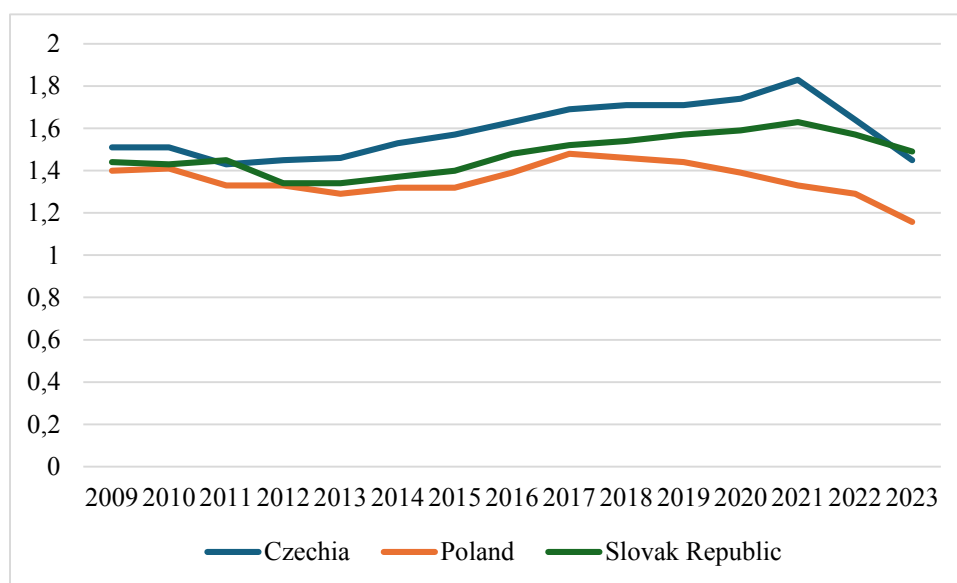


Figure 5. Changes in the Total Fertility Rate (TFR) in Czechia, Poland, and the Slovak Republic between 2009 and 2023.

Source: Authors' own research based on World Bank data.

In Poland, fertility levels were highly variable. Following a decline to 1.29 in 2013, the rate rose to 1.48 in 2017, only to decrease again to 1.33 by 2021 and to 1.16 by 2023. These fluctuations may indicate the absence of a coherent and long-term family policy strategy. The introduction of the 500+ program produced only a short-term effect, supporting the argument found in the literature that financial transfers alone are insufficient without institutional support and improvements in housing or employment conditions for families (Magda et al., 2020; Sikorska, 2021; Kaźmierczak-Kałużna, 2023).

In the Slovak Republic, a moderate yet relatively stable increase in fertility was observed—from 1.44 in 2009 to 1.63 in 2021. Although the rate of growth was slower than in Czechia, the country displayed greater consistency than Poland. The literature suggests that even with moderate financial outlays, employment stability, relatively good social infrastructure,

and predictable state policy can positively influence reproductive decisions (Hacker, 2009; Carson, 2012; Kimura, Yasui, 2023). The Slovak case aligns well with this interpretation.

The varied directions of change suggest that reproductive decisions are sensitive to a wide range of socio-economic factors, the strength and durability of which differ across countries. The increase in fertility in Czechia may point to the effectiveness of a long-term and comprehensive family policy, in contrast to the short-term impact of measures taken in Poland. Preliminary data analysis indicates that effective family support policy should rely not only on financial transfers but also on economic stability, access to childcare services, and investment in education.

The study examined the link between fertility rates (TFR) and the rate of gross domestic product (GDP) growth in three Central European countries: Poland, Czechia, and the Slovak Republic, covering the years 2009 to 2023 (Table 1).

Table 1.

Fertility Rates and GDP Growth in Poland, Czechia, and the Slovak Republic (2009-2023), with Pearson Correlation Coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	GDP growth (annual %)	fertility rate, total (births per woman)	GDP growth (annual %)	fertility rate, total (births per woman)	GDP growth (annual %)
2009	1,4	2,62	1,51	-4,80	1,44	-5,51
2010	1,41	3,17	1,51	2,71	1,43	6,79
2011	1,33	5,26	1,43	1,77	1,45	2,56
2012	1,33	1,51	1,45	-0,77	1,34	1,57
2013	1,29	0,68	1,46	-0,04	1,34	0,70
2014	1,32	3,92	1,53	2,25	1,37	2,71
2015	1,32	4,43	1,57	4,96	1,4	5,18
2016	1,39	3,03	1,63	2,58	1,48	1,95
2017	1,48	5,15	1,69	5,17	1,52	2,87
2018	1,46	6,25	1,71	2,83	1,54	4,06
2019	1,44	4,58	1,71	3,57	1,57	2,28
2020	1,39	-2,04	1,74	-5,30	1,59	-2,59
2021	1,33	6,93	1,83	4,03	1,63	5,73
2022	1,29	5,26	1,64	2,85	1,57	0,45
2023	1,158	0,14	1,45	-0,09	1,49	1,38
Pearson Correlation Coefficients	0,328		0,263		0,012	

Source: Authors' own research based on World Bank data.

In the case of Poland, the Pearson correlation coefficient was 0.328, indicating a weak positive relationship between TFR and GDP growth. However, this value is not statistically significant, which means that changes in the pace of economic growth did not have a clear impact on fertility levels during this period.

Similarly, in Czechia, the correlation coefficient was 0.263, which also did not reach statistical significance. Although Czechia experienced a systematic increase in fertility during the analyzed period, this trend cannot be directly linked to the pace of economic growth. It is more likely that other factors were responsible for the rise in TFR, such as stable family policies, investments in childcare, or a high level of job security.

The lowest correlation was observed in the Slovak Republic, where the coefficient reached only 0.012, indicating no meaningful relationship between GDP growth and TFR. This suggests that fertility levels in this country remained relatively independent of economic growth rates.

Economically, the absence of a statistically significant correlation between fertility rates and GDP growth across all three countries examined is a finding of particular relevance for comprehending the underlying dynamics of the phenomenon. These results suggest that fertility in Central Europe is not a straightforward function of the economic situation as measured by GDP growth. Given that, according to World Bank data, the population of Poland in 2023 was 36 387 353, that of Czechia was 10 864 004, and that of the Slovak Republic was 5 426 740, it is important to account for these demographic differences in the economic analysis. Since overall GDP growth does not reflect variations in population size, GDP per capita growth is considered a more precise indicator of economic well-being. Therefore, the authors decided to additionally examine and compare the relationship between GDP per capita growth and fertility rates in the three countries (Table 2).

The statistical analysis of data for Poland, Czechia, and the Slovak Republic from 2009 to 2023 allowed for an assessment of the relationship between fertility levels and the gross domestic product growth rate per capita. An effort was made to examine whether economic growth has a meaningful impact on reproductive decision-making in Central European countries. The calculated Pearson correlation coefficients were 0.24 for Poland, 0.34 for Czechia, and 0.03 for the Slovak Republic. Although these values indicate weak or very weak positive correlations, none of the results confirm a clear and statistically significant relationship. Particular attention should be paid to Czechia, the only country analyzed to show a systematic increase in fertility during the examined period. However, even in this case, it is not possible to clearly identify GDP per capita growth as the main driver of this trend. The results for the Slovak Republic clearly indicate a lack of connection between TFR and GDP per capita dynamics, suggesting that fertility levels in this country were virtually independent of economic conditions. A similar situation occurred in Poland, where, despite the short-term effects of family policies, fertility levels showed high variability and only a weak association with economic development.

Table 2.

Fertility Rate and GDP per Capita Growth in Poland, Czechia, and the Slovak Republic (2009-2023), with Pearson Correlation Coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	GDP per Capita Growth (annual %)	fertility rate, total (births per woman)	GDP per Capita Growth (annual %)	fertility rate, total (births per woman)	GDP per Capita Growth (annual %)
2009	1,4	2,55	1,51	-5,34	1,44	-5,63
2010	1,41	3,46	1,51	2,42	1,43	6,69
2011	1,33	5,20	1,43	1,56	1,45	2,43
2012	1,33	1,51	1,45	-0,91	1,34	1,40
2013	1,29	0,75	1,46	-0,07	1,34	0,60
2014	1,32	4,00	1,53	2,14	1,37	2,61
2015	1,32	4,50	1,57	4,75	1,4	5,08
2016	1,39	3,08	1,63	2,38	1,48	1,82
2017	1,48	5,14	1,69	4,89	1,52	2,72
2018	1,46	6,25	1,71	2,49	1,54	3,92
2019	1,44	4,61	1,71	3,16	1,57	2,14
2020	1,39	-1,86	1,74	-5,53	1,59	-2,67
2021	1,33	9,58	1,83	5,93	1,63	5,95
2022	1,29	5,71	1,64	1,24	1,57	0,74
2023	1,158	0,51	1,45	-1,85	1,49	1,47
Pearson Correlation Coefficients	0,242		0,345		0,035	

Source: Authors' own research based on World Bank data.

Overall, the rate of economic growth within the observed period did not prove to be a strong predictor of fertility levels in the countries analyzed. Decisions about having children are likely influenced more by institutional stability, social conditions, and cultural norms than by short-term changes in macroeconomic indicators.

Given that no significant relationship was found between reproductive decisions and GDP growth, it is important to consider other economic indicators that may better reflect the well-being of an average household and potentially influence fertility patterns. Investigating the association between the fertility rate and the unemployment rate could offer a more comprehensive understanding of the factors influencing reproductive behavior (Table 3). In Poland, the Pearson correlation coefficient between TFR and unemployment for the years 2009–2023 was -0.034, indicating no significant relationship. Despite a decline in the unemployment rate from 10.6% in 2013 to 2.8% in 2023, fertility levels did not show a clear upward trend. This may suggest that in Poland, reproductive decisions were not strongly linked to labor market conditions and were likely shaped by other factors.

In Czechia, a much stronger correlation coefficient of -0.76 was observed, indicating a clear negative relationship. As unemployment decreased, fertility levels increased. For example, unemployment fell from 6.7% in 2011 to 2.8% in 2021, while the TFR rose from 1.43 to 1.83 during the same period. These data suggest that a stable labor market may have been an important factor in encouraging family expansion in Czechia, further supported by effective family policies.

Table 3.

Relationship between fertility rate and unemployment rate in Poland, Czechia, and the Slovak Republic (2009-2023), including Pearson correlation coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	unemployment rate (percentage of the population in the labour force)	fertility rate, total (births per woman)	unemployment rate (percentage of the population in the labour force)	fertility rate, total (births per woman)	unemployment rate (percentage of the population in the labour force)
2009	1,4	8,50	1,51	6,70	1,44	12,00
2010	1,41	10,00	1,51	7,30	1,43	14,30
2011	1,33	10,00	1,43	6,70	1,45	13,50
2012	1,33	10,40	1,45	7,00	1,34	13,90
2013	1,29	10,60	1,46	7,00	1,34	14,10
2014	1,32	9,20	1,53	6,10	1,37	13,10
2015	1,32	7,70	1,57	5,10	1,4	11,50
2016	1,39	6,30	1,63	4,00	1,48	9,60
2017	1,48	5,00	1,69	2,90	1,52	8,10
2018	1,46	3,90	1,71	2,20	1,54	6,50
2019	1,44	3,30	1,71	2,00	1,57	5,70
2020	1,39	3,20	1,74	2,60	1,59	6,70
2021	1,33	3,40	1,83	2,80	1,63	6,80
2022	1,29	2,90	1,64	2,20	1,57	6,10
2023	1,158	2,80	1,45	2,60	1,49	5,80
Pearson Correlation Coefficients	-0,034		-0,760		-0,876	

Note. The unemployment rate is the number of unemployed persons as a percentage of the labour force based on the International Labour Office (ILO) definition. The labour force is the total number of people employed and unemployed. Unemployed persons comprise persons aged 15 to 74 who: - are without work during the reference week; - are available to start work within the next two weeks; - and have been actively seeking work in the past four weeks or had already found a job to start within the next three months.

Source: Authors' own research based on World Bank and Eurostat data.

The strongest correlation was recorded in the Slovak Republic, where the coefficient reached -0.876. This indicates a very strong inverse relationship between unemployment and fertility – the lower the unemployment rate, the higher the TFR. Between 2013 and 2023, unemployment fell from 14.1% to 5.8%, while fertility increased from 1.34 to 1.49. This may suggest that improved economic conditions and a greater sense of job security played a key role in reproductive decisions in that country.

Thus, the relationship between the unemployment rate and fertility level varies by country. In Poland, it was practically negligible, whereas in Czechia and the Slovak Republic, there was a strong, inverse correlation. These results confirm that the labor market, as an important socio-economic indicator, can play a significant role in shaping fertility, although its impact depends on local conditions, social policies, and public trust in the system.

Another important factor determining the stability of the economic environment is the inflation rate, which makes it essential to identify its relationship with the fertility rate (Table 4).

The statistical analysis of fertility rates and inflation in Poland, Czechia, and Slovakia from 2009 to 2023 enables an assessment of the strength and direction of the relationship between these variables in the context of the article's objective, which is to examine the relationship between fertility and selected socio-economic indicators. In Poland, the Pearson correlation coefficient was -0.534, indicating a moderate negative relationship between inflation and fertility. This means that during periods of higher inflation, especially in the years 2020-2021, a decline in fertility was observed, which may suggest that rising living costs and economic uncertainty negatively affected decisions to expand families. This result is consistent with academic literature that emphasizes the importance of economic stability in reproductive decision-making.

In the case of Czechia, the correlation coefficient was very weak, at 0.044, indicating no significant relationship between inflation and TFR. Despite a moderate increase in prices, fertility in Czechia grew steadily, suggesting that other factors, such as a stable and consistent family policy, high levels of social trust, and supportive institutional conditions, may have played a more important role in shaping reproductive decisions. In this case, inflation variability does not appear to have had a noticeable impact on fertility behavior.

Table 4.

Relationship Between Fertility Rate and Inflation in Poland, Czechia, and the Slovak Republic (2009-2023), Including Pearson Correlation Coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	inflation (annual %)	fertility rate, total (births per woman)	inflation (annual %)	fertility rate, total (births per woman)	inflation (annual %)
2009	1,4	3,80	1,51	1,02	1,44	1,62
2010	1,41	2,58	1,51	1,47	1,43	0,96
2011	1,33	4,24	1,43	1,92	1,45	3,92
2012	1,33	3,56	1,45	3,29	1,34	3,61
2013	1,29	0,99	1,46	1,44	1,34	1,40
2014	1,32	0,05	1,53	0,34	1,37	-0,08
2015	1,32	-0,87	1,57	0,31	1,4	-0,33
2016	1,39	-0,66	1,63	0,68	1,48	-0,52
2017	1,48	2,08	1,69	2,45	1,52	1,31
2018	1,46	1,81	1,71	2,15	1,54	2,51
2019	1,44	2,23	1,71	2,85	1,57	2,66
2020	1,39	3,37	1,74	3,16	1,59	1,94
2021	1,33	5,06	1,83	3,84	1,63	3,15
2022	1,29	14,43	1,64	15,10	1,57	12,77
2023	1,158	11,53	1,45	10,66	1,49	10,53
Pearson Correlation Coefficients	-0,534		0,044		0,331	

Note. Inflation, as measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

Source: Authors' own research based on World Bank data.

In Slovakia, a positive correlation of 0.331 was found, indicating a weak but noticeable positive relationship between inflation and fertility. The increase in inflation in this country coincided with rising fertility, which may suggest that other factors such as increased public spending or social support may have offset the negative effects of rising prices. It is possible that in the context of improving social and economic security, inflation was not perceived as a barrier to having children.

Hence, the relationship between inflation and fertility across the three analyzed countries was varied. In Poland, inflation had a discouraging effect, in Czechia it had little to no impact, and in Slovakia, it may have coincided with an increase in fertility. These results confirm that the influence of inflation as a socio-economic indicator on reproductive decisions is not straightforward and depends on the specific economic, political, and institutional context of each country. Therefore, the findings support the article's assumption that economic indicators alone are not sufficient to explain fertility dynamics and must be interpreted within a broader social and policy framework.

The analysis of the relationship between fertility levels and government expenditure on education (as a percentage of GDP) in Poland, Czechia, and Slovakia between 2009 and 2021 provides interesting insights in the context of modern public policy (Table 5).

Table 5.

Relationship Between Fertility Rate and Government Expenditure on Education (% of GDP) in Poland, Czechia, and the Slovak Republic (2009-2021), Including Pearson Correlation Coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	government expenditure on education, total (% of GDP)	fertility rate, total (births per woman)	government expenditure on education, total (% of GDP)	fertility rate, total (births per woman)	government expenditure on education, total (% of GDP)
2009	1,4	4,99	1,51	4,15	1,44	4,01
2010	1,41	5,11	1,51	4,03	1,43	4,04
2011	1,33	4,86	1,43	4,24	1,45	3,90
2012	1,33	4,86	1,45	4,22	1,34	3,86
2013	1,29	5,02	1,46	4,05	1,34	4,07
2014	1,32	4,97	1,53	3,97	1,37	4,22
2015	1,32	4,82	1,57	5,75	1,4	4,58
2016	1,39	4,66	1,63	5,55	1,48	3,90
2017	1,48	4,57	1,69	3,81	1,52	3,93
2018	1,46	4,61	1,71	4,27	1,54	3,95
2019	1,44	4,68	1,71	4,54	1,57	4,27
2020	1,39	4,85	1,74	4,72	1,59	4,76
2021	1,33	4,67	1,83	4,80	1,63	4,80
Pearson Correlation Coefficients	-0,506		0,292		0,494	

Note. General government expenditure on education (current, capital, and transfers) is expressed as a percentage of GDP. It includes expenditures funded by transfers from international sources to the government.

Source: Authors' own research based on World Bank data.

In Poland, the Pearson correlation coefficient was -0.506, indicating a moderate negative relationship between public education expenditure and fertility. This means that despite relatively stable government education spending, fertility not only failed to increase but showed a downward trend. While this does not imply a direct causal relationship, it highlights a potential inverse association between these two variables. One possible interpretation is that greater public investment in education may be linked to broader socioeconomic changes, such as higher educational attainment (especially among women) and delayed family planning, both of which can contribute to lower fertility rates in Poland.

In the case of Czechia, a correlation of 0.292 was observed, indicating a weak but positive relationship between education spending and fertility levels. During the analyzed period, TFR showed a consistent upward trend despite moderate levels of education expenditure, which at times were even declining. This may suggest that in Czechia, the positive impact of education on fertility may have been indirect, for example, through building trust in institutions, better organization of childcare systems, or greater social awareness regarding the balance between professional and family life.

In Slovakia, the Pearson correlation coefficient was 0.494, indicating a moderate positive relationship between the analyzed variables. This implies that in this country, higher education spending coincided with an increase in fertility levels. It may suggest that greater investment in the education sector translated into improvements in institutional infrastructure and childcare conditions, which in turn encouraged decisions to have children.

Thus, the relationship between government spending on education and fertility levels varied across the analyzed countries. In Poland, a moderate negative correlation was observed, possibly indicating either an insufficient translation of educational expenditure into effective family support or a tendency among the more educated population to postpone family expansion in favor of career development. In contrast, Czechia and Slovakia exhibited positive correlations, which may reflect more effective use of educational resources within the context of family-oriented policies. These findings align with the article's objective by demonstrating that selected socio-economic indicators, such as education spending, can influence fertility levels, although not always directly, and that their effectiveness depends on the broader political and institutional context of each country.

Various forms of government social benefits, expressed through subsidies and other transfers, represent an important component of a country's social policy, which should also be reflected in the national fertility rate. Table 6 presents data on the TFR and subsidies and other transfers (as a percentage of total government expenditure) in Poland, Czechia, and the Slovak Republic for the period 2009-2022.

The analysis of the relationship between fertility rates and government social expenditures (expressed as a percentage of public expense) in Poland, Czechia, and Slovakia from 2009 to 2022 provides important insights in the context of the article's objective, which is to identify which socio-economic indicators are significantly associated with fertility levels. In the case of

Poland, the Pearson correlation coefficient was -0.276, indicating a weak negative relationship between the analyzed variables. This means that despite relatively stable and high levels of social spending (around 44-45%), no positive impact on fertility was observed, which, in fact, declined throughout most of the analyzed period. This may suggest that social policy in Poland was not sufficiently targeted at supporting families with children or did not adequately address their actual needs.

In Czechia, a positive correlation of 0.548 was recorded, indicating a moderate positive relationship between social spending and fertility. During the analyzed period, fertility clearly increased, while public expenditures on social purposes also gradually rose. This may indicate that the Czech social protection system was effectively linked with family support mechanisms, which translated into reproductive decisions within the population. Citizens' trust in the system and a coherent family policy may have further reinforced this effect.

Table 6.

Relationship Between Fertility Rate and Subsidies and other transfers (% of expense) in Poland, Czechia, and the Slovak Republic (2009-2022), Including Pearson Correlation Coefficients

Year	Poland		Czechia		Slovak Republic	
	fertility rate, total (births per woman)	subsidies and other transfers (% of expense)	fertility rate, total (births per woman)	subsidies and other transfers (% of expense)	fertility rate, total (births per woman)	subsidies and other transfers (% of expense)
2009	1,4	44,55	1,51	46,76	1,44	48,59
2010	1,41	44,38	1,51	46,85	1,43	50,99
2011	1,33	44,23	1,43	48,53	1,45	49,36
2012	1,33	44,50	1,45	48,55	1,34	50,09
2013	1,29	45,12	1,46	51,67	1,34	50,13
2014	1,32	45,63	1,53	50,94	1,37	49,64
2015	1,32	45,57	1,57	50,90	1,4	47,60
2016	1,39	44,66	1,63	51,13	1,48	48,79
2017	1,48	44,12	1,69	51,01	1,52	47,26
2018	1,46	44,49	1,71	50,26	1,54	45,74
2019	1,44	44,63	1,71	50,29	1,57	45,30
2020	1,39	47,15	1,74	51,34	1,59	44,37
2021	1,33	44,89	1,83	51,59	1,63	44,82
2022	1,29	44,90	1,64	50,52	1,57	46,45
Pearson Correlation Coefficients	-0,276		0,548		-0,884	

Note. Subsidies, grants, and other social benefits.

Source: Authors' own research based on World Bank data.

In Slovakia, by contrast, the correlation coefficient was -0.884, indicating a very strong negative relationship between social spending and fertility levels. The data suggest that despite a high level of social expenditures, fertility did not increase and instead showed a declining trend, especially in the first half of the analyzed period. This may imply that spending was not efficiently allocated to areas that directly affect family living conditions, such as childcare services, availability of nurseries, labor market flexibility, or direct child-rearing benefits.

Thus, the relationship between government social expenditures and fertility levels varied greatly by country. In Poland and Slovakia, the negative correlation may indicate the inefficacy of social policy in supporting reproductive decisions.

In contrast, in Czechia, the positive correlation suggests that a well-designed system of social spending can positively influence fertility. These findings support the article's premise that macroeconomic indicators alone are not sufficient to explain changes in fertility and that the quality of public policies and their adaptation to the local institutional and social context play a crucial role.

5. Summary

The bibliometric analysis conducted as part of this study clearly demonstrates a geographical imbalance in fertility-related research across Europe. While Western and Northern European countries dominate the academic discourse on fertility, Central European nations, particularly Poland, Czechia, and the Slovak Republic, remain largely underexplored. This is especially surprising given the pronounced demographic challenges these countries face, including some of the lowest fertility rates in the European Union.

Although Czechia appears more frequently in the academic literature compared to its regional neighbors, the overall scarcity of comparative, policy-oriented studies focused specifically on Central Europe limits the ability of scholars and policymakers to understand the region's unique socio-economic and institutional dynamics. Accordingly, this study contributes to filling a significant gap in the literature by providing an in-depth, evidence-based analysis of fertility trends in these three countries—an area of growing importance for demographic research and public policy alike.

A comprehensive review of the literature, along with an analysis of empirical data, underscores the critical importance of addressing the issue of low fertility in Central European countries. The findings of this article confirm that fertility in selected countries of Central Europe is shaped by a complex interplay of socio-economic factors rather than by any single economic indicator. Across Poland, Czechia, and Slovakia, no statistically significant correlation was found between GDP growth and fertility levels, suggesting that macroeconomic expansion alone does not translate into higher reproductive rates. The labor market, however, showed a much stronger association, particularly in Slovakia, where the inverse correlation between unemployment and fertility was the most pronounced. Similarly, Czechia also demonstrated a significant negative correlation between unemployment and TFR, highlighting the role of employment stability.

Inflation had a discouraging effect on fertility in Poland, but this relationship was weak or inconsistent in Czechia and Slovakia. Government expenditure on education showed the most favorable correlation with fertility in Slovakia, indicating the potential impact of institutional investments. In contrast, in Poland, educational spending correlated negatively with fertility, revealing possible inefficiencies in translating public investment into family support outcomes. This means that despite relatively stable education spending, fertility not only failed to increase but showed a downward trend. While this does not imply a direct causal relationship, it highlights a potential inverse association between these two variables. One possible interpretation is that greater investment in education may be linked to broader socioeconomic changes, such as higher educational attainment (especially among women) and delayed family planning, both of which can contribute to lower fertility rates in Poland. These findings underscore the importance of further investigation into the complex interactions between educational investment, social behavior, and demographic trends.

Regarding social spending, Czechia again showed a moderate positive correlation, while Slovakia revealed a strongly negative one, pointing to structural mismatches in how resources were allocated.

Overall, the most meaningful associations with fertility were observed in Czechia, where both social and labor market indicators aligned with rising fertility rates. This suggests that a consistent and coherent family policy embedded in a stable institutional environment is more influential in shaping reproductive behavior than purely economic growth metrics.

The analysis demonstrates that low fertility levels cannot be fully accounted for by economic factors alone. While economic conditions undoubtedly play a role, their influence varies significantly across countries and does not appear to be the primary determinant. The divergent patterns observed suggest that fertility outcomes result from a broader constellation of influences, including institutional settings, social trust, and cultural norms. These findings imply that economic incentives and constraints, though important, are insufficient on their own to shape reproductive behavior. Therefore, effective policy responses must consider the multifaceted nature of fertility determinants beyond purely economic dimensions.

An important practical implication of this study is that economic indicators exhibited divergent effects on fertility levels across different countries. This highlights the need for a more nuanced and in-depth examination of the economic determinants of fertility.

Another key implication for fiscal policy is the recognition that purely economic instruments are insufficient to stimulate higher fertility. This underscores the growing importance of modern public policy to anticipate potential demographic challenges and risks and to design proactive economic measures aimed at mitigating their long-term impact.

The analysis shows that family policies based solely on financial transfers have a limited and short-term effect on increasing fertility. The most effective measures combine financial support with access to childcare services, labour market flexibility, and affordable housing.

Country-specific differences were also observed—Czechia and Slovakia seem to achieve relatively better outcomes, potentially due to the more comprehensive nature of their interventions. These findings highlight the importance of integrated, long-term family policy strategies tailored to national socio-economic contexts.

Thus, the findings of this study have led the authors to identify several directions for further research:

1. Expanding the analysis through a PEST framework to examine the issue of low fertility in Central European countries, particularly Poland, which has the lowest fertility rate among the countries studied.
2. Investigating the risks associated with persistently low fertility in Central Europe and exploring strategies for mitigating these risks through appropriate economic mechanisms.

However, it is important to acknowledge that this study focused exclusively on selected macroeconomic indicators and employed only the Pearson correlation coefficient to assess statistical relationships. While this approach provides initial insights into potential associations, it does not capture non-linear dynamics, lag effects, or the influence of cultural, political, or institutional factors. Further research using multivariate models and broader socio-demographic data is needed to fully understand the complexity of fertility trends in Central Europe. These limitations should be taken into account when interpreting the results and formulating policy recommendations.

References

1. Brabec, T. (2022). *Population development and social structure of the population of Prague in the context of European cities*. Praha: IPR Praha.
2. Carson, S.A. (2012). Fertility and Public Policy: How to Reverse the Trend of Declining Birth Rates. *The Social Science Journal*, Iss. 49, No. 2, pp. 245-246. <https://doi.org/10.1016/j.soscij.2012.04.007>
3. CZSO (2025). *Births*. Retrieved from: <https://csu.gov.cz/births?pocet=10&start=0&podskupiny=133&razeni=-datumVydani>, 26.06.2025.
4. Gauthier, A.H. (2007). The impact of family policies on fertility in industrialized countries: a review of the literature. *Population Research and Policy Review*, Iss. 26, No. 3, pp. 323-346.
5. GUS (2025). *Polska w liczbach 2025*. Retrieved from: <https://stat.gov.pl>, 26.06.2025.
6. Hacker, B. (2009). Hybridization Instead of Clustering: Transformation Processes of Welfare Policies in Central and Eastern Europe. *Social Policy & Administration*, Iss. 43, No. 2, 152-169.

7. Kaźmierczak-Kałużna, I. (2023). Fertility as an object of influence of public policies of the state. *Social Policy Issues*, Iss. 62, No. 3, pp. 1-19. <https://doi.org/10.31971/pps/172233>
8. Kimura, M., Yasui, D. (2023). Fertility differential, public policy, and development. *Economics Letters*, Iss. 226, 111105. <https://doi.org/10.1016/j.econlet.2023.111105>
9. Kocourková, J., Šťastná, A., Burcin, B. (2023). The influence of the increasing use of assisted reproduction technologies on the recent growth in fertility in Czechia. *Scientific Reports*, Iss. 13, 10854. <https://doi.org/10.1038/s41598-023-37071-7>
10. Luci-Greulich, A., Thévenon, O. (2013). The impact of family policies on fertility trends in developed countries. *European Journal of Population*, Iss. 29, No. 4, pp. 387-416.
11. Lutz, W., O'Neill, B.C., Scherbov, S. (2008). Demographics. Europe's population. *Science*, Iss. 299, No. 5615, pp. 1991-1992.
12. Magda, I., Kiełczewska, A., Brandt, N. (2020). The effect of child benefit on female labor supply. *IZA Journal of Labor Policy*, Vol. 10, Iss. 1, <https://doi.org/10.2478/izajolp-2020-0017>
13. Matysiak, A., Sobotka, T., Vignoli, D. (2021). The Great Recession and Fertility in Europe: A Sub-national Analysis. *European Journal of Population*. Iss. 37, pp. 29-64. <https://doi.org/10.1007/s10680-020-09556-y>
14. McDonald, P. (2006). Low fertility and the state: The efficacy of policy. *Population and Development Review*, Iss. 32, No. 3, pp. 485-510.
15. Mills, M., Rindfuss, R.R., McDonald, P., Te Velde, E. (2011). Why do people postpone parenthood? Reasons and social policy incentives. *Human Reproduction Update*, Iss. 17, No. 6, pp. 848-860.
16. Sikorska, M. (2021). Is it possible to increase the fertility rate in Poland? *IBS Policy Paper*, Vol. 4.
17. Sobotka, T., Zeman, K., Kantorová, V. (2021). Childbearing postponed and foregone: fertility trends and policy responses. *Population and Development Review*, Iss. 47, No. S1, pp. 55-80.
18. Statistical Office of the SR (2025). *Demographic development in Slovakia in 2024*. Retrieved from: <https://slovak.statistics.sk>, 26.06.2025.

DETERMINATION OF EVACUATION TIMES OF EMPLOYEES FROM A PRODUCTION AND SERVICE BUILDING USING A COMPUTER APPLICATION

Adam DUDA^{1*}, Patrycja ZORYCHTA²

¹ Faculty of Mining, Safety Engineering and Industrial Automation; adam.duda@polsl.pl,
ORCID: 0000-0003-4952-828X

² EXTIN Fire Protection Consulting Office; p.zorychta2002@gmail.com

* Correspondence author

Purpose: This paper presents the results of a computer simulation of the evacuation of employees from a manufacturing and service building. Pathfinder specialist software was used to carry out the simulation. As part of the research described in the article, a digital model of the analysed building was created, taking into account its architectural layout, the number and distribution of employees and the available evacuation routes. A number of simulations were carried out for different hazard scenarios and variants of space organisation and occupant behaviour. Based on the results, evacuation times were determined and possible bottlenecks and elements that need to be optimised in order to improve employee safety during emergencies were identified.

Design/methodology/approach: The main objective of the article was to examine the evacuation times of employees from the building. The article uses the results of computer simulations and trial evacuations of employees from the building.

Findings: The results obtained made it possible to check the time differences between the actual evacuation and the results of the computer simulation of the evacuation. In addition, the assumption of different scenarios in the computer simulation made it possible to determine the evacuation times when additional obstacles to its implementation occurred.

Practical implications: The results obtained made it possible to verify the effectiveness of evacuation for various emergency scenarios occurring in the analysed company.

Originality/value: The article is aimed at companies that, by using computer simulation for employee evacuation, can assume various evacuation scenarios and thus apply procedures to ensure the safety of employees in the event of an emergency.

Keywords: safety, evacuation, computer simulation, fire.

Category of the paper: research paper, case study.

1. Introduction

The primary duty of the employer is to ensure the safety of employees in the workplace. This obligation is fulfilled by means of the organizational measures taken and the technical means used, both in the area of occupational health and safety and the area related to the safety of the buildings and grounds on which employees work. In both of these spaces, the employer's actions result from the implementation of current regulations, which the employer's relevant departments monitor with regard to changes in new obligations and legal requirements. In accordance with the current provisions of the Decree of the Minister of Internal Affairs and Administration of June 7, 2010 on fire protection of buildings, other buildings and grounds (2023), more specifically - chapter 4, paragraph 17a, an obligation is imposed to conduct a trial evacuation in a building with more than 50 permanent occupants.

Checking the time to get all building occupants outside, if necessary, is a key element for life safety. In existing buildings, there is no problem with conducting a test evacuation in the organization, due to the participation of those responsible for health and safety at the enterprise and ensuring fire safety, as well as representatives of the State Fire Service. The situation may be different when constructing new buildings or carrying out construction work on the premises of existing buildings (reconstruction, expansion) if there are design or execution errors that require carrying out additional construction work or obtaining a variance in the scope of a particular provision, for example, when the building does not meet the maximum length of the evacuation access, an evacuation simulation is carried out, which reproduces the time of potential evacuation. This simulation is intended to show that despite the fact that all building requirements are not met, the safety of users will not be affected.

Using modern evacuation simulation software, it is possible to accurately plan the most effective evacuation routes and predict how people will move in emergency situations. The results obtained from the simulations are used by the employer to improve the safety of employees in emergency situations requiring evacuation, such as fire, chemical spills or terrorist threats. The primary purpose of conducting simulations is to identify potential hazards, traffic bottlenecks and evaluate the effectiveness of evacuation procedures. The models adopted in simulations allow a realistic representation of the behavior of people in the above-mentioned emergency situations, the literature distinguishes several main approaches to evacuation modeling: macroscopic models - e.g., flow-based models in which the crowd is treated as a liquid (Hughes, 2002), microscopic models - focus on the individual behavior of people, e.g., Agent-Based Modeling, where each worker is represented by an independent agent with specific characteristics and decisions (Pan et al., 2006), Cellular model - space is divided into a grid and simulated people move according to specific rules (Blue et al., 2001), Social Force Model - describes pedestrian behavior as a result of physical and psychological forces (Helbing et al., 2000).

Simulations are carried out using various programs and applications, e.g. Pathfinder - a tool based on the agent and force model, popular in building design, FDS+Evac - combines fire modeling (FDS) with human evacuation, AnyLogic - an agent modeling environment with extensive crowd simulation capabilities, A-evac (Aamks component) models human evacuation in a fire environment produced by a zonal fire model simulator.

The above-mentioned simulation models and software provide a very wide range of possibilities for application in industry. Boonmee et al., (2021) presented an integrated evacuation model for an industrial plant, combining multi-criteria decision analysis (MCDA) techniques with fire and evacuation simulation. The study used also Fire Dynamics Simulation to model fire development and Pathfinder to simulate agent evacuation. Various scenarios were analyzed, taking into account factors such as the location of the fire, the number of people and the presence of people with disabilities. Lu T et al. (2015) studied the influence of behavioral factors in evacuation, where an agent-based approach was used with varying levels of employee knowledge of exit placement and knowledge of procedures. Scenarios with low knowledge of procedures led to bottlenecks and chaotic crowd movement. In office buildings and skyscrapers, Ronchi et al. (2013) analyzed the effectiveness of evacuation using passenger lifts. In traditional systems, elevators are automatically deactivated during a fire.

However, simulations with Pathfinder and an additional queuing algorithm have shown that the use of elevators according to specific strictures (NFPA 101 standard) can significantly reduce evacuation times, especially for people with limited mobility. In a study by Alazbah et al. (2023), artificial intelligence (AI) techniques, particularly multi-agent systems (MAS), were used to build a simulation model of evacuation from hazardous locations. NetLogo was used as a simulation tool to comprehensively understand human behavior in hazardous environments, using AI and MAS, a simulation model was created to capture the complex dynamics of evacuation scenarios. Lovreglio et al. (2016) studied the behavior of office workers, analyzing the impact of stress levels and familiarity with the building on decision-making during an evacuation. The study used a virtual reality (VR) environment. Kuligowski et al. (2010, 2013) included empirical data from evacuees after the 9/11 attack in their analysis of the World Trade Center evacuation, the study found that lack of information and ambiguous messages were significant factors in delaying evacuation. Computer simulations confirmed that fast, unambiguous communication could reduce evacuation times by up to 25%.

Evacuation from a shopping center was analyzed by Cao et al. (2018), and the work included experiments and simulation modeling at different levels of visibility, analyzing the evacuation behavior of evacuees under conditions of good and limited visibility, focusing on the choice of emergency exits and evacuation time. The results showed that limited visibility significantly affects evacuation decisions and can lead to delays in exiting a building. Niu et al. (2023) presented a study that used an improved version of the YOLOv5s model in conjunction with AnyLogic to simulate emergency evacuation. The study focused on analyzing crowd behavior under conditions of reduced visibility due to smoke and optimizing evacuation strategies based

on video detection data. The results showed that integrating video detection data with agent-based simulations can significantly improve the effectiveness of emergency evacuation.

This paper presents results from a simulation of employee evacuation from a service and production building using Pathfinder software. The research presented in the article and its results are original findings of work carried out by a researcher and a student who is a member of a research club, and are being published for the first time.

2. Methods and results

During the research work described in this article, two research methods were used: the experimental method, involving a physical evacuation from a building, and the computer simulation method, using the commercially available Pathfinder software. This choice was dictated by the nature of the article and the authors' access to a specific computer application.

In order to be able to evaluate the evacuation time of all people from the building, it is necessary to carry out a trial evacuation, this is usually done on the basis of an evacuation scenario, prepared by health and safety services. On the other hand, new possibilities are provided by a program used to simulate evacuation. The result of the evacuation time obtained as a result of the simulation is an information or warning for the employer about the possibility of problems during the evacuation of employees. Before the actual evacuation as well as carrying out its computer simulation, technical data must be established, such:

- fire resistance class,
- fire load density,
- human hazard category,
- number and area of fire zones,
- the height category of the building and the use of the zones.

Having established the above-mentioned parameters in the enterprise, compliance with the regulations on escape routes, the width and number of emergency exits, signage, water supply for external firefighting, the number and filling of fire extinguishers, the efficiency of fire extinguishing systems, the layout of the fire route, the timing of inspections of equipment, the list of people familiarized with the fire safety manual in the production and warehouse building with office and social facilities was checked.

The longest passage in the hall is 115 m (allowed due to the height of the hall >5 m, which gives the possibility of extending the evacuation passage by 25%), in the gatehouse building 5 m and in the administration building 28 m, and in each case the passage does not exceed 3 rooms and has an appropriate width.

Emergency exits (Figure 1) located in the production and storage hall must open to the outside (condition fulfilled) due to the possibility of more than 50 people at once. Due to the insufficient anticipated number of people, the provision does not apply to the administrative part as well as the gatehouse building.



Figure 1. Emergency exit.

Source: Own elaboration.

Doors used to evacuate people from the hall and from the office building met the minimum width of min.1.2 m and 0.9 m respectively.

The length of the evacuation access is measured along the axis of the evacuation route, according to the wording of Article 256 of the Ordinance of the Minister of Infrastructure of April 12, 2002 on the technical conditions to be met by buildings and their location (2022), the length of the evacuation route from the exit of a room on this route to the exit to another fire zone or outside the building, hereinafter referred to as “evacuation access”. If the evacuation access is terminated by a fire vestibule, this length is measured to the first door of this vestibule, the permissible lengths of evacuation accesses in different types of fire zones for production and storage (PM)/hazardous people (ZL) buildings are shown in Table 1.

Table 1.

Length of emergency accesses

Number	Type of fire zone	Length of access (m)	
		with one access	with at least 2 accesses
1	With explosive room	10	40
2	PM with fire load density $Q > 500 \text{ MJ/m}^2$ without explosive room	30	60
3	PM with fire load density $Q < 500 \text{ MJ/m}^2$ without explosive room	60	100
4	ZL I, II i V	10	40
5	ZL III	30	60
6	ZL IV	60	100

Source: Own elaboration based on: Regulation of the Minister of Infrastructure of April 12, 2002 on technical conditions to be met by buildings and their location.

In the hall area, the length of the access does not exceed 70 m (allowed 100 m due to the presence of more than one access in the zone), while in the office building, which also has more than one evacuation access, the length does not exceed 30 m.

An additional factor that contributes to a more efficient exit from any place in the hall or social and office building are visible signs (at least one), so that you know which way to go to get to the nearest emergency exit (Figure 2).



Figure 2. Evacuation signs.

Source: Own elaboration.

After analyzing the regulations on the efficiency of movement along evacuation routes to the outside or to an adjacent fire zone, it was concluded that technical conditions should not negatively affect evacuation times. In addition, the distribution of fire extinguishing agents in key locations and evacuation routes was also checked. It was found that they were selected in accordance with the regulations, i.e. for each 100 m² of the zone classified as a human hazard, min. 2 kg of extinguishing agent and, in the case of a zone classified as production and storage, for every 300 m² also min. 2 kg of extinguishing agent. In the fire zone classified as PM, internal hydrants have been placed to provide water coverage over the entire area of the hall. According to the provisions of §6(3) of the Regulation of the Minister of Internal Affairs and Administration of July 24, 2009 on fire water supply and fire roads (2009), the basis for adopting the calculation of the amount of water needed for the entire plant is the fire zone requiring the largest amount of water, i.e. 30 l/s. Using the same provision, a compliant fire road was brought to the plant. Due to the volume exceeding 1000 m³, a fire safety instruction was developed, regularly updated every two years, and the facility was secured with a fire circuit breaker, which cuts off the flow of electricity to all circuits excluding those needed during a fire.

2.1. Running simulations using Pathfinder software

The first stage of the work was to model the geometry of the object. To do this, a CAD file in a suitable format (e.g., DWG or IFC) was imported, and if necessary - missing elements were completed or drawn directly in the Pathfinder editor (Figure 3). Care was taken to ensure that all relevant building components, such as walls, doors, staircases, elevator shafts and emergency exits, were correctly mapped. The floors were then defined - each level was assigned a height and its connections to other levels were defined, creating logical connections (stairs, ramps, vertical passages).

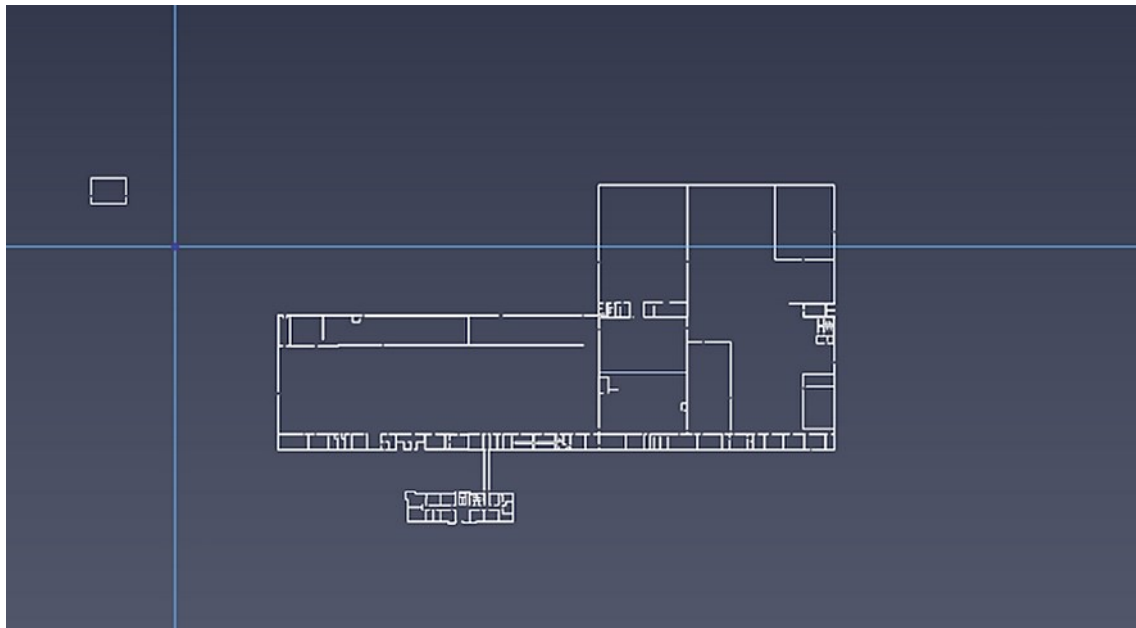


Figure 3. Imported projections to Pathfinder.

Source: Own elaboration.

In the following part, the usable area of the building (Figure 4) and the space surrounding the plant were determined, which made it possible to simulate the removal of people to the assembly areas, as shown later in the article in Figure 7. In the later stage of the work, on mapping the space of the building, more than 100 m² of free space was removed due to the locations of industrial machinery or racks, so that this space was not included in the simulation performed by the computer application. The program requires the user to map the area in such a way as to ensure the free movement of workers and other people scheduled for evacuation. Subsequently, doorways with a minimum width of 0.9 m were plotted according to the actual situation based on the floor plan, and a staircase with a mezzanine floor was added (Figure 5), which makes it possible to simulate the evacuation of people on the upper floor. Traffic on the staircase was adopted in accordance with the standards-right-hand traffic.

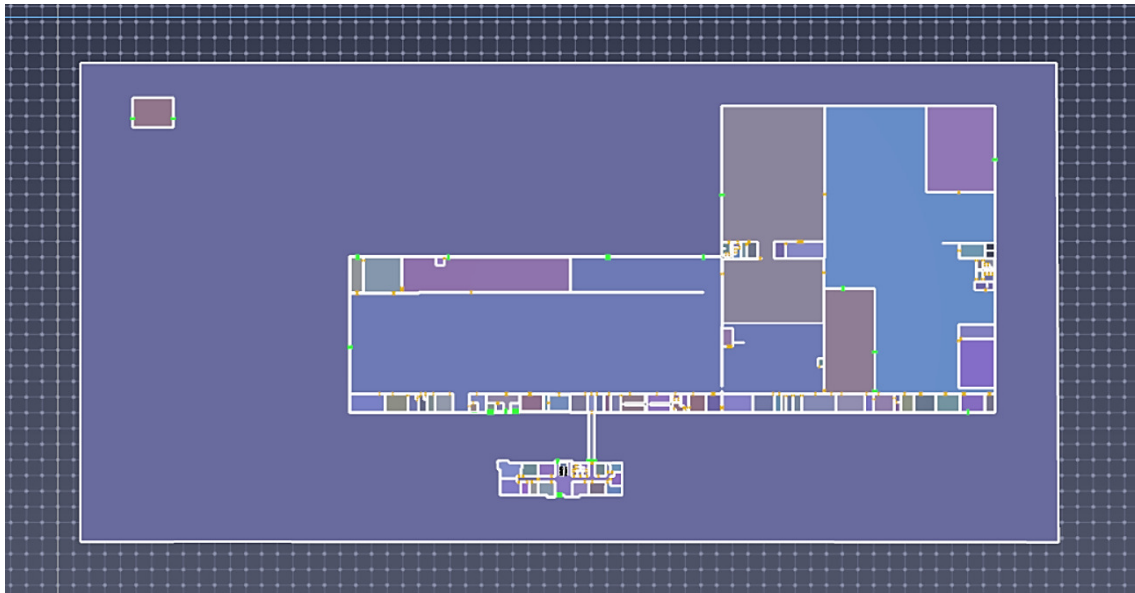


Figure 4. Mapping surfaces and exits.

Source: Own elaboration.

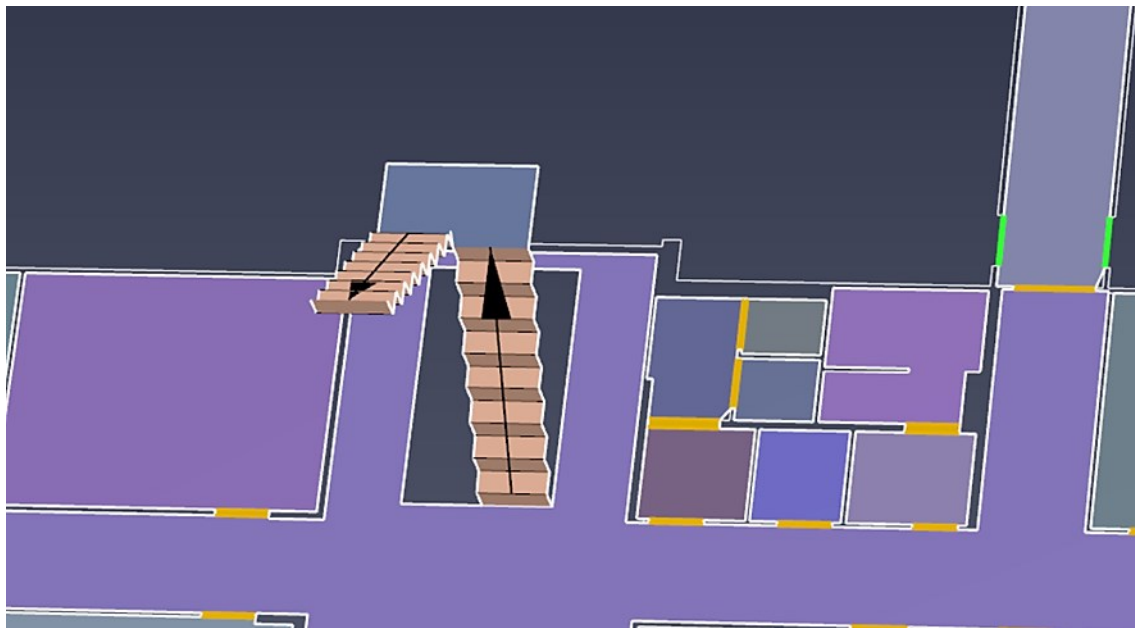


Figure 5. Staircase.

Source: Own elaboration.

The next stage of the work within the created simulation was the construction of profiles of the plant's occupants during the evacuation, consisting of office, production, and security personnel (Figure 6). The aforementioned people were given their physical appearance using available 3D models. They were tasked with a speed corresponding to standard moving conditions, i.e. 1.2 m/s. Each person occupied an area with a diameter of 45 cm around their own axis.

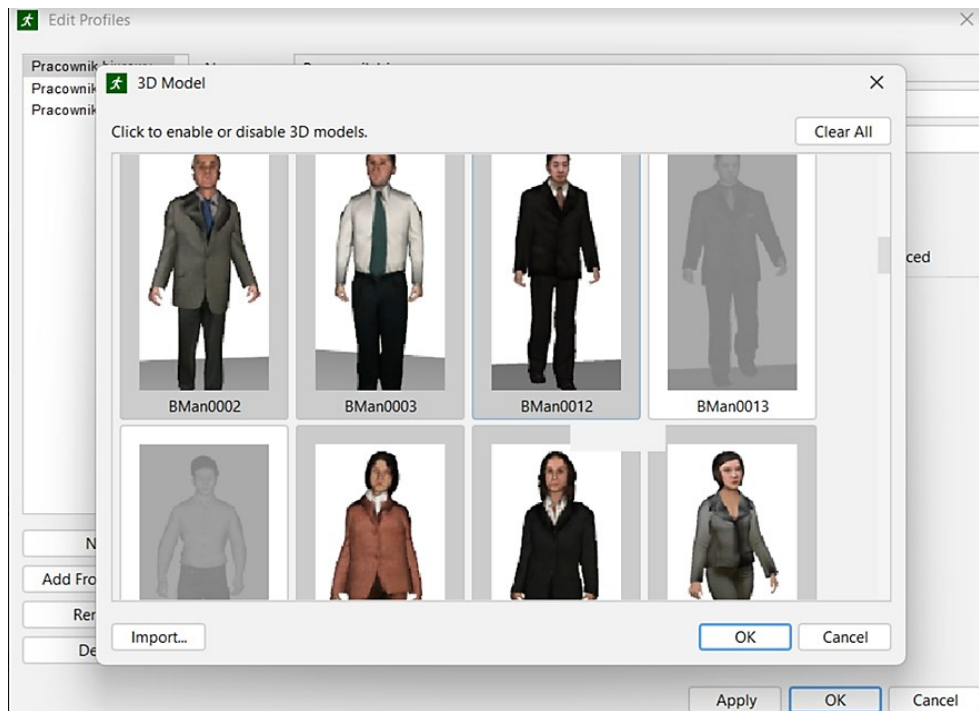


Figure 6. Attribution of characteristics to employees.

Source: Own elaboration.

Next, evacuation paths were defined for each group, which meant that production workers, together with a security officer, were directed to an assembly point located at the gatehouse, and office workers to an assembly point in front of the office part of the building (Figure 7). The team of blue-collar workers had 9 opportunities to get out of the zone, while the rest had a well-defined track marked in green in Figure 8. To make this possible, behaviors of going to designated places were created and assigned to people located in accordance with the place corresponding to the type of work performed.

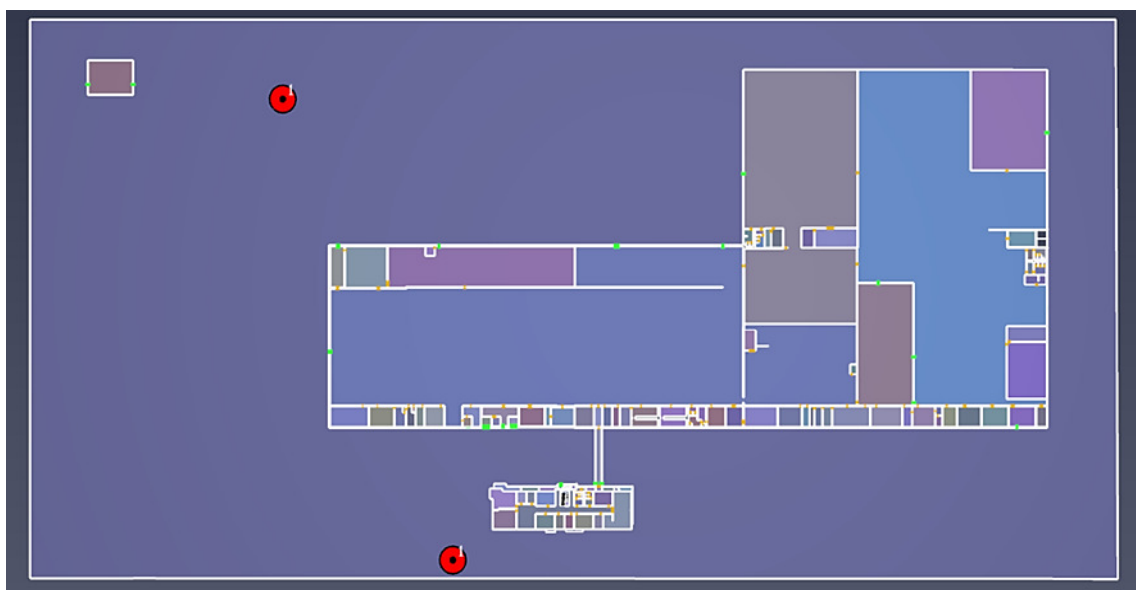


Figure 7. Designated assembly points for evacuation.

Source: Own elaboration.

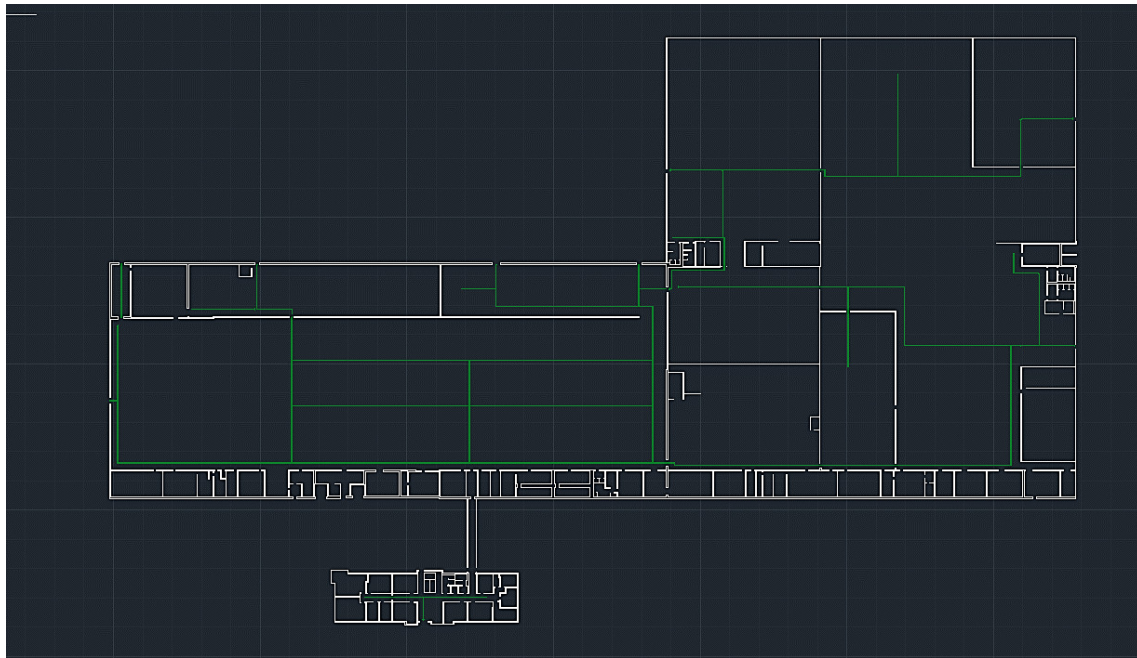


Figure 8. Evacuation routes (ground floor).

Source: Own elaboration.

The trial evacuation scenario is designed not only to test the effectiveness of procedures, but also to increase the sense of security among employees and prepare them for an actual emergency.

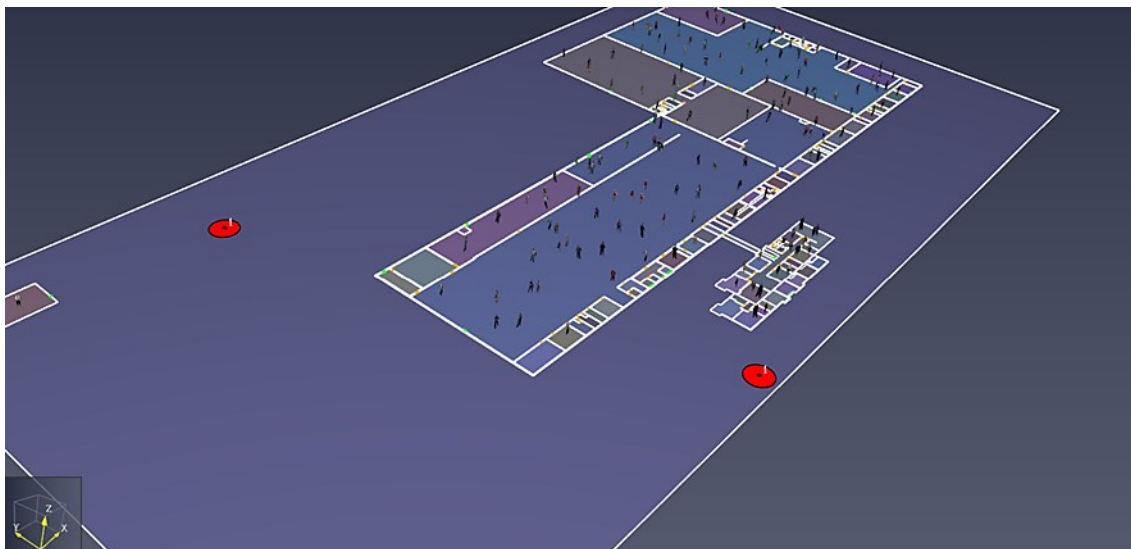


Figure 9. 3D view.

Source: Own elaboration.

Simulation 1 - the standard evacuation course assumes smooth, coordinated actions that ensure the safety of all people in a building or area. It is based on pre-assumed conditions and behaviors, as shown in the 3D view in Figure 9.

Simulation 2 - The scenario assuming that the signage at the plant was incorrect. The reaction of evacuees changes, people went in a direction that deviated from the planned evacuation route. In order for the assumptions to be reflected in the program, two destination points were added as in Figure 10, where evacuees had to be located, after which they went to the already designated destination.

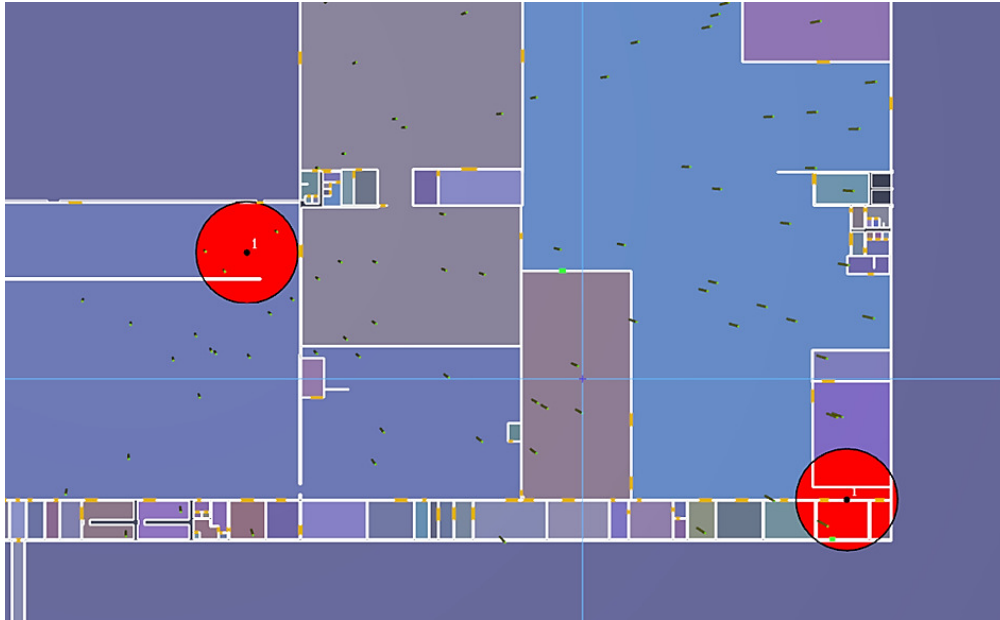


Figure 10. Places of incorrect evacuation.

Source: Own elaboration.

Simulation 3 - Scenario assuming obstacles on escape routes. A fire was assumed to occur in the southern part of the production hall. As a result of the rapid spread of the fire and the increase in temperature, the load-bearing capacity of the ceiling was significantly weakened. The structure could not withstand the load under fire conditions and there was a partial collapse of the ceiling. Falling structural elements and concrete fragments blocked three of the nine emergency exits for production workers. On the other side of the building, in the office section, which was separated from the production hall by a communication connecting passageway, there was damage to the ceiling in the main lobby, where one of the emergency exits was located. The structure in this part did not collapse completely, but detached fragments of suspended ceilings, falling elements of the ceiling installation and intense smoke made this exit considered impassable and out of service.

In order to best represent the conditions, the selected doorway was treated as a section of the building wall as in Figure 11.

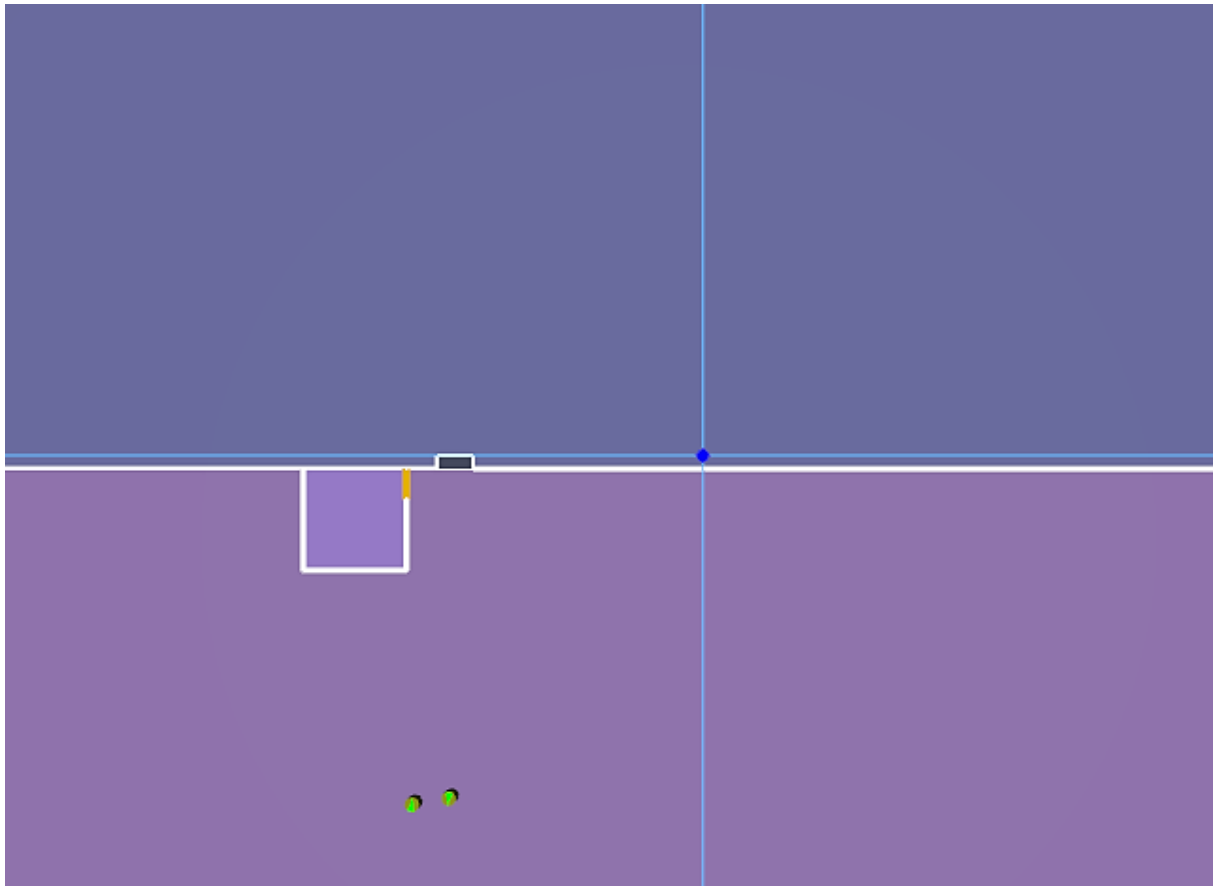


Figure 11. Blocked doorways.

Source: Own elaboration.

3. Discussion

The first simulation resulted (Figure 12) in an evacuation duration of 5 minutes and 5 seconds. Thanks to the possibility of comparing the time of the simulation carried out with the time of the last trial evacuation at the plant, for which the evacuation time was 5 minutes and 37 seconds, it can be concluded that the program reproduces in a very good way the conditions that accompany the occurrence of a threat to life and property.

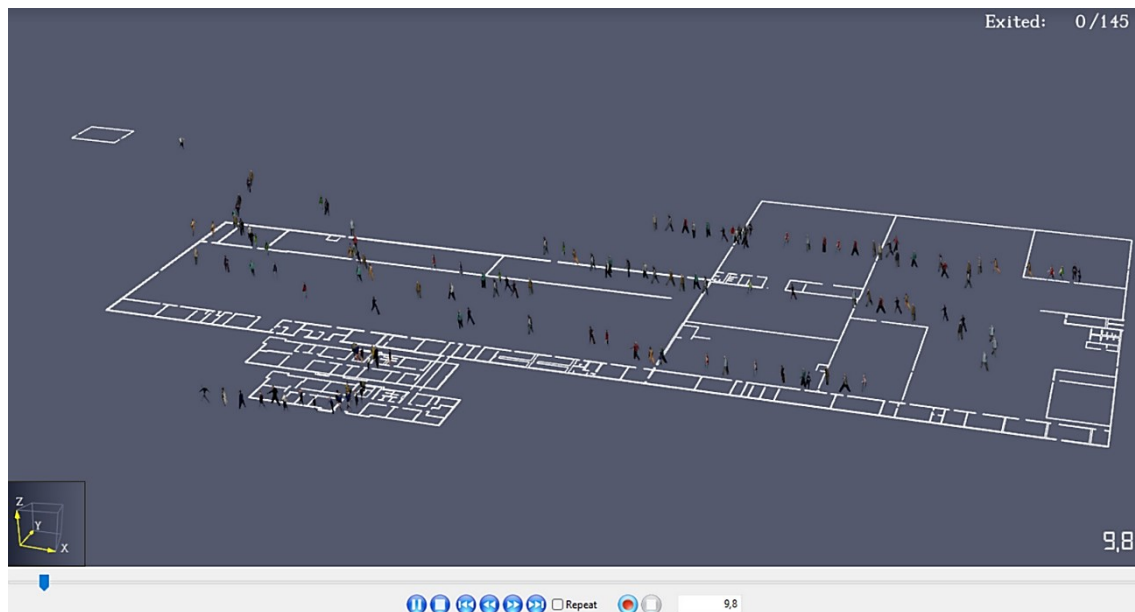


Figure 12. Simulation 1 – standard evacuation procedure.

Source: Own elaboration.

The evacuation time in the second scenario was 6 minutes and 57 seconds, which differed significantly from the time expected for a correctly marked route. Due to incorrect signage, the evacuation participants had to cover a route that was more than 60 metres longer (Figure 13).

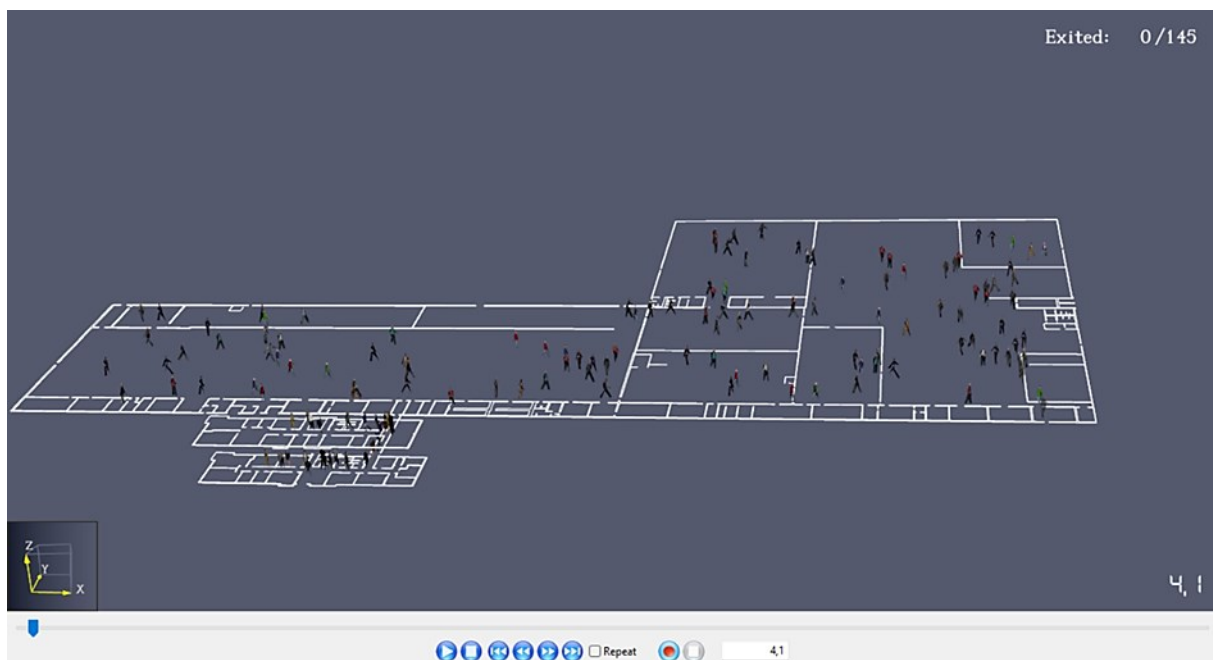


Figure 13. Simulation 2 – evacuation in incorrect direction.

Source: Own elaboration.

In scenario three due to the limitation of available exits, workers had fewer evacuation options, resulting in an increase in evacuation time by 33 seconds compared to the standard scenario - to 5 minutes and 38 seconds (Figure 14).



Figure 14. Simulation 3 – evacuation with some emergency exits unavailable.

Source: Own elaboration.

Data of the times from the conducted scenarios are shown in the table (Table 2).

Table 2.
Evacuation times

Scenario	Time
Sample evacuation at the plant	5 minutes and 37 seconds
Scenario 1	5 minutes and 5 seconds
Scenario 2	6 minutes and 57 seconds
Scenario 3	5 minutes and 38 seconds

The differences in evacuation times presented in the table above may not seem significant, but they should be considered in relation to the conditions that threaten the life and health of employees during fires and emergencies, when every minute of delay in leaving the danger zone is of great importance, especially in a situation where the threat is spreading, for example, a fire spreading and blocking or closing of subsequent zones or rooms in the building affected by the fire.

The strength of using computer simulations to analyse the employees' behaviour and their choice of escape routes during emergency situations is the ability to build various scenarios and then, based on the results obtained, modify the designation and marking of escape routes. The above activities are possible without incurring losses for the entrepreneur associated with the need to suspend production, which occurs during an actual evacuation of employees. The disadvantages include the need for a very detailed analysis of the construction documentation and a complete reflection of the building's structure when mapping it to the computer programme used, which requires knowledge of both the software and aspects related to fire protection.

The research identified the elements that require special attention when designating material storage areas in a company so that key escape routes are not blocked. It also identified the importance of training employees on these escape routes and properly marking all elements related to the evacuation of employees from the building. The results also confirmed that the simulation of employee evacuation times from the building, carried out using a computer application, accurately reflected the actual conditions that occurred during the physical evacuation of employees.

In further research, computer simulations will be carried out on other buildings, where tests will also be conducted assuming various scenarios of emergency situations, such as fires and, for example, toxic substance leaks requiring the evacuation of employees from the building.

4. Conclusions

The main difference between a trial evacuation and an evacuation at the time of a potential emergency is that a trial is designed to evaluate and refine procedures under controlled conditions, while an evacuation in an actual emergency takes place under stress and uncertainty, where speed of response, clarity of communication and adherence to procedures are crucial.

The program effectively replicated the behavior of employees during an evacuation. The difference in times between the trial evacuation and the assumed scenario 1 was only 32 seconds. Such a result demonstrates the high precision of the simulation, which largely corresponds to actual evacuation conditions.

Simulation 2 showed that erroneous signage has a significant impact on increasing the total evacuation time, and can also lead to dangerous confusion for some employees, especially those unfamiliar with the current organization of the space. This scenario clearly indicates the need for regular review and verification of the compatibility of evacuation signage with the actual spatial layout of the building, as well as the need for training and refresher exercises that consolidate the patterns of correct action in emergency situations.

The blocking of most of the emergency exits in the production section and the cutting off of one of the exits in the office section, as shown in Scenario 3, severely overloaded the remaining available routes. As a result, evacuation times were significantly increased, and local congestion and slowdowns were created at some points in the facility, which could pose a real threat to the life and health of evacuees.

The preventive measures implemented at the plant are yielding positive results, as no fires have been reported so far. And carrying out trial evacuations eliminates the possibility of unforeseen situations as well as allows verification of the current state and the introduction of possible additional solutions.

A computer program can help plan, model and simulate the evacuation process, but it is not a substitute for a physical evacuation. Computer simulations can show how people will move in different evacuation scenarios, allowing optimization of evacuation routes and identification of potential problems, such as narrow corridors, congestion or improper exit placement.

It is worth noting that prevention is often much cheaper than repairing damage.

Maintaining fire protection systems and regularly training employees are investments that save money in the long run. With effective prevention, it is possible not only to reduce the risk of fire, but also to protect life, property and the environment, ultimately benefiting society as a whole.

References

1. Alazbah, A., Fakeeh, K., Rabie, O. (2023). *Enhancing Evacuation Planning through Multi-Agent Simulation and Artificial Intelligence: Understanding Human Behavior in Hazardous Environments*. Retrieved from: <https://arxiv.org/pdf/2307.09485>.
2. Blue, V., Adler, J. (2001). Cellular automata microsimulation for modeling bi-directional pedestrian walkways. *Transportation Research Part B: Methodological*, Vol. 35, Iss. 3, pp. 293-312, doi.org/10.1016/S0191-2615(99)00052-1.
3. Boonmee, J., Phruksaphanrat, N. (2021). Integrated IEW-TOPSIS and fire dynamics simulation for agent-based evacuation modeling in industrial safety. *Safety*, 7(2), 47. doi.org/10.3390/safety7020047.
4. Cao, S., Fu, L., Wang, P., Zeng, G., Song, W. (2018). Experimental and modeling study on evacuation under good and limited visibility in a supermarket. *Fire Safety Journal*, Vol. 102, pp. 27-36, doi.org/10.1016/j.firesaf.2018.10.003.
5. Decree of the Minister of Infrastructure of April 12, 2002 on the technical conditions to be met by buildings and their location. Dz.U.2022.0.1225 (2022).
6. Decree of the Minister of Internal Affairs and Administration of June 7, 2010 on fire protection of buildings, other buildings and grounds. Dz.U.2023.0.822 (2023).
7. Decree of the Minister of Internal Affairs and Administration of July 24, 2009 on fire water supply and fire roads. Dz.U.2009.124.1030 (2009).
8. Helbing, D., Farkas, I., Vicsek, T. (2000). Simulating dynamical features of escape panic. *Nature*, 407, pp. 487-490, doi.org/10.1038/35035023.
9. Hughes, R. (2002). A continuum theory for the flow of pedestrians. *Transportation Research Part B: Methodological*, Vol. 36, Iss. 6, pp. 507-535, doi.org/10.1016/S0191-2615(01)00015-7.

10. Kuligowski, E., Peacock, R., Averill, J. (2013). Modeling the Evacuation of the World Trade Center Towers on September 11, 2001. *Fire Technology*, Vol. 49, pp. 65-81, doi.org/10.1007/s10694-011-0240-y.
11. Kuligowski, E., Peacock, R., Hoskins, B. (2010). *A review of building evacuation models. U.S. Department of Commerce, NIST Technical Note 2nd Edition*. Retrieved from: https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=906951.
12. Lovreglio, R., Ronchi, E., Nilsson, D. (2016). An Evacuation Decision Model based on perceived risk, social influence and behavioral uncertainty. *Simulation Modelling Practice and Theory*, Vol. 66, pp. 226-242, doi.org/10.1016/j.simpat.2016.03.006.
13. Lu, T., Mingyuan, H., Hui, L. (2015). Agent-based simulation of building evacuation: Combining human behavior with predictable spatial accessibility in a fire emergency. *Information Sciences*, Vol. 295, pp. 53-66, doi.org/10.1016/j.ins.2014.09.029.
14. Niu, C., Wang, W., Guo, H., Li, K. (2023). Emergency Evacuation Simulation Study Based on Improved YOLOv5s and Anylogic. *Applied Sciences*. Vol. 13, Iss. 9, <https://doi.org/10.3390/app13095812>.
15. Pan, X., Han, C., Dauber, K., Law, K. (2006). Human and social behavior in computational modeling and analysis of egress. *Automation in Construction*, Vol. 15, Iss. 4, pp. 448-461, doi.org/10.1016/j.autcon.2005.06.006.
16. Ronchi, E., Nilsson, D. (2013) Fire evacuation in high-rise buildings: a review of human behaviour and modelling research. *Fire Science Reviews*, Vol. 2, Iss. 7, <https://doi.org/10.1186/2193-0414-2-7>.

PERCEPTION OF THE ROLE OF HIGHER EDUCATION IN SHAPING THE LIVING STANDARDS AND CAREER OPPORTUNITIES

Michał DZIADKIEWICZ^{1*}, Paulina BANASIK²

¹ Czestochowa University of Technology, Faculty of Management; michal.dziadkiewicz@pcz.pl,
ORCID: 0000-0001-5450-1669

² Czestochowa University of Technology, Faculty of Management; paulina.banasik@pcz.pl,
ORCID: 0009-0001-2855-262X

* Correspondence author

Purpose: The aim of this article is to analyse social beliefs about the role of education in shaping the standard of living, professional opportunities and access to the labour market. Particular attention is paid to assessing the relationship between the level of education and the possibilities of achieving higher earnings and career development.

Design/methodology/approach: The first part of the study reviewed the literature on the role of education in the labour market. The next part of the study analysed the results of a survey conducted at the end of 2024. The questionnaire included questions about the perception of the impact of education on the quality of life, professional situation and access to the labour market, as well as gender equality in access to higher and specialised education. Data were collected based on six substantive questions assessed on a five-point Likert scale.

Findings: Analysis of the research results showed that the vast majority of respondents see a clear link between the level of education and the quality of life and professional opportunities. The article also addresses issues related to the perception of exclusion from the job market in the context of one's lack of education, as well as equal access to education between women and men in various fields of science and professions.

Practical implications: The results of the study may constitute a starting point for designing activities in the field of educational policy and the job market aimed at increasing access to education and strengthening the role of education in counteracting professional exclusion.

Social implications: The data obtained indicate that society largely perceives education as a key factor in determining professional and material success. There is also a growing acceptance of equal access to education regardless of gender. However, the results also suggest the need for further work on social awareness regarding equal opportunities and counteracting persistent stereotypes in terms of the value attributed to education and its impact on professional career.

Originality/value: The article contributes to the debate on the social perception of education as a factor differentiating life and career opportunities. The analysis shows a clear societal belief in the benefits of education, while also pointing out areas where further action is needed to support equality and inclusiveness in the access to education and the labour market.

Keywords: education, labour market/job market, equal opportunities, human capital, educational stereotypes, professional development

Category of the paper: Research paper.

1. Introduction

Higher education has for many years been perceived as one of the key factors determining an individual's professional, social and economic success (Small et al., 2018). For decades, a university diploma has been a symbol of social prestige, and at the same time a gateway to better paid, more stable and more satisfying work (OECD, 2022). In the reality of a knowledge-based economy and dynamic changes in the global labour market, obtaining a higher education is still considered an important investment in an individual's future (Maheshwari et al., 2023). At the same time, however, with the increasing access to education and the increasing number of university graduates, questions about the real value of a diploma and its actual impact on the quality of life and career opportunities are increasingly being asked (Tomlinson, 2008; Brown et al., 2011).

The phenomenon of democratization of higher education, which led to an increase in the number of people completing their studies, also contributed to the so-called education inflation – i.e. a decrease in its value on the job market (Barro, Lee, 2013; Kwiek, 2019). More and more young people with higher education degrees are having difficulty entering the job market, often working below their qualifications or in jobs unrelated to their field of study (Allen, van der Velden, 2001). Despite this, empirical data still confirm the existence of a clear correlation between the level of education and the amount of income, employment stability, level of self-esteem and the overall quality of life (Chevalier, 2003; Eurostat, 2023). In Poland, according to the Education and Training Monitor 2024, already 46.3% of people aged 25-34 have a higher education – which is not only above the EU average, but also meets the goal set for 2030.

In the area of modern human resources management, the role of education is of particular importance. Modern organizations, striving to build their competitive advantage, are increasingly focusing on the effective use of employee potential - regardless of their gender, age, origin or level of education (Sukiennik, Dziadkiewicz, 2024). At the same time, it is the level and field of education that often determine not only access to the labour market, but also the career path, promotion opportunities, expectations regarding organizational culture, management style and the level of employee participation (Somers et al., 2019). In this context, issues related to equal opportunities and social justice are becoming increasingly important, especially in relation to equal access to education and equal treatment in the workplace. There is more and more talk about the need to build inclusive organizational structures and transparent and objective criteria for assessing employee competences (Banasik, 2024; Iwasaki, Satogami, 2023). Of particular importance here are issues related to gender equality – both in the context of access to specific educational programmes – and the opportunities for professional development for women and men (Szczepańczyk, Dziadkiewicz, 2024).

The research presented in the report *University Graduates in the Polish Labor Market* (2024) confirmed that individuals with higher education have a lower risk of unemployment and higher earnings compared to the national average. These findings emphasize the role of higher education as a factor that enhances the economic stability of individuals and improves their professional situation, which is of significant importance for social and economic policy.

The data presented in the OECD report *Earnings by Educational Attainment* further emphasize the economic value of a higher education diploma. The earnings premium of approximately 100% compared to individuals with lower educational attainment provides clear evidence of the financial benefits associated with completing higher education. This income advantage has important implications both for individuals and for entire economic systems, underlining higher education's role as an investment in human capital and a factor increasing competitiveness in the labour market.

The conducted research analyses beliefs and attitudes regarding the impact of education on professional life and the perception of equal opportunities in various social groups, providing valuable data allowing for a better understanding of the mechanisms operating both in the labour market and in the education system. These results can serve as a starting point for creating more equitable educational and management policies. Therefore, it is particularly important to examine how higher education is perceived by people representing different social, professional and educational environments, as well as what importance they attribute to the role of education in the context of achieving a higher standard of living and fulfilling professional aspirations.

2. Methods

The purpose of the study was to identify public opinions on the importance of education in the context of the quality of life, employment opportunities and equal professional opportunities for women and men. For this purpose, the following research hypotheses were formulated:

1. Most respondents believe that higher education increases opportunities in the job market and translates into higher earnings and standard of living.
2. Women and men are not perceived as having equal access to all fields of study.
3. Lack of education is seen as a factor which limits access to expected employment.

A total of 360 respondents took part in the study. The respondents were selected randomly. The research group was diverse in terms of gender, age and level of education, which allowed for a broad perspective on the analysed issues.

Women constituted 52.2% of participants, while men constituted 47.8%. Also, a significant percentage of participants had primary education (31.4%) and vocational education (20.8%). People with higher education constituted 28.3% of the subjects. The age structure was

dominated by people aged 36-45 (30.6%) and 46-55 (25.8%). Participants aged 26-35 years constituted 18.3% of the total, while those over 65 years of age constituted 3.9%. A small part of the sample was made up of people under 18 years of age (1.1%).

Considering the place of residence, 58.3% of respondents indicated an urban commune, 23.3% an urban-rural commune, while 14.4% indicated a rural commune.

The survey questionnaire consisted of two parts: a substantive part, containing five closed questions regarding opinions on the impact of education and gender equality on the labour market, and a personal data part. A five-point scale of responses was used, with each issue being assessed according to the following assigned value:

- 1 – I strongly disagree.
- 2 – I disagree.
- 3 – I have no opinion.
- 4 – I agree.
- 5 – I strongly agree.

Results are presented as percentages, rounded to one decimal place, in accordance with the recommendations of the American Psychological Association (7th ed.) (APA PsycNET, 2020, p. 179) for the presentation of numerical data in social research.

3. Results

The article will further present detailed results of the study on the perception of higher education in the context of professional and social life. The analysis includes respondents' opinions on the relationship between education level and quality of life, the amount of income, career opportunities and equal access to education.

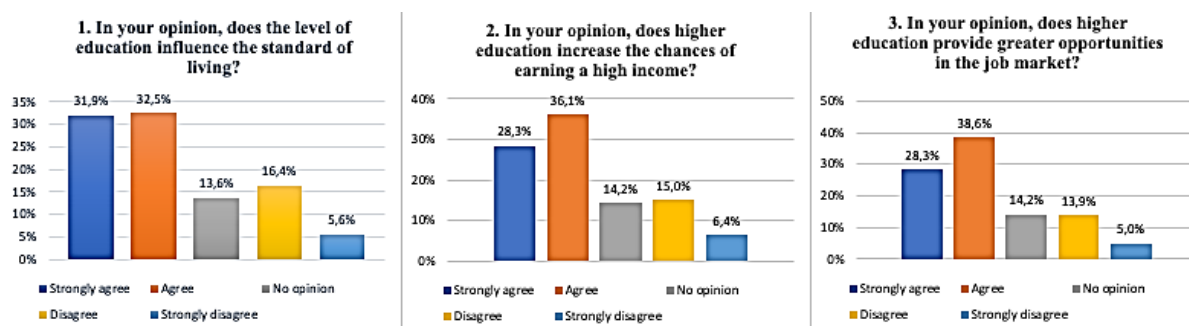


Figure 1. Summary of respondents' answers to questions related to the impact of education on the standard of living, earnings and opportunities in the job market.

Source: Own study.

The analysis of the answers to question 1 regarding the impact of one's level of education on the standard of living shows that the vast majority of respondents see a strong correlation between these two aspects. As many as 64.4% of respondents expressed the belief that

education significantly affects the quality of life – including 31.9% who selected the answer “I strongly agree” and 32.5% who selected “I agree”. This result indicates the prevailing belief within society in the value of education as a factor contributing to better economic and social functioning.

At the same time, it should be noted that almost a quarter of respondents (22%) were sceptical about this relationship – 16.4% of respondents answered “I disagree” and 5.6% “I strongly disagree”. This attitude may result from individual professional experiences in which higher education did not translate into the expected promotion, financial stability or job satisfaction. It may also be an expression of the assumption that the quality of life is now determined to a greater extent by other factors – such as soft skills, network of contacts, professional flexibility, location or practical experience, and not the level of formal education itself.

In the second question, most respondents see a connection between the level of education and the amount of income achieved. As many as 64.4% of our study subjects expressed the opinion that higher education affects the level of earnings - including 28.3% who expressed strong agreement, and 36.1% who indicated the answer "I agree". Such a high percentage of affirmative responses reflects the belief that investing in education translates into the access to better-paid positions. This belief may have its sources in observations of the labour market, where professional advancement and employment in managerial and expert positions very often require higher education. In many cases, it is the level of education that determines the possibility of crossing the so-called "glass ceiling" in the professional hierarchy (Taparia et al., 2022).

A group of 21.4% questioned this relationship. Their scepticism may stem from personal professional experiences in which completing higher education did not translate directly into adequate remuneration. This may also be a reflection of the realities of the modern labour market, where practical competences, professional flexibility, mobility and experience are becoming increasingly important (Guryan et al., 2014).

In the third question related to the impact of education on opportunities on the job market, as many as 66.9% of subjects expressed the belief that having a university degree increases employment opportunities – including 28.3% of respondents who answered “I strongly agree” and 38.6% who answered “I tend to agree.” This result confirms the deeply rooted assumption that higher education opens up access to a wider range of job offers, especially in positions requiring specialist competences, higher responsibility or the ability to manage a team (OECD, 2023).

At the same time, however, 18.9% of our study respondents expressed the opposite opinion. Among them, 13.9% disagreed with such a statement, and 5% indicated the answer "I strongly disagree". Their position may be the result of observing the growing role of practical competences, professional experience, interpersonal skills, language proficiency or professional flexibility (Lewandowska et al., 2020). In some industries, an academic diploma

is no longer a clear condition for professional success, and what counts most is efficiency and real skills (Kajta et al., 2025).

The analysis of respondents' answers indicates that the prevailing belief in the significant impact of education on the quality of life, income and chances on the labour market is prevalent in society, which confirms hypothesis 1. Most study subjects see a correlation between the level of education and professional and economic opportunities, which indicates a strong belief in the value of education as a tool for improving life circumstances.

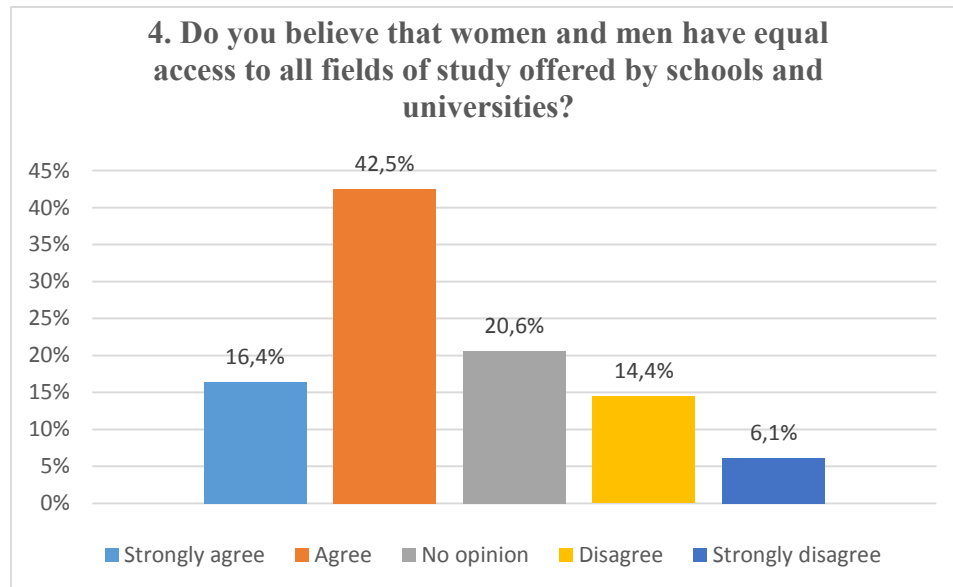


Figure 2. Summary of respondents' answers to the question related to equal access to education for women and men.

Source: Own study.

The analysis of the answers to the fourth question shows that the majority of respondents perceive the education system in Poland as equal in terms of access to the offered fields of study for women and men. As many as 58.9% of respondents expressed their belief in the existence of such equality. This result may indicate a socially established assumption that formal recruitment rules and regulations of educational institutions do not differentiate candidates based on gender. For many people, the education system appears to be neutral and equally accessible to all.

Only 20.6% of respondents expressed the belief that this equality is not always reflected in reality. Of these, 14.4% indicated the answer "I disagree" and 6.1% - "I strongly disagree". These attitudes may result from observations of social conditions and cultural patterns that – despite formal equality – still shape the educational preferences of women and men. In practice, this means continuing divisions into “typically male” and “typically female” fields of study, such as the dominance of men in technical fields (e.g. computer science, engineering) or women in the care and education sector (e.g. nursing, pedagogy) (Zawistowska, 2024).

In summary, the majority of respondents perceive the education system in Poland as equal in terms of access to fields of study for women and men, which indicates a strong social belief in the neutrality and fairness of recruitment rules and the functioning of educational institutions, regardless of gender. Thus, **hypothesis 2, which states that women and men are not perceived as having equal access to all educational fields, cannot be confirmed.**

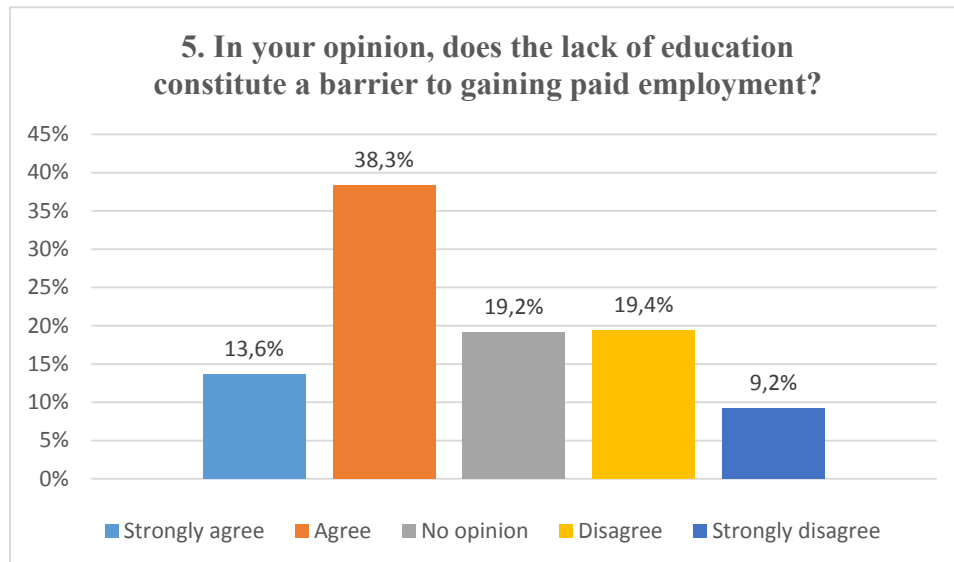


Figure 3. Summary of respondents' answers to the question related to the impact of education on gaining paid employment.

Source: Own study.

The results of the answers to question 5 indicate that a significant proportion of respondents perceive the lack of education as a significant barrier in accessing employment. A total of 51.9% of respondents stated that the lack of formal education limits the possibilities of finding a job – including 13.6% who chose the answer “I strongly agree” and 38.3% “I agree”. This demonstrates the deeply rooted belief that graduating is one of the basic conditions for participating in the labour market. This may result from observations of recruitment practices as well as from experiences in which the lack of education is often associated with limited access to better-paid, stable positions.

On the other hand, 28.6% of subjects expressed the opposite opinion. In this group, professional experience, specific practical skills, interpersonal skills or flexibility in action may play a key role, which often outweigh the importance of formal qualifications - especially in a dynamically changing professional environment.

To sum up, **most of respondents see the limitations that the lack of education entails in the context of employment, which may indicate the existence of social and systemic barriers that make it difficult for people without formal qualifications to actively participate in the labour market, which confirms hypothesis 3.**

4. Summary

The aim of the study was to identify public opinions on the importance of higher education in the context of the quality of life, employment opportunities and equal opportunities for women and men in the educational and professional market. The analysis of the results provided a number of interesting observations that allow for the formulation of both theoretical and practical conclusions.

The obtained results clearly indicate that in the public awareness, higher education remains a key determinant of social mobility and professional success. The vast majority of respondents treat a university diploma as an instrument enabling them to achieve a higher standard of living, obtain higher income and increase competitiveness in the job market. The obtained results are consistent with previous studies indicating the significant role of higher education in shaping individuals' living conditions and professional opportunities. OECD (2022) research has shown that people with higher education attain higher levels of employment and income compared to those with lower educational attainment. Conclusions highlights that university graduates in Poland are less likely to experience long-term unemployment and are more often employed in positions aligned with their qualifications. Despite the increasingly discussed phenomenon of education inflation, the belief in its fundamental importance is still deeply rooted.

In relation to the issue of gender equality in one's access to education, the obtained findings indicate a dominant belief in formal equality of opportunities. The majority of respondents declare that women and men have equal access to all fields of education. Despite being aware of the social and cultural conditions that influence educational choices and the reproduction of gender stereotypes, study subjects most often perceive the education system as gender neutral.

The conducted study allowed to verify the following formulated hypotheses:

Hypothesis 1: The majority of respondents believe that higher education increases opportunities on the job market and translates into higher earnings and standard of living – this was confirmed. The data showed a strong public belief in the benefits of higher education.

Hypothesis 2: Women and men are not perceived as having equal access to all educational fields – this was not confirmed. The majority of respondents expressed their belief in equal access to education.

Hypothesis 3: Lack of education is seen as a factor that limits one's access to expected employment – this was confirmed. More than half of subjects indicated the lack of education as a significant limitation in the labour market.

The presented research findings carry significant practical implications for various stakeholders involved in the education system and the labor market. They can support the development of educational policies aimed at increasing access to higher education and promoting gender equality in education and employment. Higher education institutions may

utilize these conclusions to adapt their educational offerings to the evolving demands of the labor market and to strengthen mechanisms of social mobility. Furthermore, the recommendations included in the article may prove useful for entities responsible for professional development and labor market policy, especially in the context of increasing digitalization and automation, which affect the structure of qualifications. From a scientific perspective, the article contributes contemporary insights to research on social perceptions of education and its role in shaping quality of life and career opportunities, providing a foundation for further interdisciplinary analyses in this field.

The study also confirms the need for further analyses on the real impact of education on the quality of life and professional mobility – especially in the context of dynamic changes taking place in the labour market and the ongoing digitalisation and automation of professions.

References

1. Allen, J., van der Velden, R. (2001). Educational mismatches versus skill mismatches: Effects on wages, job satisfaction, and on-the-job search. *Oxford Economic Papers*, Vol. 53, Iss. 3, pp. 434-452.
2. Banasik, P. (2024). Znaczenie zarządzania różnorodnością w przedsiębiorstwach z perspektywy pracowników różnych pokoleń. *Przegląd Organizacji*, 38-44.
3. Barro, R.J., Lee, J.W. (2013). A new data set of educational attainment in the world, 1950-2010. *Journal of Development Economics*, Vol. 104, pp. 184-198.
4. Becker, G.S. (1993). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. Chicago: University of Chicago Press.
5. Brown, P., Lauder, H., Ashton, D. (2011). *The Global Auction: The Broken Promises of Education, Jobs, and Incomes*. Oxford: Oxford University Press.
6. Chevalier, A. (2003). Measuring over-education. *Economica*, Vol. 70, Iss. 279, pp. 509-531.
7. Eurostat (2023). *Education and training statistics*. Retrieved from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Education_and_training_statistics_introduced, 29.06.2025.
8. Główny Urząd Statystyczny (2018). *Statystyka wskaźników edukacyjnych*. Retrieved from: <https://ws.stat.gov.pl/Article/2018/7/025-036>, 29.06.2025.
9. Guryan, J., Pane, J. (2021). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics*, Vol. 132, Iss. 4, pp. 1593-1640.
10. Iwasaki, I., Satogami, M. (2023). Gender wage gap in European emerging markets: a meta-analytic perspective. *Journal for Labour Market Research*, 57(1), 9.

11. Kajta, J., Sarnowska, J., Pustulka, P., Kwiatkowska, A. (2025). Planning for the future in the shadow of the polycrisis: Young women's uncertain transitions to adulthood. *Acta Sociologica*.
12. Komisja Europejska (2023). *Monitor edukacji i szkoleń: Polska*. Retrieved from: <https://op.europa.eu/webpub/eac/education-and-training-monitor/pl/country-reports/poland.html>, 29.06.2025.
13. Kwiek, M. (2019). *Changing European academics: A comparative study of social stratification, work patterns and research productivity*. London: Routledge.
14. Lewandowska, A., Stopa, M. (2020). The impact of innovative professional qualifications on the sense of employment security: Evidence from Poland. *Economics & Sociology*, 13(3), 72-83.
15. Maheshwari, G., Kha, K.L., Arokiasamy, A.R.A. (2023). Factors affecting students' entrepreneurial intentions: a systematic review (2005-2022) for future directions in theory and practice. *Management Review Quarterly*, 73(4), 1903-1970.
16. OECD (2022). *Earnings by educational attainment. OECD Indicators*. Paris: OECD Publishing.
17. OECD (2023). *Education at a Glance 2022: OECD Indicators*. Paris: OECD Publishing.
18. Pilipiec, P., Groot, W., Pavlova, M. (2021). The effect of an increase of the retirement age on the health, well-being, and labor force participation of older workers: a systematic literature review. *Journal of Population Ageing*, 14, 271-315.
19. Polski Instytut Ekonomiczny (2024). Raport: *Absolwenci uczelni na polskim rynku pracy*.
20. Słomczyński, K.M., Janicka, K. (2010). Stratyfikacja społeczna a wykształcenie i pozycja zawodowa. *Studia Socjologiczne, Vol. 2, No. 197*, pp. 23-45.
21. Small, L., Shacklock, K., Marchant, T. (2018). Employability: a contemporary review for higher education stakeholders. *Journal of Vocational Education & Training*, 70(1), 148-166.
22. Somers, M.A., Cabus, S.J., Groot, W., van den Brink, H.M. (2019). Horizontal mismatch between employment and field of education: Evidence from a systematic literature review. *Journal of economic surveys*, 33(2), 567-603.
23. Sukiennik, K., Dziadkiewicz, M. (2024). Managing environmental social responsibility in cities according to the young generation. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, 527-541.
24. Szczepańczyk, M., Dziadkiewicz, M. (2024). Social inequalities and discrimination against women in access to high-level positions. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, 597-607.
25. Taparia, M., Lenka, U. (2022). An integrated conceptual framework of the glass ceiling effect. *Journal of Organizational Effectiveness: People and Performance*, Vol. 9, No. 3, pp. 372-400.

26. Tomlinson, M. (2008). 'The degree is not enough': Students' perceptions of the role of higher education credentials for graduate work and employability. *British Journal of Sociology of Education*, Vol. 29, Iss. 1, pp. 49-61.
27. Zawistowska, A. (2024). *Gender gap in education. How society, economy, and culture influence educational choices of women and men in Poland*. Warszawa: Fundacja Rozwoju Systemu Edukacji. Retrieved from: https://www.frse.org.pl/brepo/panel_repo_files/2024/06/28/6iolqc/luka-plci-w-edukacji-online-ang.pdf, 29.06.2025.

ADDRESSING UNCERTAINTY IN COST-BENEFIT ANALYSIS OF INTERGENERATIONAL INVESTMENTS – INSIGHTS FROM POLAND’S FRAMEWORK

Monika FOLTYN-ZARYCHTA

University of Economics in Katowice; monika@foltyn-zarychta@ue.katowice.pl,
ORCID: 0000-0002-3507-2122

Purpose: The study identifies key shortcomings in how uncertainty is incorporated into Cost-Benefit Analysis (CBA) for intergenerational investments in Poland and puts forward recommendations for improving the regulatory project evaluation framework.

Design/methodology/approach: The paper draws the Polish framework limitations and improvement recommendations by critically reviewing relevant literature, including empirical studies, the CBA regulatory framework in Poland, and internationally recognized best practices, particularly from the US and UK.

Findings: The current evaluation framework in Poland lacks sufficient empirical grounding and relies heavily on EU CBA guidelines, which inadequately address intergenerational uncertainty. National guidelines should specifically recognize the limitations of standard risk assessment methods for intergenerational issues, recommend approaches such as real options analysis, define normative principles that reflect intergenerational ethical concerns, and adopt declining discount rates to better account for long-term uncertainty.

Research limitations/implications: The study primarily focused on the Polish framework, particularly concerning good practices in the US and UK evaluation guidelines. Including perspectives from additional countries—both in terms of regulatory contexts and case study-based research—would deepen understanding of intergenerational equity and uncertainty role in project evaluation.

Practical implications: The findings provide practical guidance for decision-making on intergenerational investments in areas such as climate change and nuclear energy, benefiting policymakers and investors.

Social implications: Adopting the recommendation would improve the quality of investment decisions and the efficiency of public spending, contributing to greater social welfare for both current and future generations.

Originality/value: Intergenerational uncertainty has not yet been addressed in Poland’s CBA regulatory framework. This paper offers recommendations with the potential to advance the research and policy-making in sectors like climate change and nuclear energy, central to achieving the EU’s climate neutrality goals.

Keywords: intergenerational investment, cost-benefit analysis, uncertainty, Poland.

Category of the paper: conceptual paper, viewpoint.

1. Introduction

Poland, one of Europe's most coal-dependent countries, faces a transition challenge to meet climate goals. Despite commitments drawn in Poland's Energy Policy 2040 (Polityka Energetyczna Polski Do Roku 2040, 2021), the country struggles with a project implementation due to climate-resilient infrastructure gap, reliance on coal, and lack of readiness for large-scale renewable or nuclear alternatives (Mrozowska et al., 2021). Substantial investments are needed, particularly to tackle climate change, as to date, climate change mitigation efforts are limited (Kundzewicz, Matczak, 2012). Transitioning from coal to cleaner sources faces a substantial challenge as well, particularly regarding nuclear energy infrastructure (Gierszewski et al., 2021).

Such investments require particular attention in their evaluation, as their life span exceeds that of the currently living generation. These projects can be defined as intergenerational investments, with impacts extending beyond a single generation (30-40 years) (Foltyn-Zarychta, 2018). These investments typically fall into the category of public projects, as a large part of their effects – such as reducing greenhouse gas emissions – have public good characteristics and therefore are not traded efficiently on markets. Relying solely on financial evaluation based on market prices can therefore lead to suboptimal decisions in terms of social welfare maximization. This calls for expanding financial appraisal into economic appraisal, specifically cost-benefit analysis (CBA), where shadow prices are used instead of market prices for estimating the true value of benefits and costs for society (Boardman et al., 2018; Dasgupta, Pearce, 1972; Zerbe, Bellas, 2006).

However, the long-time frame combined with environmental impacts creates a substantial level of uncertainty that must be addressed during the evaluation of such projects (Hartzell-Nichols, 2012; Pindyck, 2000). Moreover, ethical concerns arise, as the recipients of the investment's future impacts are unable to participate in the decision-making process. (Piacquadio, 2020; Randall, 2020; Taebi, 2012).

The prevailing practice of public project evaluation in Poland relies heavily on EU guidelines. However, both the general risk assessment procedure and the intergenerational perspective regarding – particularly climate change and energy sectoral characteristics – appear to be insufficiently addressed, both concerning regulations and guidelines, and empirical research studies devoted to Poland. Although EU CBA guidelines (European Commission, 2021; European Commission, 2015) offer some tools for dealing with uncertainty in project appraisal procedures, such as sensitivity analysis or expected Net Present Value (NPV), these approaches are vulnerable to several limitations specific to intergenerational investments.

This limited empirical evidence, coupled with a weak country-specific regulatory framework, creates a pivotal research gap, with potentially crucial practical and social implications, as Poland faces substantial investment needs regarding intergenerational investments.

At the same time, recent advances in some of the countries leading in CBA frameworks developments, such as the US and the UK, have increasingly recognized the importance of intergenerational risk and uncertainty in climate and energy project appraisals. In the US, the Environmental Protection Agency's (EPA) guidelines address the issues of environmental justice and intergenerational transfers, including social discount rate recommendations (EPA, 2024). The UK's HM Treasury Green Book introduces declining discount rates and explicit treatment of uncertainty to better reflect intergenerational equity (HM Treasury, 2022).

Thus, the paper aims to answer the following question: What are the main shortcomings in incorporating uncertainty into CBA for intergenerational investments in Poland? The purpose of the study is to propose recommendations for improving the regulatory evaluation framework.

The novelty of the research stems from investigating the uncertainty in the intergenerational context in Poland's CBA framework, which – to the best of author's knowledge – was not addressed distinctively in the capital budgeting literature in Poland so far. The results, particularly the recommendations addressing the deficiencies of the existing framework, hold significance for the research and policy-making in sectors such as climate change and nuclear energy, central to achieving the EU's climate neutrality goals.

The methods of investigation in the paper employ a critical review of relevant literature, including CBA empirical studies for Poland, and the Polish regulatory framework consisting of CBA's guidelines for project evaluation and legal acts addressing CBA. A comparative analysis of country developments and internationally recognized best practices from the US and UK is performed concerning intergenerational uncertainty's economic and ethical dimensions to generalize findings into policy recommendations.

The paper begins by introducing various concepts of uncertainty in project evaluation, then moves on to discuss the key uncertainty issues related to intergenerational investments. Next, a critical analysis of how the CBA framework in Poland addresses uncertainty is presented, followed by suggestions for methodological improvements based on international experiences. The paper concludes with a summary of the main findings and the study's limitations.

2. Uncertainty in project evaluation

Risk and uncertainty are complex issues. For project evaluation, both concepts need careful clarification. In economics, the concept of risk is separated from uncertainty. Risk can be defined as randomness with knowable probabilities, while uncertainty – as randomness with unknown probabilities (Knight, 1921).

Riesch highlights three dimensions of uncertainty (Riesch, 2013):

- location – where the uncertainty is located: the parameters, outcomes, probabilities, the model, or input data,
- level – the level of uncertainty, ranging from classically defined risk with known states and probabilities to total ignorance,
- nature – the source of uncertainty, subdivided into epistemic and ontological. Epistemic uncertainty refers to systematic uncertainty, where some facts could theoretically be known but remain uncertain due to, for example, a lack of precision in data observations. Ontological uncertainty, on the other hand, refers to a state of insufficient knowledge, often described as “unknown unknowns”.

Spash distinguishes between weak and strong uncertainty. The former is further divided into weak objective uncertainty, which aligns with the concept of risk in economics, and weak subjective uncertainty, where only outcomes are known and probabilities are assessed based on human preferences. Strong uncertainty includes partial ignorance, where outcomes are unknown, and “indeterminacy,” where outcomes are unpredictable (Spash, 2020).

Distinguishing between the known and unknown future, Stirling proposes dividing both facets of uncertainty – outcomes and probabilities – into “problematic” and “unproblematic” categories, based on the level of knowledge. When both areas are unproblematic, a decision-maker faces a situation of risk. When probabilities are known but outcomes are not, the situation is described as “ambiguity”. Conversely, when outcomes are known but probabilities are problematic, the situation is characterized by “uncertainty”. Finally, “ignorance” arises when there is poor knowledge of both outcomes and probabilities (Stirling, 2007).

Fusari interprets “true” or “radical uncertainty” as a form of uncertainty that cannot be represented by probability distributions. It results from the limits of human knowledge and is therefore an expression of human ignorance. Radical uncertainty may be reduced through the acquisition of information; on the other hand, it is also stimulated by social change and innovation. The author further explains that uncertainty reflects the degree of ignorance, as it is not driven by people’s expectations, but rather by the instability and/or illusory nature of those expectations. (Fusari, 2013). Alchian states that “uncertainty arises from at least two sources: imperfect foresight and human inability to solve complex problems containing a host of variables even when an optimum is definable” (Alchian, 1950). This form of ignorance—referred to as “unknown unknowns”—is also defined as radical uncertainty. In the economics literature, it is discussed in the context of the impossibility of foreseeing the outcomes of scientific and technological developments, as well as long-term, intergenerational investments such as those related to climate change or nuclear energy.

Finally, some researchers highlight the ethical dimension of uncertainty, which—although often implicitly included in evaluation processes—should be addressed explicitly and separately. Taebi et al. argue that, in addition to scientific and technical uncertainties, normative uncertainties also play a pivotal role in risk-related decision-making. They define normative

uncertainties as situations in which all available options are, to some extent, morally indefensible (Taebi et al., 2020).

3. Uncertainty in intergenerational time frame – economics and ethics perspective

Referring to the distinction between weak and strong uncertainty, as well as to its location, level, and nature, intergenerational investments inevitably tend toward the highest levels of ontological uncertainty. Numerous sources in the literature emphasize the particularly high levels of uncertainty associated with long-term investments. Hartzell-Nichols points out that, given the temporal scale alone, uncertainty is almost always present (Hartzell-Nichols, 2012). This issue is especially prominent in discussions on climate change and nuclear energy investments, due to their extremely long life cycles and the substantial risks they pose to future generations.

In case of climate change, the impacts of greenhouse gas (GHG) emissions will extend to many generations (and multiple locations globally), inflicting long-term risks like flooding, high temperature, and other weather extremes. IPCC defines it as burdened with deep or severe uncertainty (IPCC, 2014). Barro argues that uncertainty is central to the analysis of climate change (Barro, 2015). Technological developments, including innovations, ecosystem response, future prices of fossil fuels, occurrence of extreme events such as cyclones, sea-level rise and droughts all create substantial sources of uncertainty (Fleurbaey et al., 2019; Jansen, Bakker, 2006).

Gardiner, in the context of climate change, distinguishes between scientific uncertainty and the uncertainty rooted in economic models used for long-term projections. He emphasizes that scientific models – used to predict global warming, CO₂ emissions, and related phenomena - often assign probabilities, which frames the situation as one of risk and shifts the focus toward a quantitative perspective. In contrast, economic models frequently fail to meet the strict requirements necessary for the meaningful assignment of probabilities (Gardiner, 2004).

Nuclear energy investments also involve extremely long time horizons and are associated with high levels of uncertainty. Nuclear waste remains hazardous for hundreds of years, posing serious health risks due to potential radiation contamination (Kermisch, Taebi, 2017; Medvecky, 2012). In some disposal methods, the waste remains radiotoxic for several thousand years. This raises questions about long-term safety and future uncertainties – such as the potential need to recover radioactive material for its residual energy value – which are particularly relevant when deciding between permanently sealed and open repositories (Taebi, Kloosterman, 2008).

Finally, what further complicates the analysis is that, when the time frame becomes multi-generational, decision-makers face incorporating ethical considerations regarding future generations when dealing with uncertainty (Friederich, Boudry, 2022). Numerous studies argue that a utilitarian-consequentialist perspective is too narrow to adequately address intergenerational ethics (Fleurbaey et al., 2019; Taebi et al., 2020). The stochastic nature of future outcomes may be addressed through various approaches—for example, by expecting less sacrifice from "hard-luck" generations and proportionally more from more "fortunate" ones (Randall, 2020).

The extant literature focuses heavily on equity and justice, given that future beneficiaries are not yet present and cannot participate in current decision-making. The standard approach to intergenerational risk draws on Harsanyi's (1955) sum of expected utilities in which generations are treated analogously to individuals (Fleurbaey et al., 2019; Harsanyi, 1955). However, as (Piacquadio, 2020) argues, this model is ill-suited to long-term risks, as it treats generations anonymously, even though each generation may be affected differently – thus raising questions of intergenerational equity.

Moreover, the non-identity problem arises: any decision made today may influence who will be born in the future and in what number, meaning that the decision will ultimately affect different individuals than would have existed had the decision not been made (Gardiner, 2006). As Hartzell-Nichols further points out, even if these future individuals are adversely affected, they arguably cannot blame the decision-makers, since the decision itself was a necessary condition for their existence and identity (Hartzell-Nichols, 2012).

For intergenerational investments - particularly where environmental changes are involved – uncertainty is often defined in relation to the potential harm that may be inflicted on the environment in the future. Hartzell-Nichols notes that risks "are generally understood as threats or possibilities of harm, though colloquially the term is sometimes applied to both negative and positive possibilities". She further emphasizes that harm is "a relatively specific moral concept which requires that a person have suffered serious interference with one or more interests that are particularly important to human well-being, and which for that reason are appropriately designated as fundamental" (Hartzell-Nichols, 2012).

The ethical doubts are also raised concerning valuation. Fleurbaey et al. argue while some impacts may be relatively easy to monetize, assigning monetary value to factors such as human health, mortality risk, or the extinction of species is far more ethically complex (Fleurbaey et al., 2019). It is also important to add that valuing non-market impacts experienced by unborn generations suffers from an inherent flaw arising from a lack of knowledge about future people's preferences.

To summarize, in the context of long-term, intergenerational investments, the most appropriate term to describe the prevailing conditions is radical uncertainty. This is due to the lack of information about factors such as ecosystem responses (including the location, extent, and severity of potential threats) and the preferences of future generations. While certain cases

may involve more conventional forms of uncertainty or even quantifiable risk, these remain relatively limited in number.

4. Uncertainty in Cost-Benefit Analysis – Poland's framework

The results of the critical review of relevant CBA literature, such as empirical studies for Poland, and the Polish regulatory framework consisting of CBA's guidelines for project evaluation and legal acts addressing CBA shows that public project evaluation in Poland rests mainly on Cost-Benefit Analysis (CBA) guidelines provided by the European Commission for Cohesion Policy (European Commission, 2008, 2015, 2021).

Separate guidelines have been developed only for the transport sector, although they are still based on the general EU guidelines and aim to facilitate access to EU funding ('Niebieskie Księgi 2021-2027', 2023; CUPT, 2016). In the area of legal regulations, the Regulation of the Minister of Climate and Environment also provides a very general framework for the appraisal procedure of energy investments. It primarily aims to implement the European Directive on energy efficiency and, while it addresses the basic structure of CBA, it does not specify detailed requirements, particularly regarding risk, uncertainty, or intergenerational issues (*Rozporządzenie w sprawie określenia metod...*, 2022). It is worth mentioning that local government units were also required to prepare CBAs for electromobility transport investments starting in 2018, according to the 2018 Act on Electromobility and Alternative Fuels. However, a recent amendment to the Act repealed this obligation (*Ustawa o Elektromobilności i Paliwach Alternatywnych*, 2025).

CBA research for Poland is also limited, including several monographs such as (Becla et al., 2012; Drobnia, 2002; Foltyn-Zarychta, 2008; Ligus, 2009); nonetheless, they address uncertainty in the intergenerational context within a very limited scope, except for (Foltyn-Zarychta, 2018) focusing on ethical components in intergenerational investments evaluation; however discussion devoted to risk is not supported by empirical data. Case study research on CBA in Poland is also scarce. Several papers apply CBA for renewable energy sources investment case studies, but they do not address the risk (Włoch, Lazarek-Janowska, 2024b, 2024a). Kołacińska & Sasin investigate nuclear sources of energy, raising the issue of long-term and substantial decommissioning costs; however, risk considerations are limited (Kołacińska, Sasin, 2016). To some extent, uncertainty is discussed in (Halytsia et al., 2022). The authors take into account sensitivity analysis as well as expert assessment of socio-economic risks related to the managed aquifer recharge system in Poland, using a qualitative approach, though they do not explicitly refer to the long-term dimension. None of the papers mentioned addresses the issue of intergenerational uncertainty considerations.

Therefore, taking into account the limited number of Poland-tailored guidelines and regulations, as well as the scarce practical evidence on CBA – particularly within the scope of long-term, intergenerational projects – it can be assumed that the general practice for project evaluation in Poland follows EU Cohesion Policy guidelines (European Commission, 2015, 2021; CUPT, 2016).

Analyzing the guidelines, two major limitations regarding the inclusion of uncertainty in project appraisal can be identified. The first weakness concerns the procedures for addressing risk and uncertainty, particularly the quantitative and qualitative approaches to risk assessment. The second significant flaw stems from the previously mentioned scarcity of country-specific regulations and guidance on the evaluation of intergenerational investments, such as those related to climate change or energy. Relying solely on the EU's main guideline, the *Vademecum*, leaves decision-makers insufficiently informed.

Regarding the risk assessment procedure, it is worth noting that although the current guidelines (European Commission, 2021) do not explicitly discuss risk assessment – or other aspects such as demand forecasting or legal considerations – these elements remain important for project appraisal. The authors of the guidelines assumed these aspects could be addressed within the broader project preparation framework, and the *Vademecum* refers readers to relevant supplementary guidance documents.

Therefore, for a standard risk assessment procedure, readers may refer, for example, to previous guidelines (European Commission, 2021; Florio, 2014). This approach is recommended for strategic projects, while smaller projects undergo a simplified CBA, in which only major risks are identified and briefly described.

In the case of large projects, risk assessment consists of several phases:

- sensitivity analysis – identifying key parameters that could significantly alter the project's outcome (e.g., turning a positive NPV into a negative one),
- qualitative risk analysis – identifying adverse events the investment may face, along with a description of their causes, effects, and levels of probabilities,
- probabilistic risk analysis – assessing the probability distribution of the project's FRR or NPV using techniques such as scenario analysis or the Monte Carlo method,
- risk prevention and mitigation – defining a risk management plan for project implementation, including measures to mitigate and prevent key risks.

The assessment procedure—regarding the intergenerational dimension of uncertainty—may be considered partly sufficient, given the recommendation to apply both quantitative and qualitative approaches. It must be emphasized, however, that all of the above methods operate under the concept of weak uncertainty, relying on probability distributions in the assessment.

The main advantage of such approaches is that they provide clear decision-making information, such as the expected NPV based on alternative scenarios. Sensitivity analysis, as well as qualitative analysis supported by risk prevention and mitigation strategies, offer a description of key factors that can significantly influence the effectiveness of the project.

However, in situations where a project is subject to strong uncertainty, these conventional approaches are largely inadequate

One of the key limitations in appropriately capturing uncertainty in CBA is the strong tendency to rely on monetary measures and quantification. Even in cases where strong uncertainty is undoubtedly present—such as greenhouse gas (GHG) impacts on global climate change—there remains a prevailing inclination to model probability distributions of impacts to enable the application of quantitative methods. For instance, probability distributions for uncertain inputs can be modeled to generate a probability distribution of the outcome, such as the net present value (NPV) (Krutilla, Graham, 2023).

However, it is important to emphasize that the process of deriving such distributions is often prone to imprecision. The CBA guidelines (European Commission, 2015) suggest that probability distributions may be based on various sources, such as experimental data, analogous cases (both of which may be unavailable under strong uncertainty), or expert opinions. The guidelines further state that, in cases of doubt, a triangular distribution may be applied and can provide “an important improvement in the understanding of the project’s strengths and weaknesses as compared with the base case”. Still, when strong uncertainty surrounds long-term scenarios, this approach may lead to significant oversimplification. Jansen and Bakker (2006), for example, found that when applying triangular distributions to estimate climate change externalities, the resulting uncertainty was greater than the estimated value of the externality itself (Jansen, Bakker, 2006). In addition to these methodological concerns, quantitative risk assessment may be particularly problematic in the Polish context. Even in the transportation sector – where guidelines are relatively well developed – recommendations often favor a qualitative approach due to the lack of national databases that would enable robust quantitative risk analyses for infrastructure projects.

While qualitative risk assessment partly addresses the problem of radical uncertainty, it still reflects the CBA’s inherent tendency to quantify all information. In qualitative assessments, risk matrices typically estimate the level of probability using a dual description: a qualitative label (e.g., *very unlikely*) and a corresponding quantitative range (e.g., 0-10% probability). Additionally, this approach relies on expert judgment. While expert input can serve as a valuable mechanism for obtaining insights in the face of limited knowledge, it must be emphasized that – even when structured – these estimates are ultimately based on opinion rather than empirical evidence (Cooke, 2013; Kunreuther et al., 2014).

Regarding the second major shortcoming—addressing intergenerational issues—the *Vademecum* refers to topics such as climate change and energy in a limited manner. It briefly discusses climate risk assessment, suggesting that significant risks should be managed and reduced to an acceptable level through adaptation measures or by deferring implementation. However, it does not explicitly reference general guiding principles—such as the precautionary principle—which could further support decisions to adopt more extensive adaptation actions, postpone, or even abandon the investment.

Additionally, although the *Vademecum* refers to the flexibility of delaying investments, it fails to mention explicitly the real options approach, which could help decision-makers explore alternative approaches to dealing with uncertainty. Furthermore, the document does not address the concept of irreversibility – one of the crucial dimensions of long-term investments. Irreversibility can pertain to both social and environmental domains. In the social context, it refers to situations where an investment turns out to be suboptimal (i.e., a better project should have been selected), but disinvestment is not feasible, leading to sunk costs and reduced social welfare. In the environmental context, irreversibility involves the permanent loss or degradation of environmental goods, such as biodiversity. Neither the current CBA guidelines nor earlier versions acknowledge this issue.

Moreover, the guidelines lack normative principles for long-term decision-making. Given that CBA is grounded in a utilitarian framework based on an additive social welfare function, incorporating alternative ethical perspectives – such as deontological approaches – could significantly enhance the ethical quality of decisions under extreme long-term uncertainty (Taebi et al., 2020). However, the *Vademecum* narrows the discussion of intergenerational equity to the issue of long-term discounting. While it recommends applying declining social discount rates for projects with long-term impacts, it fails to provide specific values. It is also worth noting that Poland still lacks official, country-specific guidelines for both intragenerational and intergenerational discounting, although relevant research exists (Buła, Foltyn-Zarychta, 2023; Catalano, Pancotti, 2022; Florio, Sirtori, 2013). For instance, Buła, Foltyn-Zarychta propose rates that decline from approximately 4.06% (for time horizons up to 30 years) to 0.67% (for horizons longer than 300 years).

Finally, the issue of uncertainty in the valuation of non-market impacts receives insufficient attention in the guidelines. It is mentioned only briefly in the waste management section, despite being relevant to many other sectors – such as energy. In current practice, air pollutants and greenhouse gas (GHG) emissions are often monetized not only in CBAs but also in cost-effectiveness analyses used for comparing project alternatives (European Commission, 2021). However, as noted by Cygler & Dubel and Jones et al., the valuation of environmental impacts remains highly uncertain, even for short-term projects (Cygler, Dubel, 2022; Jones et al., 2014). For intergenerational investments, these challenges are even greater, as impacts may unfold over extremely long time horizons. In such cases, valuation becomes difficult not only because of uncertainty surrounding the efficient price of public goods but also due to the fundamental lack of knowledge of the preferences of future generations.

5. Directions to improve the uncertainty assessment process for intergenerational public projects in Poland

Considering recommendations for improving how uncertainty is addressed in public project evaluation, the primary direction for progress in Poland is to expand the existing empirical research base beyond the mandatory EU guidelines. Uncertainty can be better incorporated through alternative methods the literature highlights: real options analysis, which captures the value of flexibility by allowing project implementation to be delayed until new information becomes available (Pindyck, 2000); or game theory, which can be employed to operationalize the precautionary principle by minimizing potential adverse outcomes (Kunreuther et al., 2014). Alternative approaches recommended for dealing with radical uncertainty may also employ Robust-Decision Making, which engages stakeholders and iteratively identifies new strategies that perform well across many scenarios and allow to prioritize flexibility and resilience over precision, which is particularly helpful for cases where we expect to gain knowledge over the investment life-time (Dittrich et al., 2016; Robust Decision Making, 2025) or scenario planning, a semi-quantitative approach that develops plausible scenarios and investigates what impact would they have via stakeholders assessment (Alizadeh et al., 2016; Amer et al., 2013).

Other useful frameworks include sets of guiding principles – such as the precautionary principle itself, minimax and maximin rules, and the safe minimum standard principle (Krutilla, Graham, 2023; Turner, 2007). A meta-analysis of evidence-based studies would provide a critical foundation for further development, serving both as a learning tool and a valuable data source – for instance, to support benefit transfer methods used in non-market valuation of project impacts (Krutilla, Graham, 2023). Given the current scarcity of case-study-based CBA research in Poland, expanding this empirical base would enhance uncertainty-related methods not only for intergenerational investments but also for broader CBA applications.

Independently of broader methodological advancements, a range of country-specific regulations, guidelines, and reports should be developed to support decision-makers in the evaluation and project selection processes.

With respect to international guidelines for project appraisal, several methodological recommendations can be drawn from the experiences of other countries – particularly the United Kingdom and the United States – which have advanced the use of Cost-Benefit Analysis to support decision-making in environmental and climate-related domains.

The UK's *Green Book* (HM Treasury, 2022) introduces several approaches that are also present in earlier EU guidelines (European Commission, 2015), such as sensitivity analysis, scenario analysis, and the Monte Carlo simulation. As alternatives to standard risk assessment, the *Green Book* further recommends the use of decision trees and real options analysis. However, it places stronger emphasis on qualitative and intergenerational aspects as well as on the issue of irreversibility compared to the EU guidance. Notably, the UK Treasury provides

supplementary guidance on intergenerational wealth transfers and social discounting. This includes a recommended declining schedule for the Social Discount Rate over time and specific advice on accounting for the impacts of climate change. The guidance highlights the use of real options analysis in situations involving potentially irreversible impacts, stressing the option value of sequential decision-making and the role of increasing information over time. In addressing the qualitative challenges of uncertainty assessment, the *Green Book* explicitly references the precautionary principle as a good practice for risk mitigation. This includes the possibility of abandoning a project – even in cases where knowledge about its effects and associated probabilities is limited.

The U.S. guidelines prepared by the Environmental Protection Agency (EPA, 2024) – considered among the most appropriate for evaluating intergenerational investments for the US – recommend several methods to address uncertainty. These include sensitivity analysis, especially concerning key assumptions, and probabilistic approaches such as Monte Carlo analysis, which help account for analytical uncertainty and variability. However, the guidelines also highlight the limitations of such methods, particularly the frequent lack of sufficient data to characterize probability distributions reliably. When decision-makers face incomplete information, the guidelines suggest alternative tools, including break-even analysis, which is especially useful when a single key parameter is unknown. In such cases, the analysis can determine the threshold (or “switch point”) of this missing value at which a project remains viable. The guidelines also advocate the use of expert elicitation, noting that uncertainty can be also reflected in the dispersion of expert opinions. In addition, the EPA recommends considering option value as a valuable tool in cases of irreversible decisions and situations where uncertainty may diminish as more information becomes available over time. While the selection of analytical tools does not differ significantly from those in EU guidance, the U.S. guidelines place greater emphasis on addressing uncertainty and knowledge gaps explicitly. Importantly, the EPA guidelines also give greater attention to intergenerational considerations than *Vademecum*. A dedicated section addresses environmental justice, while intergenerational equity is primarily covered in the context of discounting. The guidelines review various approaches to estimating social discount rates for long-term investments, advocating the use of declining discount rates or explicitly incorporating uncertainty in future consumption growth rates – one of key components in social discount rate calculations.

To summarize, drawing upon international experience – and in addition to developing a stronger body of evidence-based research – Poland could benefit from creating country-specific guidelines that explicitly address the following areas:

- The limitations of standard risk and uncertainty assessment procedures when applied to intergenerational timeframes and sector-specific contexts.
- Theoretical approaches designed to address limited information in long-term evaluations, such as the real options approach or robust-decision making, which can support decision-making under uncertainty.

- Qualitative, prescriptive principles – particularly the precautionary principle – which can help balance the heavily quantitative nature of CBA. Such principles also allow for the inclusion of normative preferences related to intergenerational equity and environmental justice, for example, prioritarianism-based principles, which could be translated into decision rules such as giving priority to projects that help to avoid catastrophic risks to future generations which over other investments.
- Declining discount rates, which reduce the social discount rate over time, thereby increasing the present value of long-term effects. This implicitly promotes more equal treatment of future generations compared to exponential discounting – which is the approach adopted currently. The new approach would be particularly relevant for projects posing significant long-term threats, such as radioactive waste management.

6. Summary

In the context of project evaluation, it is essential to distinguish between risk and uncertainty. When a situation is characterized by a lack of sufficient knowledge – whether descriptive or prescriptive (ethical) – substantial uncertainty arises. This type of uncertainty requires particular attention, especially in decisions involving intergenerational impacts. Projects such as those addressing climate change or nuclear energy are subject to strong uncertainty due to extended timeframes, unpredictable ecosystem responses, and unknown effects on social welfare of future generations. These conditions limit the applicability of quantitative methods, as both outcomes and probabilities are often inadequately and imprecisely defined.

Poland's current framework for evaluating such projects - relying primarily on EU Cost-Benefit Analysis guidelines and lacking a robust base of empirical, case study-driven research – offers predominantly quantitative tools geared toward risk rather than uncertainty evaluation. These tools are insufficient for addressing the deeper complexities of uncertainty. Oversimplification often results from assigning probabilities in contexts of limited knowledge or relying heavily on expert opinion in the absence of empirical data. Additionally, current guidelines pay insufficient attention to issues such as irreversibility, flexibility in the project lifecycle, and ethical concerns related to intergenerational justice.

Drawing on international best practices, particularly from the United States and the United Kingdom, Poland could develop national guidelines that explicitly:

- Acknowledge the limitations of standard risk assessment approaches when applied to intergenerational investments.
- Promote the use of uncertainty-aware methods such as real options.

- Emphasize normative principles that reflect ethical considerations across generations and complement quantitative analysis.
- Adopt declining discount rates to ensure fairer treatment of future generations.

These recommendations offer practical guidance for improving decision-making for intergenerational public investments in high-uncertainty sectors such as climate change mitigation and adaptation and nuclear energy. Implementing such measures could enhance the quality of public investment decisions, increase the efficiency of public spending, and contribute more effectively to maximizing social welfare across generations.

However, the study has its limitations. While this research focused on best practices in the U.S. and U.K., expanding the analysis to include other countries would offer a broader comparative perspective. For instance, France also has adopted a declining discount rate scheme for investment horizons exceeding 30 years (Attema et al., 2018). A systematic review of CBA case studies from multiple countries would help clarify how intergenerational considerations—including equity, uncertainty, irreversibility, and epistemic limitations—are taken into account.

It must also be acknowledged that certain challenges, such as uncertainty over future generations' preferences, are inherently irresolvable. Nonetheless, by drawing on international best practices and expanding the empirical research base, Poland has the opportunity to gradually build a more robust and ethically sound project evaluation framework.

References

1. Alchian, A.A. (1950). Uncertainty, Evolution, and Economic Theory. *Journal of Political Economy*, 58(3), 211-221. <https://doi.org/10.1086/256940>
2. Alizadeh, R., Lund, P.D., Beynaghi, A., Abolghasemi, M., Maknoon, R. (2016). An integrated scenario-based robust planning approach for foresight and strategic management with application to energy industry. *Technological Forecasting and Social Change*, 104, 162-171. <https://doi.org/10.1016/j.techfore.2015.11.030>
3. Amer, M., Daim, T.U., Jetter, A. (2013). A review of scenario planning. *Futures*, 46, 23-40. <https://doi.org/10.1016/j.futures.2012.10.003>
4. Attema, A.E., Brouwer, W.B.F., Claxton, K. (2018). Discounting in Economic Evaluations. *Pharmacoeconomics*, 36(7), 745-758. <https://doi.org/10.1007/s40273-018-0672-z>
5. Barro, R.J. (2015). Environmental Protection, Rare Disasters and Discount Rates. *Economica*, 82(325), 1-23. <https://doi.org/10.1111/ecca.12117>
6. Becla, A., Czaja, S., Zielińska, A. (2012). *Analiza kosztów-korzyści w wycenie środowiska przyrodniczego*. Difin. <https://ksiegarnia.difin.pl/analiza-kosztow-korzysci-w-wycenie-srodowiska-przyrodniczego>

7. Boardman, A., Greenberg, D., Vining, A., Weimer, D.L. (2018). *Cost-Benefit Analysis*. Cambridge University Press. <https://EconPapers.repec.org/RePEc:cup:cbooks:9781108401296>
8. Buła, R., Foltyn-Zarychta, M. (2023). Declining Discount Rates for Energy Policy Investments in CEE EU Member Countries. *Energies*, 16(1), Article 1. <https://doi.org/10.3390/en16010321>
9. Catalano, J., Pancotti, C. (2022). *Estimation of SDR in selected countries* (No. 202201; Working Papers). CSIL Centre for Industrial Studies. <https://ideas.repec.org/p/mst/wpaper/202201.html>
10. Cooke, R.M. (2013). Uncertainty analysis comes to integrated assessment models for climate change...and conversely. *Climatic Change*, 117(3), 467-479. <https://doi.org/10.1007/s10584-012-0634-y>
11. Cygler, M., Dubel, K. (2022). *Analiza kosztów i korzyści działań adaptacyjnych jako wsparcie w procesie podejmowania decyzji*. Instytut Ochrony środowiska – Państwowy Instytut Badawczy. <https://ios.edu.pl/strona-glowna/analiza-kosztow-i-korzysci-dzialan-adaptacyjnych-jako-wsparcie-w-procesie-podejmowania-decyzji/>
12. Dasgupta, A.K., Pearce, D.W. (1972). *Cost-benefit analysis: Theory and practice*. Macmillan International Higher Education.
13. Directorate-General for Regional and Urban Policy (European Commission) (2008). *Guide to cost-benefit analysis of investment projects: Structural Funds, Cohesion Fund and Instrument for Pre-Accession*. Publications Office of the European Union. <https://data.europa.eu/doi/10.2776/82794>
14. Dittrich, R., Wreford, A., Moran, D. (2016). A survey of decision-making approaches for climate change adaptation: Are robust methods the way forward? *Ecological Economics*, 122, 79-89. <https://doi.org/10.1016/j.ecolecon.2015.12.006>
15. Drobniak, A. (2002). *Zastosowanie analizy kosztów i korzyści w ocenie projektów publicznych*. Akademia Ekonomiczna w Katowicach. <http://bazekon.icm.edu.pl/bazekon/element/bwmeta1.element.ekon-element-000171600105>
16. *Economic Appraisal Vademecum 2021-2027—General Principles and Sector Applications*. (2021). European Commission. https://ec.europa.eu/regional_policy/en/information/publications/guides/2021/economic-appraisal-vademecum-2021-2027-general-principles-and-sector-applications
17. Fleurbaey, M., Ferranna, M., Budolfson, M., Dennig, F., Mintz-Woo, K., Socolow, R., Spears, D., Zuber, S. (2019). The Social Cost of Carbon: Valuing Inequality, Risk, and Population for Climate Policy. *The Monist*, 102(1), 84-109. <https://doi.org/10.1093/monist/ony023>
18. Florio, M. (2014). *Applied welfare economics: Cost-benefit analysis of projects and policies*. Routledge.

19. Florio, M., Sirtori, E. (2013). *The social cost of capital: Recent estimates for the EU countries*. CSIL Centre for Industrial Studies. <https://EconPapers.repec.org/RePEc:mst:wpaper:201303>
20. Foltyn-Zarychta, M. (2008). *Analiza kosztów-korzyści w ocenie efektywności inwestycji proekologicznych*. Uniwersytet Ekonomiczny w Katowicach. <http://bazekon.icm.edu.pl/bazekon/element/bwmeta1.element.ekon-element-000162311470>
21. Foltyn-Zarychta, M. (2018). *Ocena inwestycji międzypokoleniowych—Kryteria etyczne w ekonomicznej ocenie efektywności projektów inwestycyjnych*. C.H. Beck.
22. Friederich, S., Boudry, M. (2022). Ethics of Nuclear Energy in Times of Climate Change: Escaping the Collective Action Problem. *Philosophy & Technology*, 35(2), 30. <https://doi.org/10.1007/s13347-022-00527-1>
23. Fusari, A. (2013). *Radical Uncertainty, Dynamic Competition and a Model of the Business Cycle* [MPRA Paper]. <https://mpira.ub.uni-muenchen.de/74015/>
24. Gardiner, S.M. (2004). Ethics and Global Climate Change. *Ethics*, 114(3), 555-600. <https://doi.org/10.1086/382247>
25. Gardiner, S.M. (2006). A perfect moral storm: Climate change, intergenerational ethics and the problem of moral corruption. *Environmental Values*, 15(3), 397-413.
26. Gierszewski, J., Młynarkiewicz, Ł., Nowacki, T.R., Dworzecki, J. (2021). Nuclear Power in Poland's Energy Transition. *Energies*, 14(12), Article 12. <https://doi.org/10.3390/en14123626>
27. *Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020*. (2015). European Commission. https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf
28. *Guidelines for Preparing Economic Analyses, 3rd Edition* (2024). US EPA. <https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses-3rd-edition>
29. Halytsia, O., Vracholi, M., Janik, K., Sitek, S., Wojtal, G., Imig, A., Rein, A., Sauer, J. (2022). Assessing Economic Feasibility of Managed Aquifer Recharge Schemes: Evidence from Cost-benefit Analysis in Poland. *Water Resources Management*, 36(13), 5241-5258. <https://doi.org/10.1007/s11269-022-03303-0>
30. Harsanyi, J.C. (1955). Cardinal Welfare, Individualistic Ethics, and Interpersonal Comparisons of Utility. *Journal of Political Economy*, 63(4), 309-321. <https://doi.org/10.1086/257678>
31. Hartzell-Nichols, L. (2012). Intergenerational Risks. In: *Handbook of Risk Theory* (pp. 931-960). Dordrecht: Springer, https://doi.org/10.1007/978-94-007-1433-5_37
32. IPCC (2014). *Climate Change 2014: Mitigation of Climate Change*. Cambridge University Press.
33. Jansen, J., Bakker, S. (2006). *Social cost-benefit analysis of climate change mitigation options in a European context*. The Hague: Energy Research Centre of the Netherlands.

34. Jones, H., Moura, F., Domingos, T. (2014). Transport Infrastructure Project Evaluation Using Cost-benefit Analysis. *Procedia - Social and Behavioral Sciences*, 111, 400-409. <https://doi.org/10.1016/j.sbspro.2014.01.073>
35. Kermisch, C., Taebi, B. (2017). Sustainability, Ethics and Nuclear Energy: Escaping the Dichotomy. *Sustainability*, 9(3), Article 3. <https://doi.org/10.3390/su9030446>
36. Knight, F. (1921). *Risk, uncertainty and profit*. The Riverside Press.
37. Kołacińska, K., Sasin, R. (2016). Analiza kosztów i korzyści wdrożenia energetyki jądrowej w Polsce. *Rynek Energii*, No. 3. <http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-01a34943-ccb7-470a-b45f-5d193b1f374e>
38. Krutilla, K., Graham, J.D. (2023). Benefit-Cost Analysis of Air Pollution, Energy, and Climate Regulations. *Elements in Public Economics*. <https://doi.org/10.1017/9781009189460>
39. Kundzewicz, Z.W., Matczak, P. (2012). Climate change regional review: Poland. *WIREs Climate Change*, 3(4), 297-311. <https://doi.org/10.1002/wcc.175>
40. Kunreuther, H., Gupta, S., Bosetti, V., Cooke, R., Dutt, V., Ha-Duong, M., Held, H., Llanes-Regueiro, J., Patt, A., Shittu, E., Weber, E. (2014). Integrated Risk and Uncertainty Assessment of Climate Change Response Policies. In: *Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 151-206). Cambridge University Press. <https://doi.org/10.1017/CBO9781107415416.008>
41. Ligus, M. (2009). *Efektywność inwestycji w odnawialne źródła energii - analiza kosztów i korzyści*. CeDeWu. <https://cedewu.pl/Efektywnosc-inwestycji-w-odnawialne-zrodla-energii-analiza-kosztow-i-korzysci-p221>
42. Medvecky, F. (2012). Valuing environmental costs and benefits in an uncertain future: Risk aversion and discounting. *Erasmus Journal for Philosophy and Economics*, 5(1), Article 1. <https://doi.org/10.23941/ejpe.v5i1.91>
43. Mrozowska, S., Wendt, J.A., Tomaszewski, K. (2021). The Challenges of Poland's Energy Transition. *Energies*, 14(23), Article 23. <https://doi.org/10.3390/en14238165>
44. Niebieskie Księgi 2021-2027 (2023). *Centrum Unijnych Projektów Transportowych*. <https://www.cupt.gov.pl/strefa-beneficjenta/wdrazanie-projektow/analiza-kosztow-i-korzysci/metodyka-analizy-kosztow-i-korzysci/niebieskie-ksiegi-2021-2027/>
45. Piacquadio, P.G. (2020). The ethics of intergenerational risk. *Journal of Economic Theory*, 186, 104999. <https://doi.org/10.1016/j.jet.2020.104999>
46. Pindyck, R.S. (2000). Irreversibilities and the timing of environmental policy. *Resource and Energy Economics*, 22(3), 233-259. [https://doi.org/10.1016/S0928-7655\(00\)00033-6](https://doi.org/10.1016/S0928-7655(00)00033-6)
47. *Polityka energetyczna Polski do roku 2040* (2021). Ministry of Climate and Environment. <https://www.gov.pl/web/ia/polityka-energetyczna-polski-do-2040-r-pep2040>.
48. Randall, A. (2020). On Intergenerational Commitment, Weak Sustainability, and Safety. *Sustainability*, 12(13), Article 13. <https://doi.org/10.3390/su12135381>

49. Riesch, H. (2013). Levels of Uncertainty. In: S. Roeser, R. Hillerbrand, P. Sandin, M. Peterson (Eds.), *Essentials of Risk Theory* (pp. 29–6). Springer Netherlands. https://doi.org/10.1007/978-94-007-5455-3_2
50. *Robust Decision Making*. Retrieved from: <https://www.rand.org/pubs/tools/TL320/tool/robust-decision-making.html>, 9 July 2025.
51. *Rozporządzenie Ministra Klimatu i Środowiska z dnia 1 lipca 2022 r. W sprawie określenia metod analizy ekonomicznej kosztów i korzyści oraz danych lub źródeł danych do celów tej analizy* (2022). <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20220001411>
52. Spash, C. (2020). *Greenhouse Economics: Value and Ethics*. Routledge. <https://doi.org/10.4324/9781003059998>
53. Stirling, A. (2007). Risk, precaution and science: Towards a more constructive policy debate. *EMBO Reports*, 8(4), 309-315. <https://doi.org/10.1038/sj.embor.7400953>
54. Taebi, B. (2012). Intergenerational Risks of Nuclear Energy. In: S. Roeser, R. Hillerbrand, P. Sandin, M. Peterson (eds.), *Handbook of Risk Theory Epistemology, Decision Theory, Ethics, and Social Implications of Risk* (pp. 295-318). Springer.
55. Taebi, B., Kwakkel, J.H., Kermisch, C. (2020). Governing climate risks in the face of normative uncertainties. *WIREs Climate Change*, 11(5), e666. <https://doi.org/10.1002/wcc.666>
56. *The Green Book. Central Government Guidance on Appraisal and Evaluation* (2022). HM Treasury. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf
57. Turner, R.K. (2007). Limits to CBA in UK and European environmental policy: Retrospects and future prospects. *Environmental and Resource Economics*, 37(1), 253-269. <https://doi.org/10.1007/s10640-007-9119-2>
58. *Ustawa z dnia 11 stycznia 2018 r. O elektromobilności i paliwach alternatywnych* (2025). <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317>
59. *Vademecum Beneficjenta* (2016). CUPT, Centrum Unijnych Projektów Transportowych. <https://www.cupt.gov.pl/strefa-beneficjenta/wdrazanie-projektow/analiza-kosztow-i-korzysci/metodyka-analizy-kosztow-i-korzysci/vademecum-beneficjenta/>
60. Włoch, P., Lazarek-Janowska, M. (2024a). Analiza kosztów i korzyści na przykładzie lądowej farmy wiatrowej. *Zeszyty Naukowe ZPSB Firma i Rynek*, 1(65), 106-114.
61. Włoch, P., Lazarek-Janowska, M. (2024b). Analiza kosztów i korzyści na przykładzie wielkoskalowej instalacji fotowoltaicznej Jastrzębniki. *Zeszyty Naukowe Zachodniopomorskiej Szkoły Biznesu Firma i Rynek*, no. 2(66), 60-72.
62. Zerbe, R.O., Bellas, A.S. (2006). *A Primer for Benefit–Cost Analysis*. Edward Elgar Publishing. <https://www.e-elgar.com/shop/gbp/a-primer-for-benefit-cost-analysis-9781843768975.html>

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE IN POLAND AND THE EUROPEAN UNION

Anna GAŚSIOREK-KOWALEWICZ^{1*}, Wiesław WASILEWSKI², Klaudia WORACH³,
Matthias NATTKE⁴

¹ University of Zielona Góra; a.kowalewicz@wez.uz.zgora.pl, ORCID: 0000-0002-3340-9318

² University of Zielona Góra; w.wasilewski@wez.uz.zgora.pl, ORCID: 0000-0001-8772-7656

³ University of Zielona Góra; k.worach@g.elearn.uz.zgora.pl, ORCID: 0009-0003-0367-9346

⁴ Brandenburg University of Technology Cottbus-Senftenberg; Matthias.Nattke@b-tu.de,
ORCID: 0000-0002-4966-0128

* Correspondence author

Purpose: The aim of this paper is to evaluate the current status and development of electric vehicle charging infrastructure in Poland, comparing it with the broader context of the European Union and to analyze its potential in reducing urban air pollution and contributing to the decarbonization of the transport sector. The article aims to present the progress in the field of electromobility by examining the number of charging stations and forecasting infrastructure development in Poland compared to the European Union.

Design/methodology/approach: The paper employs a systematic review of the literature and a critical analysis of selected publications to identify the problem and research gap. Research questions were formulated to guide the study, and hypotheses were adopted based on existing data. The analysis includes both Polish and foreign literature, scientific articles, legal acts, websites focused on electromobility, and infrastructure aspects. The descriptive method is used to analyze and present the collected materials. Additionally, the paper reviews legal requirements for charging infrastructure, evaluates the current state of development in Poland and the EU, and presents technical specifications of typical publicly available charging stations.

Findings: The findings indicate that Poland's electric vehicle charging infrastructure is underdeveloped compared to other EU countries, limiting its ability to achieve the climate goals associated with electromobility. There is a significant discrepancy between the growing number of electric vehicles and the insufficient development of charging stations. Despite national plans to increase the number of charging points, the existing infrastructure in Polish cities and along transportation routes remains inadequate. The study highlights the necessity for more strategic investments and legislative support to overcome these limitations and foster the adoption of electric vehicles.

Research limitations/implications: The paper primarily relies on secondary data sources and existing literature, which may not capture real-time developments in electromobility infrastructure. Additionally, data discrepancies between different sources can affect the reliability of findings. Future research should incorporate more empirical data collection and field surveys to validate the conclusions drawn.

Practical implications: The practical implications include recommendations for policymakers to focus on expanding the charging infrastructure, particularly fast charging stations, in urban and rural areas. The paper suggests that integrating charging systems with mobile applications for booking and payment can enhance user experience and adoption rates. It also emphasizes the importance of meeting EU standards and regulations to ensure efficient and widespread deployment of charging stations.

Social implications: The social implications of the study underscore the need for reducing urban air pollution and addressing public health issues associated with vehicle emissions. The transition to electric vehicles can significantly improve air quality, reduce noise levels, and enhance the overall living conditions in cities. The paper stresses the importance of developing infrastructure that is accessible to all residents, promoting equitable growth and environmental sustainability.

Originality/value: This paper contributes to the existing body of research by providing a comprehensive analysis of the development and future prospects of electric vehicle charging infrastructure in Poland, comparing it to the EU. It offers valuable insights into the challenges and opportunities associated with electromobility, and proposes actionable strategies to accelerate the transition to low-emission transport. The study's originality lies in its critical evaluation of policies and infrastructure development plans, providing a foundation for further research in the field.

Keywords: Electric Vehicle Charging Infrastructure, Electromobility, Sustainable Transport Solutions, Charging Stations, EU Policy, Spatial Inequality in Infrastructure, EU Climate Goals.

Category of the paper: Research paper.

1. Introduction

Road transport plays a significant role in the land transport system, especially in the context of cities but at the same time it brings numerous social, economic, and environmental challenges. These include climate change, air pollution, noise, and traffic jams.

Currently, nearly 95% of global transportation relies on liquid fuels derived from fossil sources (Leach et al., 2020). The energy and transport sectors are responsible for 70% of global greenhouse gas emissions (Duan et al., 2016; IEA, 2021; Leach et al., 2020).

In 2021, according to data from the European Environment Agency (EEA, 2023), the total greenhouse gas emissions from the 27 European Union countries amounted to 3,311 million tons of CO₂. The transport sector had the largest share of emissions, which accounted for 24% of total greenhouse gas emissions in the EU, and 17.6% in Poland (Fig. 1 and 2).

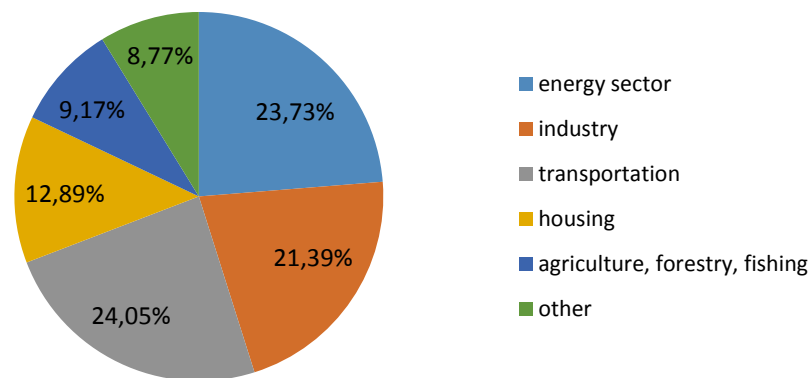


Figure 1. CO2 emissions by sector in the EU-27 in 2021.

Source: own study based on the (EEA, 2023).

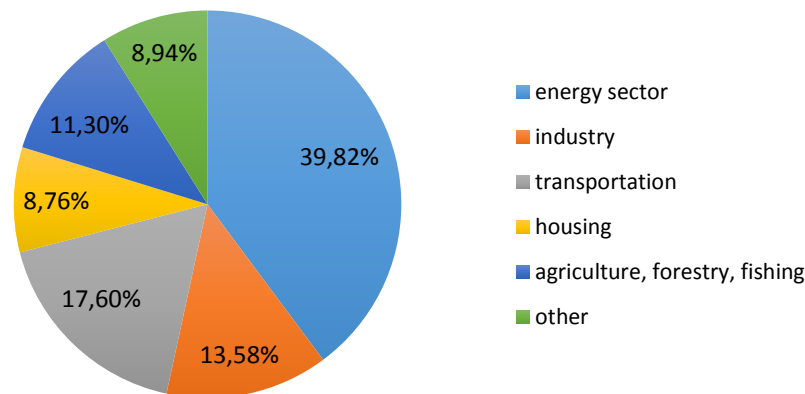


Figure 2. CO2 emissions by sector in Poland in 2021.

Source: own study based on the (EEA, 2023).

According to information available from the European Economic Area, between 1990 and 2017, emissions from the transport sector in Poland increased by as much as 206%, which is a significantly higher value than the European Union average of 28%. The highest levels of emissions occur locally in cities (Huo et al., 2015). Air pollution is also one of the major challenges in Poland, as it contributes to approximately 93,000 premature deaths per year (IEA, 2021). According to IQAir data from 2019, out of the one hundred European cities most polluted with PM_{2.5} particles, twenty-nine are located in Poland (IQAir, 2019). The environmental impact of transport is not limited to atmospheric emissions resulting from the combustion of conventional fuels—it also includes the release of harmful substances into soil and water, as well as noise generation.

To achieve decarbonization goals in line with the Paris Agreement, it is crucial to immediately implement more energy-efficient and energy-saving technologies and fuels (IEA, 2017, 2019). A notable suggestion for complying with this implementation are autonomic

vehicles, as they are oftentimes electric, meaning they contribute to mitigating the effects of climate change, including reducing CO₂ emissions, and additionally they improve air quality and reduce noise levels. The introduction of autonomous vehicles into the transportation system is only a matter of time. However, it is a gradual process, similar to the previous electrification of vehicles (Wasilewski et al., 2023, p. 174).

In recent years, there has been a growing interest in smart city solutions on the European market. According to data from Statzon.com (2023), the global smart city solutions market reached a value of €1024 billion in 2021, and it is projected to grow fivefold by 2030. This growth is mainly driven by the need for environmental protection and the efficient management and use of electricity (Tundys, Wiśniewski, 2023).

Global sales of electric vehicle increased by 41% since 2019, and the market share of electric vehicles worldwide reached a record high of 4.6% in 2020 (Virta, 2021). The number of newly registered vehicles with non-traditional propulsion systems is also steadily increasing. According to the International Energy Agency (IEA), in the European Union in 2020, the number of new electric vehicle registrations more than doubled to 1.4 million, accounting for 10% of all cars sold (IEA, 2022).

The transition to low-emission mobility - in addition to the technological and economic aspects - is also a major political and organizational challenge. This goal can be achieved by addressing key issues, such as the development of a sufficiently dense and efficient network of charging stations. This infrastructure plays a crucial role in promoting the success of the electric vehicle market by eliminating range anxiety and building consumer confidence in electric vehicles.

The priority seems to be the development of a publicly accessible charging network for electric vehicles throughout the EU, which is necessary to achieve the goals of the European Green Deal and the expected significant development of electromobility. In order to implement the indicated objectives, it is crucial to provide users of electric vehicles with charging options, especially fast charging stations located at distances that will make travelling across the EU countries by electric car as easy and accessible as possible.

2. Materials and methods

The aim of this paper is to evaluate the current state of electric vehicle charging infrastructure in Poland and to examine its impact on the potential for implementing electromobility as a strategy to reduce road transport emissions. This paper compares Poland's situation with that of other European Union countries, identifies the main barriers and challenges, and outlines the necessary actions for achieving a sustainable transformation in transportation. The following research questions were formulated:

1. To what extent can the development of electromobility contribute to reducing urban air pollution?
2. How does Poland's electric vehicle charging infrastructure compare to that of other European Union countries?
3. What infrastructural, energy, and institutional factors limit the implementation of low-emission transport strategies in Poland?
4. Considering the current state of infrastructure and energy conditions, is it feasible to achieve the climate goals associated with the development of electromobility?

A systematic review of the literature and a critical analysis of selected publications have made it possible to identify the problem and the research gap. The following research hypotheses were adopted:

- H1: Growing emissions from road transport, particularly in urban areas, caused by the increasing number of vehicles, should be minimized through investment in electromobility promoting zero emissions.
- H2: Poland's electric vehicle charging infrastructure is considered underdeveloped compared to other countries in the European Union.
- H3: Insufficient infrastructure and the energy crisis mean that achieving the assumed goals regarding emission reduction and implementation of electromobility in cities may be impossible.

In addition to presenting the current level of infrastructure development in the country, the authors assess the factors influencing the development of electromobility. They also criticize the Polish charging infrastructure development plan in relation to the assumptions of strategic documents at the Polish and EU level.

The study uses a review of Polish and foreign literature, scientific articles, legal acts, websites in the field of electromobility, infrastructure aspects and concepts that focus on the availability, expansion and density of electric vehicle infrastructure. The descriptive method was used to analyze and present the collected materials.

3. Legal requirements for charging infrastructure

Protection of air quality and actions related to the reduction of greenhouse gas emissions from transport are a priority of the climate and energy policy of the European Union authorities. The implementation of alternative fuels and the development of the related infrastructure are the key elements of the Polish and European climate and energy policy. In response to the growing challenges related to the decarbonization of the transport sector, both the European Union and Poland have developed a set of strategic documents and legal acts aimed at systematic support for the energy transformation in the area of mobility (see Table 1).

Table 1.*List of the most important EU and Polish documents)*

EU strategic documents	Polish strategic documents
• European strategy for low-emission mobility (2016) • Action plan on alternative fuels Infrastructure (2017) • The European Green Deal (2019) • Strategy for sustainable and smart mobility • “Fit for 55” package (2021) • “Hydrogen strategy for a climate-neutral Europe” (2020)	• Electromobility development plan in Poland – “Energy for the future” • National policy framework for the development of alternative fuels infrastructure • Sustainable Transport Development Strategy until 2030 • National energy and climate plan for 2021-2030 • Polish energy policy until 2040 • National Recovery and Resilience Plan • Polish Hydrogen Strategy
EU legal acts	Polish legal acts
• RED II Directive • RED III Directive • EU Taxonomy • AFIR Regulation – Alternative Fuels Infrastructure Regulation • LDV and HDV Regulations (Light Duty Vehicles and Heavy Duty Vehicles) • FuelEU Maritime Regulation (maritime transport) + REFuelEU Regulation • EU ETS Directive (introducing EU ETS BRT)	• Act on electromobility and alternative fuels • Act on bio-components and liquid biofuels • Act on renewable energy sources • Act on monitoring and controlling fuel quality • Energy Law Act

Source: Ministry of Climate and Environment (2025). National framework for the development of alternative fuels infrastructure policy (version of January 10, 2025).

The EU and Polish strategic documents and legal acts clearly indicate the development of electromobility and charging infrastructure as key elements of the transformation of transport towards zero emissions. Within the European Green Deal (European Commission, 2019) and the “Fit for 55” package (European Commission, 2021a), special emphasis was placed on the implementation of electric vehicles and ensuring their efficient power supply through an extensive and publicly available network of charging stations. The AFIR Regulation (European Parliament & Council, 2023) establishes uniform requirements in this area, obligating member states to provide a minimum number of charging points along the main transport corridors. Poland, in pursuing its own electromobility development strategy (“Energy for the Future”; Ministry of Energy, 2017) and the Act on Electromobility and Alternative Fuels (Journal of Laws 2022, item 1083), aims to increase the number of electric vehicles on the roads and expand the infrastructure, particularly in cities and along major transportation routes. These investments are also supported by funds from the National Recovery Plan (Chancellery of the Prime Minister, 2021) and the Energy Policy of Poland until 2040 (Ministry of Climate and Environment, 2021). Energy transformation in the transport sector requires a change in the types of propulsion systems used in new vehicles and the replacement of the liquid and gas fuel distribution infrastructure with an infrastructure for the distribution of electricity.

Polish implementation programs foresee that by 2030, there will be 600,000 electric vehicles in Poland. In line with this goal, the Act on Electromobility outlines regulations that impose certain obligations on public entities and multi-family housing units located in

municipalities with more than 50,000 residents, requiring the establishment of designated control points (Sendek-Matysiak, Szumska, 2018). Municipalities are also required to build charging points for electric vehicles. Additionally, commercial facilities are obligated to ensure that at least 20% of parking spaces are equipped with charging infrastructure (Wieczorek-Hodyra, 2025).

Table 2 presents the guidelines for the minimal distribution of publicly accessible charging stations, demographic specifications, and transport energy supply in various municipalities across Poland.

Table 2.

Requirements regarding the number of charging points in local government units in Poland

Characteristics of the municipality	Required number of electric vehicle charging points
• Population > 1 000 000. • Number of registered motor vehicles $\geq$ 600 000. • Motorization rate (number of registered vehicles per 1000 residents) $\geq$ 700.	1000
• Number of residents > 300 000. • Number of registered motor vehicles $\geq$ 200 000. • Motorization rate $\geq$ 500.	210
• Population > 150 000. • Number of registered motor vehicles $\geq$ 95 000. • Motorization rate $\geq$ 400.	100

Source: own study based on the Act of 11 January 2018 on electromobility and alternative fuels (consolidated text: Journal of Laws 2023, item 875).

Taking into account the number of residents and vehicles, and in accordance with the guidelines included in the Act on Electromobility and Alternative Fuels, it follows that the public charging points need to be established according to the decision makers only in 32 out of 2477 communes in Poland (Sendek-Matysiak, Łosiewicz, 2021). The data for analysis is presented in Table 3.

Table 3.

Minimum number of public charging points in accordance with the Act of 11 January 2018 on electromobility and solid fuels

Voivodeship	Municipality	Number of stations	Voivodeship	Municipality	Number of stations
Zachodniopomorskie	Szczecin	210	Kujawsko-Pomorskie	Bydgoszcz Toruń	100 100
Lubuskie	Zielona Góra Gorzów Wlkp.	60 60	Łódzkie	Łódź	210
Dolnośląskie	Wrocław	210	Śląskie	Bytom Częstochowa Dąbrowa Górnicza Gliwice Katowice Ruda Śląska Rybnik Sosnowiec Tychy Zabrze	60 100 60 100 100 60 60 100 60 60

Cont. table 3.

Pomorskie	Gdańsk Gdynia	210 100	Podlaskie	Białystok	100
Wielkopolskie	Poznań Kalisz	210 60	Mazowieckie	Płock Radom Warszawa	60 100 1000
Opolskie	Opole	60	Świętokrzyskie	Kielce	100
Warmińsko- Mazurskie	Olsztyn	60	Małopolskie	Kraków	210
Lubelskie	Lublin	100	Podkarpackie	Rzeszów	100

Source: own study based on: Sendek-Matysiak, Łosiewicz, 2021, p. 222.

The electromobility market is a rapidly growing segment in recent years, which now requires the creation of new solutions and products. A key element in the development of electromobility is to provide users with convenient and optimal conditions for charging vehicles. To this end, it is necessary to deploy charging stations in high-traffic areas, such as city centers, residential areas and transportation hubs. Equally important is their reliability and round-the-clock availability, which influences users' sense of security and comfort. In addition, the integration of charging systems with mobile applications that allow booking and payment significantly improves the quality of service.

The technical specifications for the charging station also include recommendations for user-friendliness. Each station should have visible instructions on how to use the device. This can take the form of a clear interface with a display containing guidelines for the charging process. It is essential that this interface is also adapted to the needs of people with disabilities.

According to research by Jochem et al. (2024), ease of use and clarity of mobile applications play a crucial role in shaping positive experiences for users of public charging stations. Users expect interfaces to be intuitive, fast, and uniform, regardless of the infrastructure operator (Wang et al., 2020). The diverse interface standards in individual European Union member states create difficulties in navigating and operating the stations, particularly in a cross-border context (Zhou et al., 2023).

Wang et al. (2025) analyzed the feedback from over 17,000 reviews of charging stations. The authors identified 12 key aspects that impact user satisfaction. These include, among others, equipment reliability, charger availability, ease of use, charging time, location, pricing, level of customer service, safety, cleanliness of the surroundings, technical condition of the infrastructure, availability of amenities (e.g., toilets, shelter), and the availability of information. It was found that negative experiences, especially those related to failures and lack of availability, have a stronger impact on ratings than positive aspects. Stations that combined a good location with hassle-free operation and a clear interface were rated particularly highly.

An important element of user satisfaction is also the availability of real-time information – for example, regarding the status of socket occupancy, waiting times, or malfunctions (Yang et al., 2024). Insufficient data updates in applications result in low user trust in the system (Arora et al., 2025). Furthermore, the lack of standardization of payment processes – the necessity to create multiple accounts or install separate applications – is one of the main

barriers indicated by EV drivers in the EU (European Commission, 2023). In response to these challenges, the European Commission is promoting the development of open payment systems and service interoperability (AFIR, 2023).

Increasingly important are automatic vehicle recognition and “plug & charge” payment features, which enable users to start a charging session without additional actions at the terminal (The Verge, 2024). The implementation of such technologies significantly enhances convenience and reduces the need for interaction with an app or screen (Kahlenborn et al., 2024). Research indicates that the availability of this option can increase overall satisfaction by up to 20% (ChargeLab, 2024). To achieve a high level of public acceptance and trust, charging infrastructure must be not only technically reliable but also accessible, intuitive, and universal in use – including for people with limited mobility (Rupprecht Consult, 2022).

The Polish legal system aims to support the development of infrastructure for charging electric vehicles. The planned mechanisms focus on creating clean transport zones in cities and building infrastructure throughout the country. Operators of public charging stations must operate in accordance with applicable regulations and standards to ensure effective, safe and convenient use of the charging infrastructure for all users of electric vehicles (Mańk-Chrulska, Puchała, 2024).

According to the Act on Electromobility and Alternative Fuels, the operator is responsible for the construction, management, safety of use, operation, maintenance and repairs of stations.

The operator of a publicly available charging station is responsible for (UDT, 2022):

- Ensuring the availability and technical efficiency of the charging station, regular inspections and maintenance of charging devices.
- Compliance of the charging station with technical and safety requirements.
- Ensuring easy access to charging stations, including appropriate signage and information for users.
- Ensuring appropriate technical support and customer service, including the ability to contact the operator in the event of problems.
- Providing information on the location, availability and prices of charging in a transparent and easily accessible manner to the Alternative Fuels Infrastructure Register.
- Monitoring energy consumption and collecting data on the charging of electric vehicles.
- Concluding a distribution agreement with the Distribution System Operator (DSO) for the operation of the charging station and the provision of charging services.

In Poland, the President of the Energy Regulatory Office (Energy Regulatory Office, 2024) designated energy companies that sell electricity to the largest number of end users connected to the distribution network in municipalities where they are to act as operators (Energia Obrót SA, Enea SA, Tauron Sprzedaż Sp. z o.o. and PGE Obrót SA). The provision of charging service provider services is carried out by the following companies: Energa-Operator SA,

Tauron Dystrybucja SA, PGE Dystrybucja SA, Innogy Stoen Operator Sp. z o.o. and Enea Operator Sp. z o.o. Despite the designation by the President of the Energy Regulatory Office of the largest energy companies as operators of publicly available charging stations, the largest market share was gained by companies specializing in providing software, such as the European GreenWay, which has about 20% share in the charging station market in Poland (Chmielewski et al., 2023).

The charging service provider offers a service that includes charging vehicles and providing access to the charging station infrastructure. It includes an energy sales contract with the electricity supplier and provides information on prices and terms of providing the charging service on its website. It is worth mentioning that the operator of a public charging station can perform the tasks of a charging service provider.

New guidelines for charging infrastructure have been specified in AFIR (Alternative Fuels Infrastructure Regulation) - a regulation of the Council of the European Union, adopted in July 2023, which replaces the previous Directive 2014/94/EU (AFID). One of the key assumptions of AFIR is the creation of charging zones every 60 kilometers along the main routes of the TEN-T core network for passenger cars and light trucks up to 3.5 tons by the end of 2025 (European Commission, 2021b). Each of these zones should have a power of at least 400 kW, with at least one charging point with a power of at least 150 kW. By the end of 2027, the power of these zones is to increase to 600 kW, with at least two charging points of 150 kW each (European Commission, 2021b). For electric trucks over 3.5 tons, charging hubs are to be located every 120 kilometers along the TEN-T route by the end of 2025.

4. Current state of development of electric vehicle charging infrastructure in Poland and the EU

According to data from the European Automobile Manufacturers Association (ACEA), there are an estimated 1.1 billion cars in the world, in Europe alone – 246.345 million cars (in 2020), and in Poland there were 26.676 million passenger cars registered in 2022 (Korzeniowski, 2022). Taking this data into account, electric cars constitute only 0.23% of the vehicle fleet in Poland (excluding public transport and delivery vehicles, e.g. InPost). In times of crisis convincing people to buy new cars will not be an easy task. In Poland, the average age of a car exceeds 12 years, and the motorization rate is 747 cars per 1000 inhabitants, which is the second highest result in Europe. However, only 25 thousand of the 24.3 million cars registered since 2021 are PHEV (plug-in hybrid electric vehicle) and BEV (battery electric vehicle) vehicles. The current car fleet is outdated and inefficient and this is a significant source of pollution harmful to the health of city residents and excessive greenhouse gas emissions, which is harmful to our planet. Therefore, significant changes in this area are necessary.

One of the desired directions of change is the transition to electric passenger cars. Unfortunately, both Italy and Poland are considered to be countries insufficiently prepared for the introduction of electric vehicles. In 2020, Poland ranked third in Europe in terms of the low number of registered electric vehicles (0.12 EV/1000 residents) (ACEA, 2022).

Construction and density of the charging infrastructure per registered electric vehicle in a given country have a significant impact on the popularity of these vehicles. In Europe, the number of electric vehicle charging stations remains insufficient. The current infrastructure does not yet allow the European Union to fully phase out the sale of new internal combustion engine vehicles in favor of electric ones by 2035.

The number of public charging points in the European Union is constantly growing (Fig. 3). In the second quarter of 2024, a total of 733,431 charging points were available in the U-27, of which 86% were slow alternating current (AC) chargers, and 14% were fast direct current (DC) charging points.

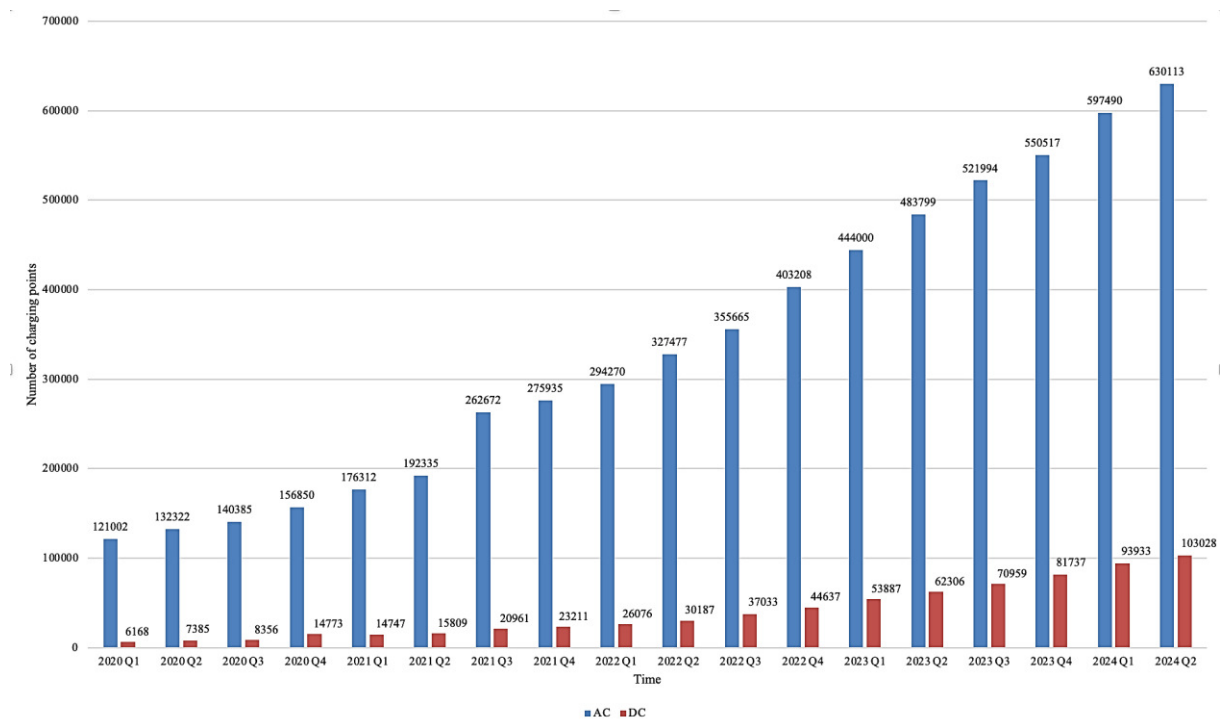


Figure 3. Total number of recharging points, according to the AFIR classification.

Source: EAFO 2024, available at: <https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/infrastructure>, 12.06.2025.

It is worth noting that the distribution of charging stations across the EU is uneven. Of all publicly available charging points in 2020, almost 69% were concentrated in just two EU countries: the Netherlands (111,821 chargers) and Germany (87,674). The area of both countries is less than 10% of the EU area, the remaining chargers are located in the remaining 90% of the region. The largest number of public charging points in the EU was located in the Netherlands (111,821), Germany (87,674), France (83,317), Italy (37,186) and Spain (34,380). The countries with the least developed electric vehicle charging infrastructure are: Latvia (660),

Lithuania (477), Estonia (300), Cyprus (69) and Malta (13) (ACEA, 2023). Data that also illustrates the development of charging infrastructure was presented by the European Court of Auditors (see Figure 4).

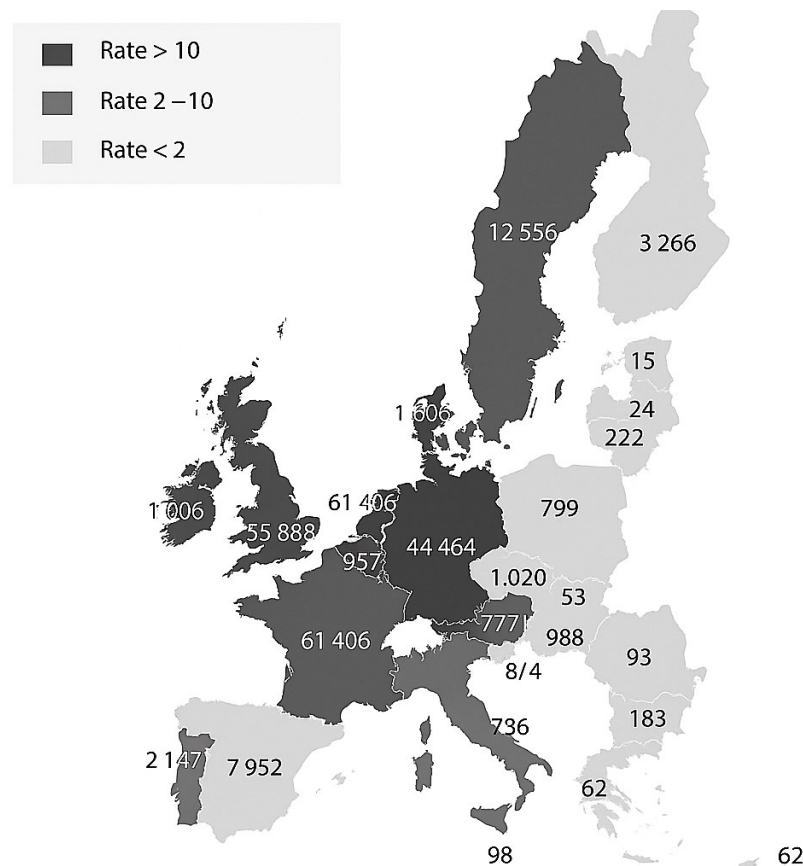


Figure 4. Number of charging points as of September 2020.

Source: European Court of Auditors (2021). Electric vehicle charging infrastructure, p. 25.

The total charging points and data on their distribution in each location. There are differences in solutions in Western European countries (in Germany, Belgium and Great Britain, the density of charging points per 100 km² was above 10 in 2020), and the lowest in Central and Eastern Europe (in countries such as Poland, the Czech Republic, Romania, Bulgaria, Slovakia, this coefficient was below 2) (European Court of Auditors, 2021, p. 25). Uneven distribution of charging infrastructure does not facilitate travel across the EU territory, so that free travel is possible throughout the entire EU area, rather than, as is currently the case, only in selected countries (Komarnicki et al., 2020, p. 4). For better and sustainable development of charging stations, the rules, incentives, and forms of support for market growth should be unified so that they are coherent, understandable and stimulating the development of electromobility. The development of this sector also means stimulating economic growth in the region, increased demand for new green jobs, new professions, and will necessitate new educational systems and training pathways for the workforce.

It is worth pointing that between 2016 and 2022 the growth rate of electric car sales in the European Union was more than three times faster than the rate of building charging points. Electric car sales increased almost 16-fold between 2016 and 2022, while the number of public chargers in the EU increased sixfold during the same period (see Table 4).

Table 4.

Number of charging points and electric cars in the EU-27 in 2016-2022

UE	2016	2017	2018	2019	2020	2021	2022	Change 2022/2016 [%]
Charging points	77038	109896	123727	133947	184392	319978	479396	+522,3%
Electric vehicles	18542	168901	240347	387325	1045893	1744520	1996738	+1584,4%

Source: ACEA, 2023.

The increase in the number of electric vehicles on the roads naturally translates into challenges for infrastructure. According to the Polish EV Outlook 2022 report (PSPA, 2022), the number of electric cars per charging point is increasing (see Figure 5). In 2019, it was 5.6 in Poland. This proportion increased to 7.4 in 2020, to 10.4 in 2021, and to 12 in mid-2022. This carries the risk of low efficiency and capacity of charging devices.

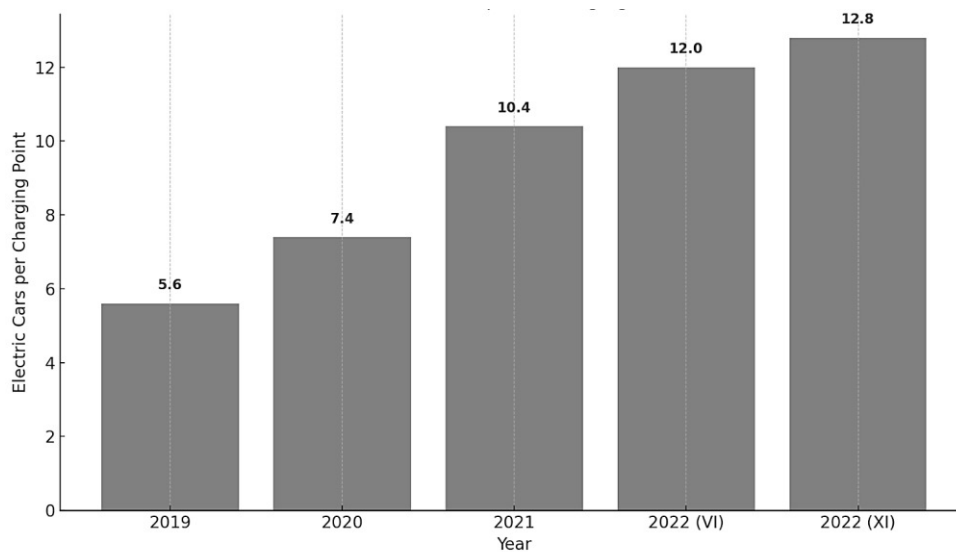


Figure 5. The number of electric cars in Poland per 1 charging point installed in a publicly accessible station.

Source: PSPA, 2022, p. 15.

The increase in the number of publicly available charging points is gaining importance in the light of the European Commission's proposal for a new regulation on infrastructure development for alternative fuels as part of the "Fit for 55" package. The regulation forces member states to achieve specific goals in infrastructure development based on an algorithm that takes into account the number of registered electric vehicles, which will be a challenge for countries such as Poland, which are at an early stage of electromobility development. Undoubtedly, improving the indicator of the optimal ratio of public chargers to vehicles will support the development of electromobility as part of intelligent mobility.

According to the PSPA report (2022), the most popular locations for publicly available charging stations are: public parking lots (41%), shopping malls (17%), hotels (16%), petrol stations (11%) and car showrooms (5%).

In Poland, the largest operators of public charging stations include companies such as GreenWay Polska, PKN Orlen, Tauron, Revnet, EV+, PGE, Innogy, Elocity, GO+, Zepta, Ekoenergetyka, Enea and Ioney.

The largest market share, accounting for over 40% of publicly available charging points according to data from Q4 2022, is held by the leading operators: GreenWay Polska with 1099 charging points at 497 stations (Greenway, 2023) and PKN Orlen with over 1000 charging points at 480 stations (PKN Orlen, 2023). A detailed description of typical, publicly available PKN Orlen and Greenway charging stations is presented in Table 5.

Table 5.
Technical specification of recharging stations in Poland

Operator	PKN Orlen			Greenway	
Producer	ABB Terra CE 54 CJG	Ekoenergetyka AXON EASY	Efacec QC45	ABB Terra Wallbox	Delta Slim 100
Example model graphical view					
EV connectors	CCS2—1 pc. CHAdeMO—1 pc. Type 2 AC—1 pc.	CCS2—1 pc. CHAdeMO—1 pc. Type 2 AC—1 pc (optional)	CCS2—1 pc. CHAdeMO—1 pc. Type 2 AC—1 pc	CCS2—1 pc. CHAdeMO—1 pc.	CCS2—1 pc. CHAdeMO—1 pc. Type 2 AC—1 pc
Output power [kW]	50 kW DC 43 kW AC	60/120/180 kW DC 43 kW AC	50 kW DC 43 kW AC	24 kW DC (peak) 22.5 kW DC (cont.)	00 kW DC 22 kW AC
Output voltage range [V]	150-500 V DC 400 V AC	150-1000 V	50-500 V	150-920 V	200-920 V
Output current [A]	125 A DC 32 A AC 3phase	CCS2 200/250/300 A CHAdeMO 125 A 32 A AC	AC: up to 63 A 3 phase DC: up to 120 A	60 A	CCS2 250 A CHAdeMO 12 A 32 A AC 3phase
Connection Power [kVA or kW]	98 kW	90/156/222 kW	n.a.	n.a.	n.a.
Supply voltage [V]	380-415 V AC AC 3-phase	400 V AC 3-phase	400 V AC +/-10%	400 V AC +/-10%	
Input current [A]	143 A	n.a.	73 A	100 A	203 A
Current type	DC AC 3-phase	DC AC 3-phase	DC AC 3-phase	DC	DC
Peak efficiency	>94%	>94%	>93	>95%	>94%

Cont. table 5.

Size DxWxH [m]	$0.78 \times 0.78 \times 1.9$	$0.98 \times 0.75 \times 2$		$0.3 \times 0.58 \times 0.77$	$0.44 \times 1.62 \times 0.89$
Communication Interface	4G, Ethernet	4G, 5G, Ethernet	3G (GSM/CDMA), LAN, Wi-Fi	GSM/4G modem, Ethernet	Ethernet, Cellular 2G/3G/4G
Load management method	OCCP	OCCP	OCPP	OCCP	OCCP
Authentication method	RFID, NFC, Pincode, App	RFID, NFC	RFID	RFID, NFC, Mifare, Calypso	RFID, NFC
Time to add 100 km (reference battery usage capacity 75 kWh)	~22 min (43 kW) ~19 min (50 kW)	~22 min (43 kW) ~16 min (60 kW) ~8 min (120 kW) ~5.5 min (180 kW)	~22 min (43 kW) ~19 min (50 kW)	~42 min (22.5 kW)	~43 min (22 kW) ~10 min (100 kW)
Charging fee [PLN/kWh]	AC for 50 kW: 1.89 PLN/kWh DC for $x \leq 50$ kW: 2.69 PLN/kWh DC for $50 \text{ kW} < x \leq 125$ kW: 2.89 PLN/kWh DC for $x > 125$ kW: 3.19 PLN/kWh	Energia STANDARD AC: 1.95 PLN/kWh DC for $x \leq 100$ kW: 2.95 PLN/kWh DC for $x > 100$ kW: 3.25 PLN/kWh	Charging fee [PLN/kWh]	AC for 50 kW: 1.89 PLN/kWh DC for $x \leq 50$ kW: 2.69 PLN/kWh DC for $50 \text{ kW} < x \leq 125$ kW: 2.89 PLN/kWh DC for $x > 125$ kW: 3.19 PLN/kWh	Energia STANDARD AC: 1.95 PLN/kWh DC for $x \leq 100$ kW: 2.95 PLN/kWh DC for $x > 100$ kW: 3.25 PLN/kWh
Parking fee [PLN/min]	0.40 PLN/min AC: after 60 min—recharging stations with AC&DC connectors AC: after 720 min—recharging stations with AC connectors only DC: after 45 min	0.40 PLN/min AC: after 600 min (valid from 7:00 to 21:00) DC: after 60 min	Parking fee [PLN/min]	0.40 PLN/min AC: after 60 min—recharging stations with AC&DC connectors AC: after 720 min—recharging stations with AC connectors only DC: after 45 min	0.40 PLN/min AC: after 600 min (valid from 7:00 to 21:00) DC: after 60 min
Cost of charging per 100 km (no parking fee)	29.3 PLN (AC—43 kW) for 22 min 41.7 PLN (DC—50 kW) for 19 min 44.8 PLN (DC—60 kW/120 kW) for 16 min/8 min 49.5 PLN (DC—180 kW) for 5.5 min	30.22 PLN (AC—22 kW) for 43 min 45.72 PLN (DC—50 kW/100 kW) for 19 min/10 min 50.37 PLN (DC— $x > 100$ kW)	Cost of charging per 100 km (no parking fee)	29.3 PLN (AC—43 kW) for 22 min 41.7 PLN (DC—50 kW) for 19 min 44.8 PLN (DC—60 kW/120 kW) for 16 min/8 min 49.5 PLN (DC—180 kW) for 5.5 min	30.22 PLN (AC—22 kW) for 43 min 45.72 PLN (DC—50 kW/100 kW) for 19 min/10 min 50.37 PLN (DC— $x > 100$ kW)

Source: Chmielewski, Piórkowski, Możaryn, Ozana, 2023, p. 4528.

An important aspect of the development of electric vehicle charging infrastructure is their location. The location of the infrastructure is closely linked to the local specificity of the city: access to the distribution network, city spatial plans including the nature of development, reported needs of residents, and state regulations. The analysis of the location of chargers shows that most private users of electric vehicles have the opportunity to charge their vehicles in private garages, private parking spaces or driveways on private properties, equipped with access to electricity, often from their own photovoltaic micro-installation. Chargers are also located in city centers or in private and neighbourhood parking lots. While access to chargers in large cities is no longer as problematic, the need to charge a car on motorways or in rural areas is a bigger problem. The fast charging network being developed along the main communication routes allows moving between the largest Polish cities, but it can be difficult to find a charging station in a rural area and match the type of charger or connector. Table 6 lists the number of vehicles and the number of electric vehicle charging points in particular voivodeships (as of December 2022).

Table 6.

Number of electric vehicles and charging stations in individual voivodeships in Poland in 2022

Voivodeship	Area km ²		Number of Electrically Driven Vehicles			Number of Charging Stations	
		Sum	BEV	PHEV	Sum	AC	DC
Pomorskie	18,31	3885	1874	2011	263	198	65
Zachodniopomorskie	22,892	1893	845	1048	190	164	26
Warmińsko-mazurskie	24,173	836	381	455	139	126	13
Podlaskie	20,187	1214	632	582	52	32	20
Mazowieckie	35,558	18,237	9139	9098	413	326	87
Kujawsko-pomorskie	17,972	1883	805	1078	153	106	47
Wielkopolskie	29,826	6280	3186	3094	158	95	63
Lubuskie	13,988	848	423	425	51	27	24
Łódzkie	18,219	2581	1290	1291	109	44	65
Dolnośląskie	19,947	4089	1996	2093	224	164	60
Opolskie	9412	827	420	407	59	41	18
Śląskie	12,333	5856	2834	3022	323	233	90
Świętokrzyskie	11,711	846	488	358	31	24	7
Małopolskie	15,183	6032	3464	2568	197	126	71
Podkarpackie	17,846	1577	755	822	61	32	29
Lubelskie	25,122	1590	823	767	37	21	16

Source: IEA. Global EV Outlook 2022. Available online: <https://www.iea.org/reports/global-ev-outlook-2022>, 12.06.2025.

Most of the available charging networks are concentrated in four voivodeships: Mazowieckie – 413, Śląskie - 323, Pomorskie - 263 and Dolnośląskie - 224, which constitute almost 50% of the total number of charging stations in Poland. Among the voivodeships with the lowest number of publicly available charging stations are the following voivodeships: Świętokrzyskie (31 stations), Lubelskie (37), Lubuskie (51), Podlaskie (52) and Opolskie (59). This is still too small a number to meet the expectations of potential consumers.

5. Charging infrastructure

Ongoing development and technological progress, especially in the area of electric vehicle charging, requires standardization of terminology. In this regard, the European Union Sustainable Transport Forum (2021) addresses key aspects related to charging infrastructure. The vehicle charging process is a set of activities aimed at transmitting and storing the energy necessary for its propulsion. Currently, it can be carried out in several ways, including by charging using a plug connector, pantograph and wirelessly using electromagnetic induction. The division of electric vehicle charging methods is presented in Figure 6.

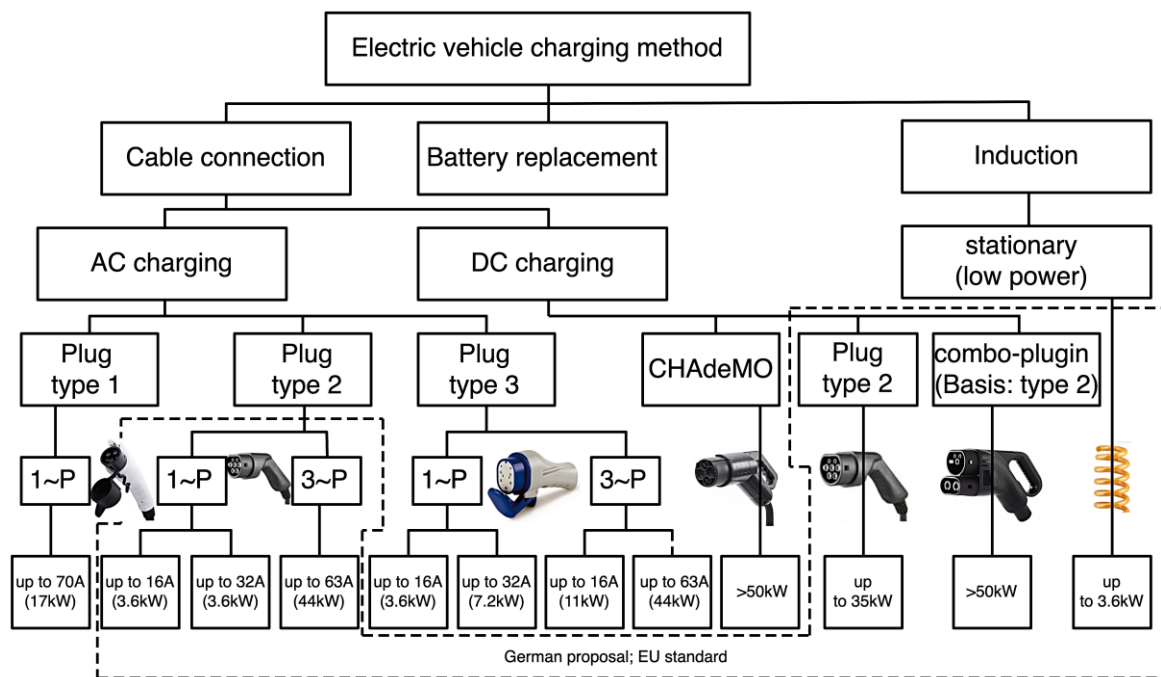


Figure 6. Charging Methods and available power connectors for electric vehicles.

Source: Zajkowski, Seroka, 2017, p. 484.

Charging can be carried out using home and garage installations, as well as charging station infrastructure designed specifically for this purpose.

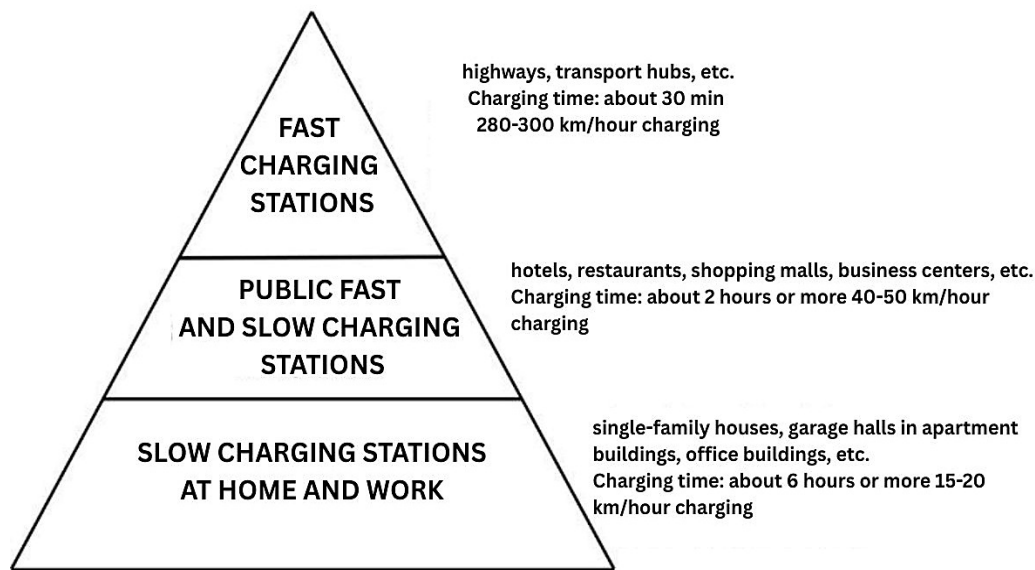


Figure 7. Location of charging stations.

Source: Zawieska, 2019.

Charging station is a dedicated place equipped with one or more devices for charging electric vehicles. The equipment of a charging station includes various components and devices that ensure efficient and safe charging of electric vehicles. Key elements of the charging station equipment include (Zawieska, 2019):

- Chargers (AC or DC).
- Connectors and sockets.
- Charging cables.
- Energy management systems (load distribution and monitoring).
- Payment terminals.
- Communication interfaces (OCPP-Open Charge Point Protocol, Wi-Fi, Ethernet, GSM).
- Safety systems (emergency switches, monitoring).
- Signage and information, including instructions for use and displays showing charging status and cost.
- Additional equipment (roof, lighting, cooling systems).

Charging point, on the other hand, is a single socket or connector at a charging station that allows one electric vehicle to be connected for charging. A charging station can have multiple charging points, which allows for the simultaneous charging of several vehicles. Charging points differ in the type of connector and the power they can deliver to the vehicle. The IEC 61851-1 (International Electrotechnical Commission, 2017) standard defines and classifies power supply methods, including protective installation, communication method and management of the charging system. This standard distinguishes four charging modes for electric vehicles: Mode 1, Mode 2, Mode 3, and Mode 4. The characteristics of wired charging systems for electric vehicles according to the IEC 61851-1 standard are given in Table 7.

Table 7.*Characteristics of electric vehicle conductive charging systems according to IEC 61851-1*

Charging type	Description	Characteristics	Application
Mode 1	Charging with alternating current (AC) using standard household outlets.	No special protective measures. Voltage: up to 250 V (single-phase) or 480 V (three-phase). Current: up to 16 A.	Mainly used for charging at homes or places with publicly accessible sockets. Requires additional protection, e.g., via residual current devices (RCDs).
Mode 2	Alternating current (AC) charging using standard household sockets but with an additional control module (ICCB) integrated in the cable.	The ICCB (In-Cable Control Box) module provides additional safety measures, such as fault detection. Voltage: up to 250 V (single-phase) or 480 V (three-phase). Current: up to 32 A.	Home charging with a higher level of safety compared to Mode 1.
Mode 3	Alternating current (AC) charging using dedicated charging stations.	Charging stations are equipped with specialized sockets as well as communication and control systems. Voltage: up to 690 V (three-phase). Current: up to 250 A.	Public and private charging stations with higher power. Enhanced safety thanks to integrated protection systems.
Mode 4	Direct current (DC) charging using dedicated charging stations.	Fast charging using direct current (DC). Voltage: up to 1000 V. Current: up to 400 A.	Public fast-charging stations, especially along highways and main routes. Designed for rapid recharging of electric vehicles in a short time.

Source: Chmielewski, Piórkowski, Możaryn, Ozana, 2023, p. 4528.

Currently, the most commonly used charging system for electric vehicles worldwide is wired energy transfer. Electric vehicle batteries can be charged using either alternating current (AC) or direct current (DC). Unfortunately, the connectors for stationary electric vehicles vary by geographic region and even model, making it impossible to charge an electric vehicle at any charging point in the world.

The following types of connectors are currently available for charging electric vehicles:

- Type 1 (SAE J1772).
- Type 2 (Mennekes).
- Type 3 (Scame).
- CHAdeMO.
- CCS (Combined Charging System).
- Tesla Supercharger.

Table 8 presents the types of power connectors and their differences depending on the charging system used.

Table 8.*Power connector and charging system used*

Connector type	Type of current	Current voltage	Power	Number of phases	Application	Region	Graphic view
AC – Type 1	Alternating (AC)	Up to 250 V	Up to 7.4 kW	1-phase	Home and public charging	North American, Japan	
AC – Type 2	Alternating (AC)	Up to 480 V	Up to 43 kW	1-phase or 3-phase	Home, public and commercial charging	Europe	
AC – Type 3	Alternating (AC)	Up to 480 V	Up to 22 kW	1-phase or 3-phase	Public charging	Italy	
DC – CHAdeMO	Direct (DC)	Up to 500 V	Up to 50 kW	1-phase	Fast public charging	Japan, world	
CCS Combo 1	Direct (DC)	Up to 1000 V	Up to 350 kW	1-phase	Fast public charging	North America	
CCS Combo 2	Direct (DC)	Up to 1000 V	Up to 350 kW	1-phase	Fast public charging	Europe	
GB/T	Direct (DC)	Up to 750 V	Up to 250 kW	1-phase	Fast public charging in China	China	
ChaoJi DC GB/T 20234 i IEC 62196	Direct (DC)	Up to 1000 V	Up to 500 kW	1-phase	Ultra-fast global charging	Asia (China, Japan, South Korea)	

The Type 1, Type 2, and Type 3 are used for AC charging, as defined in the IEC-62196-2 standard (Chmielewski et al., 2023). The IEC-62196-3 (International Electrotechnical Commission, 2022) standard specifies standards for DC charging connectors. Connectors compliant with this standard are designated in the following configurations: CHAdeMO, CCS Combo 1 (SAE J1772 Combo), CCS Combo 2 (IEC Type 2 Combo), GB/T 20234.3 DC. Currently, work is also being done on the ChaoJi DC standard, combining the GB/T 20234 and IEC 62196 standards.

Source: Benmouna, 2024, p. 33.

6. Summary

Based on the conducted research, it was found that the development of electric vehicles contributes to reducing environmental pressure. Most of the existing studies show that charging infrastructure has a significant positive impact on the adoption of electric vehicles (Dhakal, Min, 2021; Fluchs, 2020; Gota et al., 2019; Klein et al., 2020; Pasaoglu et al., 2016; Sæther, 2022).

The use of battery-powered electric vehicles, charged from a grid where electricity is mainly generated from coal, has the potential benefit of reducing emissions in congested cities. In Poland, where over 80% of electricity is generated from hard coal and lignite, it is difficult to justify the use of electric vehicles in terms of a positive impact on the environment and climate protection. Of course, pollution caused by energy production dominated by coal is high, but it is emitted outside the boundaries of congested cities. Transferring emissions from one place to another is not a way to solve the problem of greenhouse gas emissions on a global scale, but as noted, it has a significant impact on reducing emissions locally in cities (Huo et al., 2015).

An important factor influencing the development of electromobility is the number of electric vehicles charging stations. Although the development of charging stations in Poland has been dynamic, the overall level of charging infrastructure remains insufficient, and the charging time for vehicles is still too long. This is reflected in the low density of charging stations, particularly public charging stations. In addition to the availability of adequate charging infrastructure, the main problem is the lack of fast-charging stations.

A deeper analysis indicates potential problems and shortcomings in the charging infrastructure. The most significant issues include:

1. A disproportionately higher rate of vehicle electrification compared to the slower growth in the number of public charging stations.
2. A low share of fast-charging stations, resulting in longer vehicle charging times.
3. Uneven distribution of public charging stations.

The implementation of electromobility is a complex issue, involving numerous economic, social, and spatial aspects. Some of the key areas that require in-depth research include local factors influencing the purchase of low-emission vehicles and the development of the infrastructure necessary for their charging. To accelerate the adoption of electric vehicles and highlight the benefits of smart electromobility, it is essential to coordinate efforts within a network of organizations. Therefore, supporting initiatives that help cities accelerate the green transition process is crucial. It is obligatory to implement a financial support system and optimize legal regulations. This will speed up the deployment of environmentally friendly solutions, stimulate the economy, and, most importantly, contribute to the sustainability of the transport system. These long-term changes in the transportation sector can have a positive impact on climate change.

In conclusion, the paper verifies all three hypotheses through empirical data and comparative analysis. It emphasizes the urgent need for strategic investments and policy interventions to develop a robust EV charging infrastructure, addressing the energy crisis, and fostering the adoption of electric vehicles for sustainable urban mobility.

References

1. ACEA (2022). *Making the Transition to Zero-Emission Mobility Progress. Report 2022*. Retrieved from: https://www.acea.auto/files/ACEA_progress_report-2022.pdf, 12.06.2025.
2. ACEA (2023). *New registrations of electric vehicles in Europe – Statistics report*. Retrieved from: www.acea.auto, 12.06.2025.
3. Arora, R., Zhang, L., Bohn, C. (2025). User trust and real-time data accuracy in EV charging networks. *Journal of Intelligent Transportation Systems*, 29(2), 118-132. <https://doi.org/10.1080/15472450.2025.1123456>
4. Benmouna, A., Rezzoug, A., Djerdir, A., Tazibt, S. (2024). Charging stations for large-scale deployment of electric vehicles. *Batteries*, 10(1), 33. doi:10.3390/batteries10010033
5. Chancellery of the Prime Minister (2021). *National Recovery and Resilience Plan (KPO)*. Retrieved from: <https://www.gov.pl/web/kpo>, 12.06.2025.
6. ChargeLab (2024). *EV user satisfaction survey 2024*. Retrieved from: <https://chargelab.co/blog/news-survey-2024>
7. Chmielewski, A., Piórkowski, P., Możaryn, J., Ozana, S. (2023). Sustainable Development of Operational Infrastructure for Electric Vehicles: A Case Study for Poland. *Energies*, 16(11), 4528.
8. Dhakal, S., Min, H. (2021). Transport electrification in cities: Challenges, policies, and opportunities. *Environmental Sustainability*, 4(2), 173-182. doi:10.1007/s42398-021-00182-y
9. Duan, H., Yu, Q., Wang, L. (2016). Life cycle energy and greenhouse gas emissions of electric vehicles in China. *Resources, Conservation and Recycling*, 120, 84-93.
10. EAFO (2024). *European Alternative Fuels Observatory*. Retrieved from: <https://alternative-fuels-observatory.ec.europa.eu>, 12.06.2025.
11. Energy Regulatory Office (2024). *Infrastructure development report*. Warsaw: URE.
12. European Commission (2019). *The European Green Deal*. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640>, 12.06.2025.
13. European Commission (2021a). *Fit for 55 package*. Retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55_en, 12.06.2025.

14. European Commission (2021b). *Proposal for a Regulation on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU*. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0559>, 12.06.2025.
15. European Commission (2023). *Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR)*. Retrieved from: <https://transport.ec.europa.eu>
16. European Court of Auditors (2021). *Electric vehicle charging infrastructure*. Luxembourg: Publications Office of the European Union.
17. European Environment Agency (2023). *Annual European Union greenhouse gas inventory 1990-2021 and inventory report 2023*. Retrieved from: <https://www.eea.europa.eu/en/analysis/publications/annual-european-union-greenhouse-gas-2?activeTab=22266594-97f5-4524-946f-095a50759ae7>, 12.06.2025.
18. European Parliament & Council (2023). *Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR)*. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1804>, 12.06.2025.
19. European Union Sustainable Transport Forum (2021). *Recommendations for public authorities on procuring and managing electric recharging infrastructure*.
20. Fluchs, S. (2020). *Infrastructure needs for electric mobility in Europe*. Brussels: Transport & Environment.
21. Gota, S., Huizenga, C., Peet, K., Medimorec, N. (2019). Decarbonising transport to achieve Paris Agreement targets. *Energy Efficiency*, 12, 363-386. doi:10.1007/s12053-018-9671-3
22. GreenWay Polska (2023). *Infrastruktura ładowania pojazdów elektrycznych w Polsce 2023: Bariery, potrzeby, szanse*. Retrieved from: <https://greenwaypolska.pl>, 12.06.2025.
23. Huo, H., Zhang, Q., He, K., Yao, Z. (2015). Vehicle-use intensity in China: Current status and future trend. *Energy Policy*, 81, 71-75.
24. International Electrotechnical Commission (2017). *IEC 61851-1: Electric vehicle conductive charging system – Part 1: General requirements*. Geneva: IEC.
25. International Electrotechnical Commission (2022). *IEC 62196-3: Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers*. Geneva: IEC.
26. International Energy Agency (IEA) (2017). *Energy Technology Perspectives*. Paris: International Energy Agency.
27. International Energy Agency (IEA) (2019). *Global EV Outlook 2019*. Paris: International Energy Agency.
28. International Energy Agency (IEA) (2021). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. Paris: IEA.
29. International Energy Agency (IEA) (2022). *Global EV Outlook 2022*. Retrieved from: <https://www.iea.org/reports/global-ev-outlook-2022>, 12.06.2025.

30. IQAir (2019). *World's most polluted cities 2019 (PM2.5)*. Retrieved from: <https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2019>, 12.06.2025.
31. Jochem, P., Kihm, A., Funke, S. (2024). Understanding consumer preferences for public EV charging infrastructure. *Energy Policy*, 182. <https://doi.org/10.1016/j.enpol.2024.113129>
32. Kahlenborn, W. et al. (2024). *Improving user experience in pan-European charging infrastructure*. Fraunhofer Institute for Systems and Innovation Research ISI.
33. Klein, M., van der Sluis, S., Heijne, R., Hofman, W. (2020). Scaling up electric vehicle charging infrastructure: A governance perspective. *Sustainability*, 12(23), 10044. doi:10.3390/su122310044
34. Komarnicki, P., Piotrowski, M., Ziółkowski, J. (2020). Rozwój infrastruktury elektromobilności w Polsce. *Przegląd Elektrotechniczny*, 96(1), 4-10.
35. Korzeniowski, B. (2022). *Samochody w UE*. Retrieved from: <https://moto.pl/MotoPL/7,175394,28476751,samochody-w-ue-ile-maja-lat-ktory-kraj-ma-najwiecej-gdzie.html>, 12.06.2025.
36. Leach, M. et al. (2020). Life cycle assessment of UK grid electricity. *Journal of Cleaner Production*, 260, 121009.
37. Mańk-Chrulska, A., Puchała, R. (2024). Elektromobilność w Polsce – aktualne trendy i wyzwania. *Przegląd Komunikacyjny*, 1, 22-30.
38. Ministry of Climate and Environment (2025). *National framework for the development of alternative fuels infrastructure policy*. Retrieved from: https://bip.mos.gov.pl/fileadmin/user_upload/bip/dostep_do_informacji/Ramy_rozwoju_rynku_paliw/20250110_Krajowe_Ramy.pdf
39. Ministry of Climate and Environment (2021). *Polityka energetyczna Polski do 2040 roku (PEP2040)*. Warsaw: Ministry of Climate and Environment.
40. Ministry of Energy (2017). *Energy for the Future. Strategy for Electromobility Development in Poland*. Warsaw: Ministry of Energy.
41. Mohamed, M., Higgins, C., Ferguson, M., Kanaroglou, P. (2018). Identifying and characterizing electric bus charging strategies: A comparative analysis. *Energy*, 158, 395-408.
42. Pasaoglu, G., Fiorello, D., Martino, A., Zubaryeva, A., Thiel, C. (2016). Projections for electric vehicle loads on the European electricity grid. *Utilities Policy*, 40, 51-61, doi:10.1016/j.jup.2016.01.006
43. PKN Orlen (2023). *Rozbudowa infrastruktury ładowania*. Retrieved from: <https://www.orklen.pl>, 12.07.2024.
44. Polskie Stowarzyszenie Paliw Alternatywnych (PSPA) (2022). *Polish EV Outlook 2022 – elektromobilność w Polsce i Europie*. Warszawa: PSPA. Retrieved from: <https://pspa.com.pl>, 01.07.2025.

45. Rupprecht Consult (2022). *Electric mobility in public space: Accessibility for all*. Retrieved from: <https://www.rupprecht-consult.eu>
46. Sæther, T. (2022). *Norway's electric vehicle policy success: Key lessons and impacts*. Oslo: Norwegian EV Association.
47. Sendek-Matysiak, E., Szumska, E. (2018). *Elektromobilność jako wyzwanie dla transportu publicznego w miastach*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.
48. Statzon (2023). *EV Market Statistics*. Retrieved from: <https://www.statzon.com>, 12.06.2025.
49. The European Union Sustainable Transport Forum (2021). *Recommendations for the safe operation of recharging infrastructure for battery electric vehicles*. Brussels: European Commission. Retrieved from: <https://transport.ec.europa.eu>, 01.07.2025.
50. The Verge (2024, September 18). *EV charging sucks – can smart cameras make it better?* Retrieved from: <https://www.theverge.com/2024/9/18/24247452/revel-juice-ev-charging-computer-vision>
51. Tundys, B., Wiśniewski, T. (2023). Elektromobilność jako kierunek zrównoważonego rozwoju transportu. *Logistyka*, 2, 18-25.
52. UDT (2022). *Sprawozdanie z działalności*. Warsaw: Urząd Dozoru Technicznego.
53. Ustawa z dnia 11 stycznia 2018 r. o elektromobilności i paliwach alternatywnych (t.j. Dz.U. 2023, poz. 875, 1394) (2023). Retrieved from: <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20230000875>, 12.06.2025.
54. Virta (2021). *The future of electric vehicle charging*. Retrieved from: <https://www.virta.global>, 01.07.2025.
55. Wang, R., Li, C., Wang, Y., Liu, Y., Zhang, H. (2025). *Beyond charging anxiety: An explainable approach to understanding user preferences of EV charging stations using review data*. arXiv. Retrieved from: <https://arxiv.org/abs/2507.03243>
56. Wang, Yue, Yao, Enjian, Pan, Long (2020). Electric vehicle drivers' charging behavior analysis considering heterogeneity and satisfaction. *Journal of Cleaner Production*, Vol. 286. 124982. Retrieved from: <https://www.sciencedirect.com/science/article/abs/pii/S0959652620350265>
57. Wasilewski, W. Szachniewicz, O., Kamiński, T., Suchodolski, O. (2023). Pojazdy autonomiczne w przestrzeni publicznej. In: K. Huk, M. Kurowski, A. Perzyńska (Eds.), *Współczesne trendy w logistyce. Procesy logistyczne w zarządzaniu przedsiębiorstwem* (p. 174). Zielona Góra: Uniwersytet Zielonogórski, Katedra Logistyki i Systemów Informacyjnych
58. Wieczorek-Hodyra, A. (2025). *Ładowarki w biurach obowiązkowe. Nowe przepisy zmieniają reguły gry*. Retrieved from: <https://www.propertynews.pl/biura/ladowarki-w-biurach-obowiazkowe-nowe-przepisy-zmieniaja-reguly-gry,189551.html>, 02.07.2025.

59. Yang, Y., Bie, Y., Chen, S. (2024). Real-time information systems for electric vehicle charging. *Transportation Research Part C: Emerging Technologies*, 154, 104-118. <https://doi.org/10.1016/j.trc.2024.104118>
60. Zajkowski, K., Seroka, K. (2017). Przegląd możliwych sposobów ładowania akumulatorów w pojazdach z napędem elektrycznym. *Autobusy: technika, eksploatacja, systemy transportowe*, 18(7-8), 484-488.
61. Zawieska, J. (2019). Infrastruktura ładowania pojazdów elektrycznych w Polsce. *Nowa Energia*, 4, 28-33.
62. Zhou, W., Madlener, R., Kloppenburg, S. (2023). Cross-border interoperability of electric vehicle charging infrastructure in Europe. *Utilities Policy*, 84, 101456. <https://doi.org/10.1016/j.jup.2023.101456>

INTEGRATED MANAGEMENT IN PUBLIC ADMINISTRATION: A CONCEPTUAL MODEL

Julia GORZELANY

University of Agriculture in Krakow; julia.gorzelany@urk.edu.pl, ORCID: 0000-0002-4340-0042

Purpose: The purpose of the article is to review concepts of public management and develop a conceptual model of integrated management in public administration. It also aims to assess the progress of work on public administration office development strategies and gain insight into the opinions of civil servants regarding management in their units. Considering the changing public needs and reformative challenges, it is crucial to gain insight into how new management concepts can enhance the efficiency and quality of public services.

Design/methodology/approach: The article includes a literature review of Polish and international sources and an analysis of regional and local development strategies, along with public administration office development strategies. Moreover, the author sent official requests for information to selected public administration offices from March to May 2025. The responses were analysed qualitatively and quantitatively. The insights were enhanced with a survey among civil servants conducted between April and June 2025.

Findings: The analyses revealed a low prevalence of formal strategies for developing public administration offices. Although public administration offices publish local development strategies, there are no documents specifying their internal objectives or priorities. Such deficits can lead to managerial inefficiency and limit the offices' adaptability. Therefore, it is crucial to implement public administration office development strategies to achieve effective planning, resource allocation, and progress monitoring. If deployed, the integrated management model can provide a foundation for designing management systems in public administration.

Research limitations/implications: The article identifies limitations caused by the lack of internal strategies in public administration offices. The study is a preliminary effort aimed at collecting basic data and initial respondent opinions as a starting point for further, more detailed analyses. Future research might attempt to devise tools for diagnosing integrated management in public administration and assessing the need for such a system.

Practical implications: The integrated management conceptual model for public administration offices may be a foundation for designing an integrated management system for public administration. Such a system can enhance office operational efficiency and better address the needs of citizens.

Social implications: The study can contribute to public policy and improve the quality of life for residents by enhancing the efficiency of public services and promoting better adaptation to the needs of local communities.

Originality/value: With its integrated management model, the article offers a new perspective to public management research. The model can be useful for public administration practitioners and researchers.

Keywords: public service efficiency, development strategy, public sector innovation, governance models, qualitative and quantitative analysis.

Category of the paper: research paper.

1. Introduction

Management in the public sector is a critical area of research and practice. It evolves in response to changing social needs and reforms. L.E. Lynn (2007) identified key periods in the history of public management that have shaped it into what it is today. The 1970s witnessed the emergence of research driven by a new public policy school in the United States. In contrast, public administrations in Europe and New Zealand underwent managerial reforms aimed at improving their efficiency. While the turn of the nineteenth century sparked a boom in political sciences, especially cameralism in German-speaking countries, the verge of the nineteenth and twentieth centuries was a time of intense research on modern administration in the USA. Still, the roots of bureaucratic management and administrative doctrine reach back to Antiquity and the Middle Ages, when they first emerged in China, Asian empires, and the West. In Poland, the concept of efficient public management was first introduced in the early twenty-first century. However, its operating principles remain poorly investigated, which is detrimental to the quality of public services and administrative efficiency (Bogacz-Wojtanowska et al., 2016).

Therefore, the primary objective of the article is to review concepts of public management and develop an original conceptual model of integrated management in public administration. It also aims to assess the progress of work on public administration office development strategies and gain insight into the opinions of civil servants regarding management in their units. The aim is pursued with the following research questions:

- What concepts can be found in the evolution of public management?
- What are the advantages and flaws of new management concepts for public administration?
- What is integrated management in public administration?
- What are the municipality's development strategy and the public administration office development strategy?
- Do public administration offices in Poland have official development strategies for themselves as organisations?
- Is there a need to improve strategic planning at the public administration office level, and is it necessary to promote and deploy an integrated management system?

The questions are addressed through a literature review of Polish and international sources and an analysis of regional and local development strategies, along with public administration office development strategies. The study was complemented with official requests to selected public administration offices for information on whether they had strategies for their organisational development. A survey in public administration offices provided additional insights.

1.1. Evaluation of management in public administration. A literature review

Public management is necessary because of reformative challenges in administration, focused on economic aspects of public finance and improvement of the quality of public services (Kozuch, 2005). Public organisations, with their specific system of objectives and values, are unlike private businesses. Defining public management is a complex task, which means researchers offer diverging approaches (Kozuch, 2004; Hausner, 2008; Glińska et al., 1996; Pollitt, Bouckaert, 2000; Izdebski, Kulesza, 2004; Stawasz, Banachowicz, 2013; Romaniuk, 2010).

The scope of public management can be defined based on the collective needs of the public and the tier of management. Romaniuk (2010) identified management in public administration (municipal, district, and voivodeship levels), economic (including public finance), public security, health, education, and culture. He also proposed the notions of micromanagement and macromanagement.

Public management today is evolving towards decentralisation and deconcentration, from centralist structures to polyarchal designs. The rejection of the concept of the state as the organisation with a monopoly on coercion leads to changes in public administration models, which are no longer ideally bureaucratic in the Weberian sense. Modern-day approaches focus on coordinating collective activities, governance, and effective change management, the latter being indispensable although not always obvious (Hausner, 2008). Therefore, public management calls for an interdisciplinary approach and multi-pronged research. The new social order brought changes to administrative structures, while decentralisation and expansion of local self-government concepts significantly guided the modern approach to management in the public sector (Wawrzyniec, 2011). Historically, public administration operations have followed diverse management models. The literature points out the traditional bureaucratic model (old public management), New Public Management, and other concepts (such as the public governance model, or new public service). These models are stages of the evolution of administration management, and their boundaries constantly move towards consecutive steps (Piotrowska, 2011).

Permanent changes in administrative models began in the nineteenth century with the emergence of the ideal bureaucracy model. M. Weber confined public administration to the framework of strict legal mechanisms, which was both beneficial and detrimental to the economy of a given territory. Bureaucratic administration is unbiased, objective,

and transparent. Still, when the model dominates, administrative efficiency declines, and there is a corresponding decrease in focus on improving economic indicators (Kudłacz, Mazur-Kurach, 2015).

The ideal bureaucracy model, as described by M. Weber in *Wirtschaft und Gesellschaft* (1965), defines three types of legitimate authority: rational (legal), traditional, and charismatic (Hausner, 2008). Rational authority is founded on legal rules, traditional authority draws on tradition, and charismatic authority is based on belief in an individual. According to Weber, the ideal public administration is impersonal and characterised by a clear hierarchy. Its competencies are precisely defined, and it is constantly monitored (Gawroński, 2010, p. 39). Bureaucracy, being a group of professional civil servants, operates within a formalised framework of rules, which makes it an efficient type of organisation (Mazur, 2002). However, Weber noted the difficulty with achieving an ideal bureaucracy and compared it to utopia, sliding towards dystopia. Bureaucratic issues, such as overregulation, monotonous work, and limited creativity, can be detrimental to efficiency (Mijal, 2016). Although F. Taylor's theory supported Weber's model, both models have flaws, such as scattered authority and poor cooperation (Hausner, 2008). Critics such as Parsons and Shils (1951) and Merton (1957) highlighted the dysfunctions of bureaucracy, while von Mises argued that democracies were ineffective (von Mises, 1944). Crozier (1973) emphasised the waste of resources and motivation in bureaucratic structures.

The criticism drove a search for new management models, which gave rise to New Public Management (NPM) in the 1970s and 1980s in the United Kingdom and the USA (Zalewski, 2006). New Public Management combines private sector management methods with public administration, focusing on results, decentralisation, and market mechanisms (Rudolf, 2010). The primary principle of NPM is 'minimum of the state, maximum of the market'. This implies that state interventions should be limited, and public management should be based more on market mechanisms (Steurer, 2007).

The critique of traditional public administration centred on the 'policy-administration dichotomy', declaring bureaucracy ineffective (Svara, 2008). New Public Management offers diverse approaches, such as efficiency, decentralisation, search for excellence in management, and public-service centrism (Nawojczyk, 2015). Its main components include managerial approach, precise performance metrics, results monitoring, and reorganisation of public structures (Hood, 1991). The deployment of NPM entailed several reforms, including political decentralisation, reorganisation, and contracts and franchises to separate operational and political accountabilities (Marchewka-Bartkowiak, 2014). The faulty concept of NPM has been redefined in recent decades (Raczkowski, 2015). Despite its flaws, NPM has considerable advantages, such as the introduction of market mechanisms, which can improve the public sector's efficiency, and deployment of new managerial methods, like the Common Assessment Framework (CAF) and Institutional Development Planning (IDP) (Szumowski, 2012).

In light of the above, NPM requires that public organisations have clearly defined objectives, while traditional organisational arrangements offered no objectives or very vague ones. Another conclusion is that the changes in public management discussed above have improved the operational flexibility of public organisations, allowing them to address citizen needs more effectively. They also paved the way for improved operational efficiency, mostly through decentralisation and stimulated vendor competition.

The dynamic surroundings of public organisations exert an increasing impact on their operations, as they must be ever more open to interactions with third parties to enhance managerial efficiency. They must learn how to manage relationships with public, grassroots, and private partners to gain access to their resources and use them for the benefit of the public. These stakeholders affect the city or regional development, while local authorities can actively use their potential to further the local development (mobilisation strategies). This perspective on the organisation, especially its openness and the urge to collaborate, is the critical component of the next model for public administration management: the Public Governance model. Its primary premises include the growth of social capital, the development of civil society, and the wide engagement of the public in drafting and deploying development strategies (Rudolf, 2025).

The concept of public governance was the foundation for defining the New Public Services model. It focuses on citizens and civil society, where civil servants provide support rather than control (Denhardt, Denhardt, 2000). Unlike NPM, which is built on market principles and individual interests, New Public Services considers citizens to be active participants, not mere passive targets of services (Bourgon, 2007). This model emphasises service to the public. The public interest is a result of a social dialogue. The central values for the New Public Services are civil democracy, civil society, organisational humanism, and the theory of dialogue. New Public Services is proposed to lean on such critical ideas as service to the citizens, strategic thinking, and accountability (Perry, 2005). Critique of NPM gave rise to New Governance. This approach emphasises cooperation among various actors, including the public sector, private sector, and NGOs, and highlights public participation (Rhodes, 1996). It is also perceived in the context of New Public Governance (NPG) (Osborne, 2006). Additionally, it can be identified with Good Governance. The definition of Good Governance in international institutions was shaped primarily by international organisations and governmental bodies operating in the global context, such as the World Bank (the Concept of Good Governance) and the United States Agency for International Development (USAID) (Prokopowicz, Kwasek, 2017).

2. Integrated management in public administration as a response to current challenges

Integrated management is a single management system that integrates all subsystems and processes into a solid, comprehensive structure, facilitating operations guided by unified objectives. People in charge of enterprises ensure growth also by combining processes, procedures, and practices aimed at implementing policies. These actions should achieve policy goals more effectively than a multi-system approach. Integrated management is a formalised and cohesive management system conforming to two standards. It facilitates the effective and simultaneous management of multiple subsystems by devising and pursuing a unified policy (Gorzelany-Dziadkowiec, Smutek, 2020).

In management, system integration refers to the process of bringing together all organisational components so that they can effectively utilise their resources. The appropriate distribution of tasks among the subsystems is central to the process. The DNA and Pyramid models contain the important components of the organisational system and can be used to design integrated management in public administration (Morgan, 1997). According to the concept of an integrated management system by Bleicher, the organisation grows on three levels: normative, strategic and operational management. All the tiers are equal, interweaving, and interacting with one another. Acceptance of the systemic definition of organisation has led to a model with three subsystems: normative, strategic, and operational. Integrated Public Management (IPM) can be defined as a comprehensive and original management model that combines key components, including mission, vision, organisational policy, and analysis of micro-, macro-, and competitive environments, to guide plans and strategies of public administration offices. The model also covers motivational systems, organisational culture, information systems, structure, decision-making, leadership, and psychosocial framework conducive to change, which supports effective and harmonised operations of public administration in response to public opinions and needs (from residents, staff, and local institutions and organisations). The IPM concept—positioned at the operational level—is designed using the DNA model discussed in detail by Gorzelany-Dziadkowiec, Smutek (2020). This is the tier of everyday operations in pursuit of strategic goals. Such elements as motivational systems, organisational culture, and structure are critical for operational management efficiency. The model of integrated management in public administration is founded on a clearly defined mission and vision, serving as the basis for all efforts of the public administration office.

In the context of public administration offices, it is crucial for the concept of IPM to distinguish between local or regional strategies and office development strategies, which are often confused. Regional and local strategies aim to ensure continuous improvement in the quality of life and attractiveness of the area. They are planning documents that define the

objectives, priorities, and directions for growth at both the local (municipal) and regional (provincial) levels. The implementation of regional and local development strategies is largely determined in public administration offices, where management plays a decisive role. Offices, just like businesses, need organisational development strategies. The strategies are plans for implementing the vision and mission, covering several years. The purpose of the strategy is to structure future tasks so that available resources can be utilised more effectively and efficiently. Such a strategy enables the association or foundation to pursue its vision and achieve its mission objectives effectively. Organisation development strategy is an extensive document. The first step should be to discuss the period the strategy will cover. The strategy period can be the same as the vision period, but the strategic time horizon is usually shorter to make it specific and feasible. The most common programming periods are two or five years. A public administration office development strategy is a document that should be drafted at the strategic level of IPM.

3. Materials and methods

3.1. Research area and process

As demonstrated by Kożuch and colleagues (2021), advanced research on changes in public management is necessary. Poland embarked on the path towards efficient public management in the early twenty-first century. However, its operating principles remain poorly investigated, which is detrimental to the quality of public services and public administration efficiency (Bogacz-Wojtanowska et al., 2016, p. 7). In the context of integrated management, public administration has to be more sensitive to the needs of residents, citizens, and entrepreneurs. The model's central goals are partnership, consultations, and efforts converging on social needs. Cooperation between authorities and stakeholders is essential for efficient management, regardless of the level: international, national, regional, or local.

The empirical study focuses on public administration offices, which are public administration bodies, organised assemblies of personnel and material assets that support these bodies in their public tasks (Izdebski, 2001). In the context of human resources, public administration offices often lack proper HR procedures, which limits their abilities to plan, recruit, and support employee development (Dziurbejko, 2006). Polish public administration offices face challenges brought by centralistic practices that hinder their operational performance. As a result, local offices often focus on providing services to authorities rather than serving the citizens (Zawicki et al., 2014). Note that public administration—just like business and NGOs—has a significant impact on the quality of life of citizens who are its clients (Hausner, 2008).

The first stage of the study was to gain a complete insight into the available knowledge and past research on management in public administration. A comprehensive and multidimensional view was developed through a systematic review of Polish and international literature on key theories, models, and empirical studies in public management. The analysis was then expanded to include deliberations on the concept of integrated management in public administration, as well as a detailed identification and description of the notions of regional and local development strategy and public administration office development strategy. This helped distinguish between the two and identify their relationships within the context of public management. This approach helped reveal diverse theoretical frameworks and practical challenges of implementing effective management systems in the public sector.

The next stage involved assessing the progress in drafting development strategies for voivodeship and marshal offices in Poland. The author investigated whether voivodeship and marshal offices in Poland have official organisational development strategies. The author requested the information and documents on strategies for public administration office development from all 16 voivodeship offices and 16 marshal offices. This stage involved official requests for information to individual public administration offices sent between March and May 2025. The author conducted qualitative and quantitative analyses of the replies to identify the scopes and types of the documents.

Moreover, the author administered a preliminary survey among municipal civil servants between April and June 2025 to gain insight into their opinions on office management and to initially verify the research assumptions regarding integrated management in public administration. The survey targeted employees from three municipalities with diverse characteristics: rural, urban, and urban-rural. A total of 81 respondents participated, allowing for the collection of varied opinions and experiences representing different types of local government units.

Due to the limited geographical scope and the number of participants, this sample cannot be considered fully representative of the entire population of public administration employees in Poland. Nevertheless, the selection of municipalities with diverse profiles provided a cross-sectional view of the situation in different administrative contexts, offering a valuable foundation for further, more comprehensive research. The results of this preliminary study helped identify key areas requiring in-depth analysis and contributed to refining the research tools used in subsequent stages of the project.

The use of a mixed-methods approach in this study stems from the need to obtain a more comprehensive and multidimensional understanding of the phenomenon under investigation. The literature review enabled the identification of theoretical foundations and existing concepts related to public administration management. The analysis of official documents allowed for an assessment of the current state of formal regulations and strategies operating within public administration offices. Meanwhile, the survey provided empirical data directly from administrative employees, which helped verify and complement the findings derived from the

literature and document analysis. This combination of qualitative and quantitative methods facilitates data triangulation, enhancing the credibility and reliability of the study's results.

The final stage involved devising and proposing a conceptual model of integrated management in public administration that encompasses the normative, strategic, and operational aspects of public administration functioning. These analyses have led to conclusions and practical recommendations aimed at supporting managerial efficiency, improving the quality of public services, and strengthening the adaptability of public offices to dynamic socioeconomic environments.

3.2. Results

The responses to official requests for information demonstrated that a vast majority of voivodeship offices and marshal offices did not have official organisational development strategies. Most voivodeship offices reported having no office development strategies (including those in Warsaw, Kraków, Wrocław, Poznań, Łódź, Lublin, Rzeszów, Białystok, Olsztyn, Szczecin, Katowice, Kielce, and Bydgoszcz). Marshal offices in these voivodeships also had no strategic documents to support their development.

In many responses, the civil servants reported pursuing tasks under applicable law, internal regulations, action plans, or quality policies, all of which are not comprehensive office development strategies.

Some offices had documents similar in nature to development strategies: Integrated Management System Policy (Marshal Office of the Małopolskie Voivodeship), Quality Policy (Marshal Office of the Łódzkie Voivodeship), Work Road Map and Strategic Goals for 2025 (Pomorskie Voivodeship Office in Gdańsk), Human Resources Management Policy and Gender Equality Plan (Marshal Office of the Pomorskie Voivodeship). These documents often define the office's mission, operational objectives, or selected development areas. However, they are not comprehensive development strategies.

One voivodeship office confirmed having an official development strategy: the Lubuskie Voivodeship Office in Gorzów Wielkopolski. The strategy, designed in 2021 by a special project team, outlines the office's mission, vision, and strategic objectives. It is available via the Public Information Bulletin. The Marshal Office of the Mazowieckie Voivodeship in Warsaw was working on a development strategy consistent with the concept of balanced scorecard for the public sector. The same office already had the Strategy of the Marshal Office of the Mazowieckie Voivodeship in Warsaw for 2018-2022.

Some responses mentioned voivodeship development strategies, but these documents are not development strategies for public administration offices as organisations. The Marshal Office of the Śląskie Voivodeship pointed out its voivodeship development strategy 'Śląskie 2030', but had no office development strategy. Other offices also often mentioned strategic documents for voivodeships, which did not concern office development.

The results revealed a substantial gap in the formal strategic planning regarding the development of public administration offices in Poland. Despite the increasing role of strategic management in the public sector, most offices do not have comprehensive strategic documents to guide their organisational development. Instead, public administration offices employ internal regulations, quality policies, operational plans, or human resource management documents. The only exceptions are the Lubuskie Voivodeship Office and the Marshal Office of the Mazowieckie Voivodeship in Warsaw, which exhibited a formalised approach to the development of the offices as organisations, which can be considered model good practices for other public administration offices. The analysis of the development strategies shows that only two of the 16 voivodeship offices employ integrated public management. These offices have visions and missions integrated with strategic goals. In terms of operations, they invest in human capital, enhance workplace relationships, and prioritise human resources development. This suggests the development of unique DNAs that distinguish these two offices.

Lack of an office development strategy may limit the potential for long-term planning, adaptability, and effective asset and process management. On the other hand, documents such as quality policies or work plans indicate efforts to improve the effectiveness and quality of office operations. This raises the question: why did only two voivodeship offices (about 6% of the sample) have office development strategies? Is it because of low awareness among office managers regarding the importance of such documents? Or perhaps ignorance of the fact that a municipality development strategy is not the same as an office development strategy? Do people in charge fail to appreciate the need to draft and implement integrated public management? Is there a need to improve strategic planning at the public administration office level, and is it necessary to promote and deploy an integrated management system? In light of the above, the author conducted preliminary original research.

The respondents in the survey of municipal office employees, who were asked to express their opinions on office management, were mostly clerks (63% of the sample). The next most numerous group were administrators, representing 23.5% of the sample. Specialists amounted to 13.5% of the sample. This sample composition reflects the diverse profile of the group, which comprises employees engaged in operational tasks, managers, and specialists, thereby enhancing the multidimensional view of management in municipal offices. The survey was preliminary in nature and anonymous. It was conducted in March 2025 in three different municipalities: a rural, urban, and mixed rural-urban municipality. The survey covered 81 respondents.

Figure 1 shows that nearly 89% of respondents confirmed that the municipalities had a municipal development strategy. As many as 8.6% of respondents were unable to answer the question, while 2.5% reported having no development strategy in their municipality.

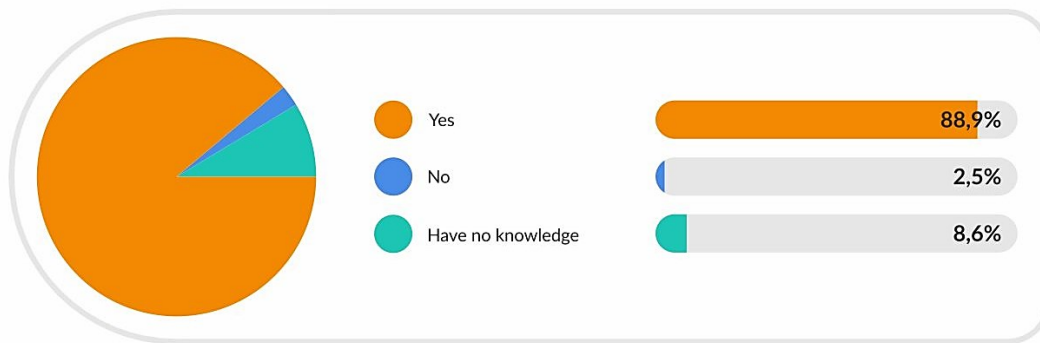


Figure 1. Existence of a municipality development strategy.

The respondents' answers regarding their knowledge of a municipality development strategy are shown in figure 2.



Figure 2. Familiarity with the municipality's development strategy among office staff.

The data in figures 2 and 3 indicate a diversified awareness and implementation of municipality development strategies. Although most respondents declared themselves to be very or partially familiar with the strategy (71.6%), this does not necessarily imply its active implementation. As many as 37.7% of the civil servants reported not implementing the strategy as part of their duties or implementing it to a minor degree. The same share reported partial implementation, and 24.6% reported that they had implemented the strategy to a large or very large extent.

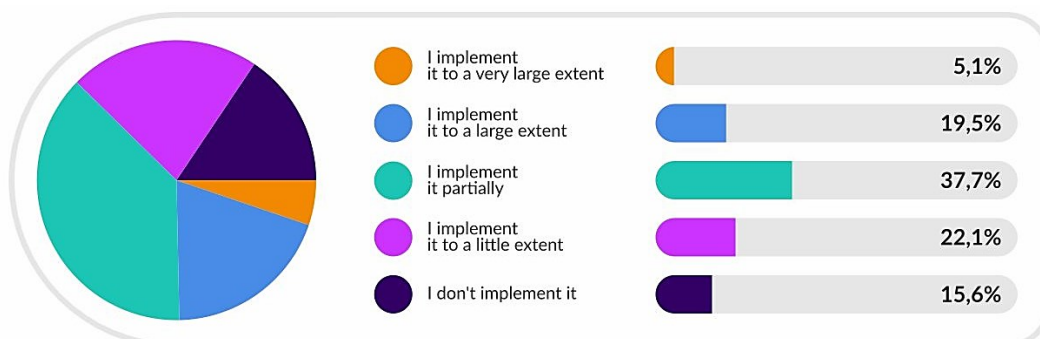


Figure 3. Implementation of the municipality development strategy among office staff.

One survey question concerned the existence of an office development strategy. The answers are presented in figure 4. The results suggest that relatively few public administration offices have their individual office development strategies. A staggering 84% of respondents indicated that no such strategy existed in their office or that they were unaware of it. This result may be a sign of either the lack of internal strategic planning or considering the municipality development strategy as the sole document guiding the office's efforts.

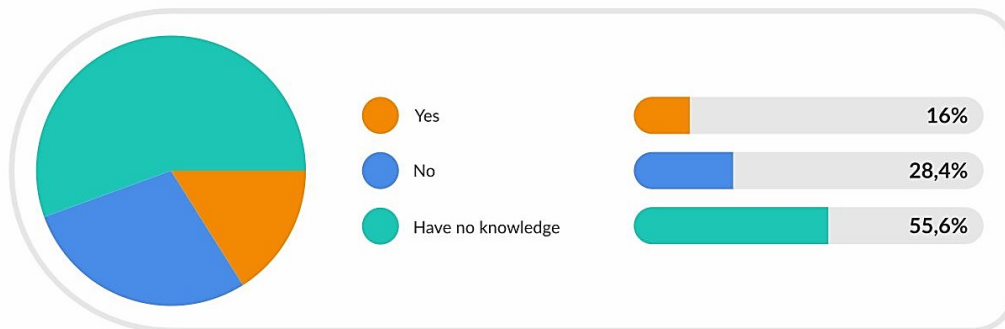


Figure 4. Existence of an office/organisation development strategy.

The next crucial issue is the differentiation between a municipality development strategy and an office development strategy. The results summarised in figure 5 demonstrate that a minuscule group of 3.7% of respondents see no difference, while 96.3% of the sample are aware that these are two different documents.

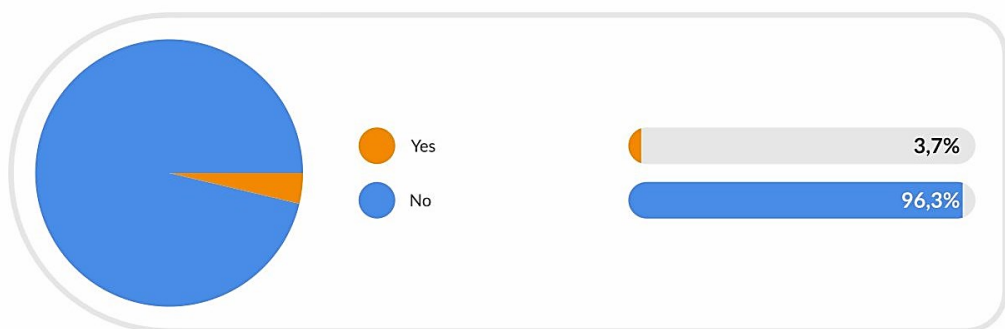


Figure 5. Perception of a municipality development strategy and office development strategy as the same document.

The next area investigated is the staff's awareness of the office's mission and strategic goals. The results are presented in figures 6 and 7. The analysis of awareness of a mission and strategic goals (figures 6 and 7) demonstrates that a total of 58% of respondents believed their office had no mission or could not answer the question. The same applies to the existence of strategic goals; 49.4% of respondents reported having no strategic goals or lacking knowledge on the topic. This suggests that not all investigated administration bodies had clearly defined internal goals and missions, which are critical to effective management and the pursuit of public tasks. Their lack can be harmful to the cohesion of organisational efforts and employee motivation.

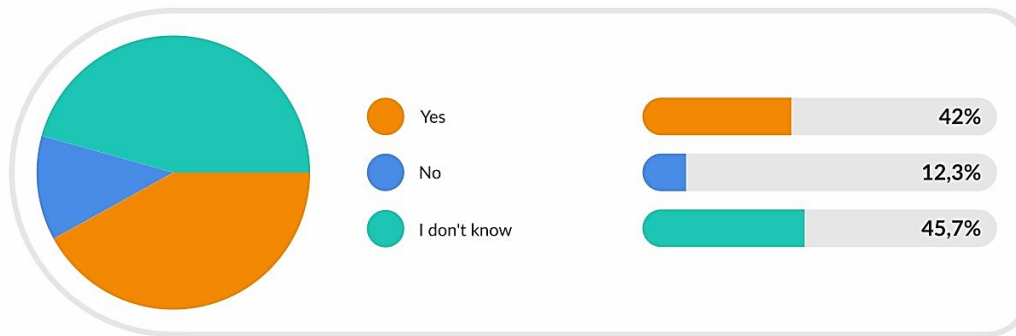


Figure 6. Awareness of the office's mission among staff.



Figure 7. Awareness of the office's strategic goals among staff.

Soft components are very important in public management. The civil servants were asked whether their offices had soft management components or integrated management. The results are presented in figure 8 and 9. The results of the diagnosis of soft management and the presence of an integrated management system (figure 8 and 9) indicate a limited use of comprehensive managerial tools in the offices. A substantial 49.4% of respondents reported a lack of knowledge in this regard or indicated that their offices did not employ soft management components. Moreover, only 28.4% of the civil servants reported having an integrated management system in their workplace, while 71.6% believed there was no such system or were unaware of it.

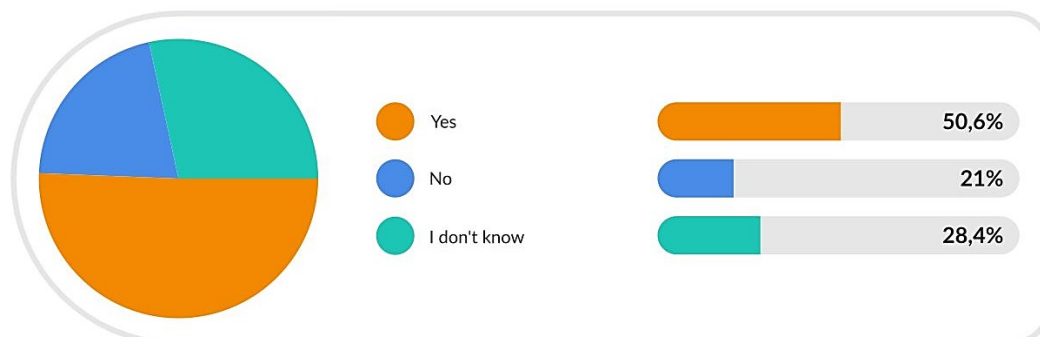


Figure 8. Diagnosis of soft management in the offices.

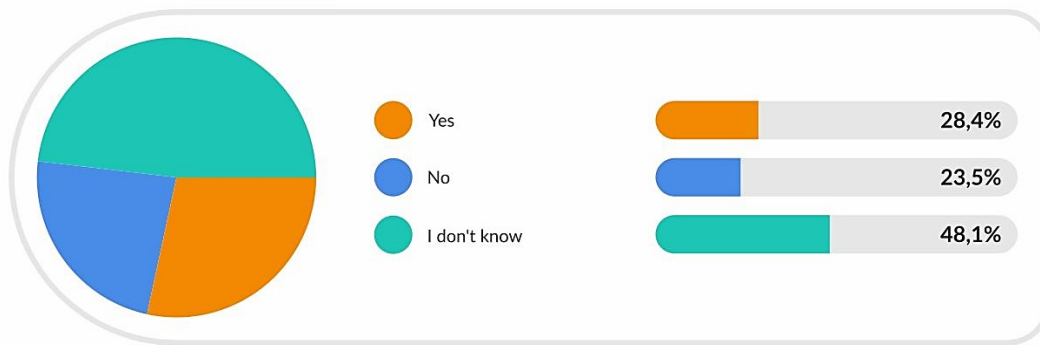


Figure 9. Presence of an integrated management system in the offices.

The results on the effects of an integrated management system on public administration office efficiency are shown in figure 10, which demonstrates that most respondents appreciate the potential benefits of an integrated management system, indicating the possible functional improvements. According to more than 91% of the participants, such a system would improve the office's operational efficiency to a very significant and significant extent or partially.



Figure 10. Perceived impact of an integrated management system on office efficiency.

Answers to questions concerning requirements for people in charge of public administration offices and the need for support for change are summarised in figures 11 and 12, which show that the deployment of modern management systems requires both adequate leadership competencies and organisational and training support. Lack of the support can be a severe barrier to the implementation of innovative managerial solutions. Eighty-four per cent of respondents emphasised that the deployment of an integrated management system requires that people in charge of the office employ a participatory and consultative management style, which empowers staff to participate in setting objectives, planning, and problem-solving. More than 75.3% of the civil servants believed support for change is necessary when an integrated management system is being deployed.

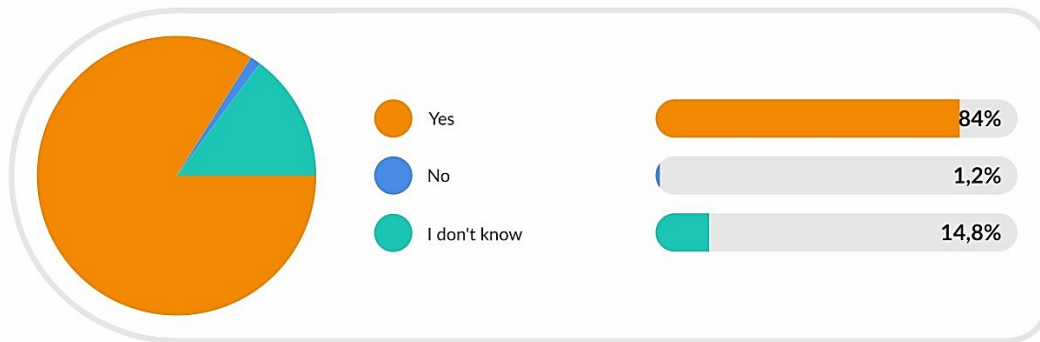


Figure 11. Leadership style requirements linked to the deployment of an integrated management system in public administration offices (participatory and consultative management style).



Figure 12. Need for support for change during the deployment of an integrated management system.

In summary, the results indicate the need for stronger strategic planning in public administration offices, as well as the promotion and deployment of integrated management systems encompassing both hard and soft management components. Furthermore, staff education and training efforts are recommended to enhance the competencies necessary for effective change management.

4. Integrated management in public administration. A conceptual model

Considering the evolution of public management and the need to adapt business management methods to the constraints of public administration, the author proposes a conceptual model of integrated management in public administration, as shown in Figure 13.

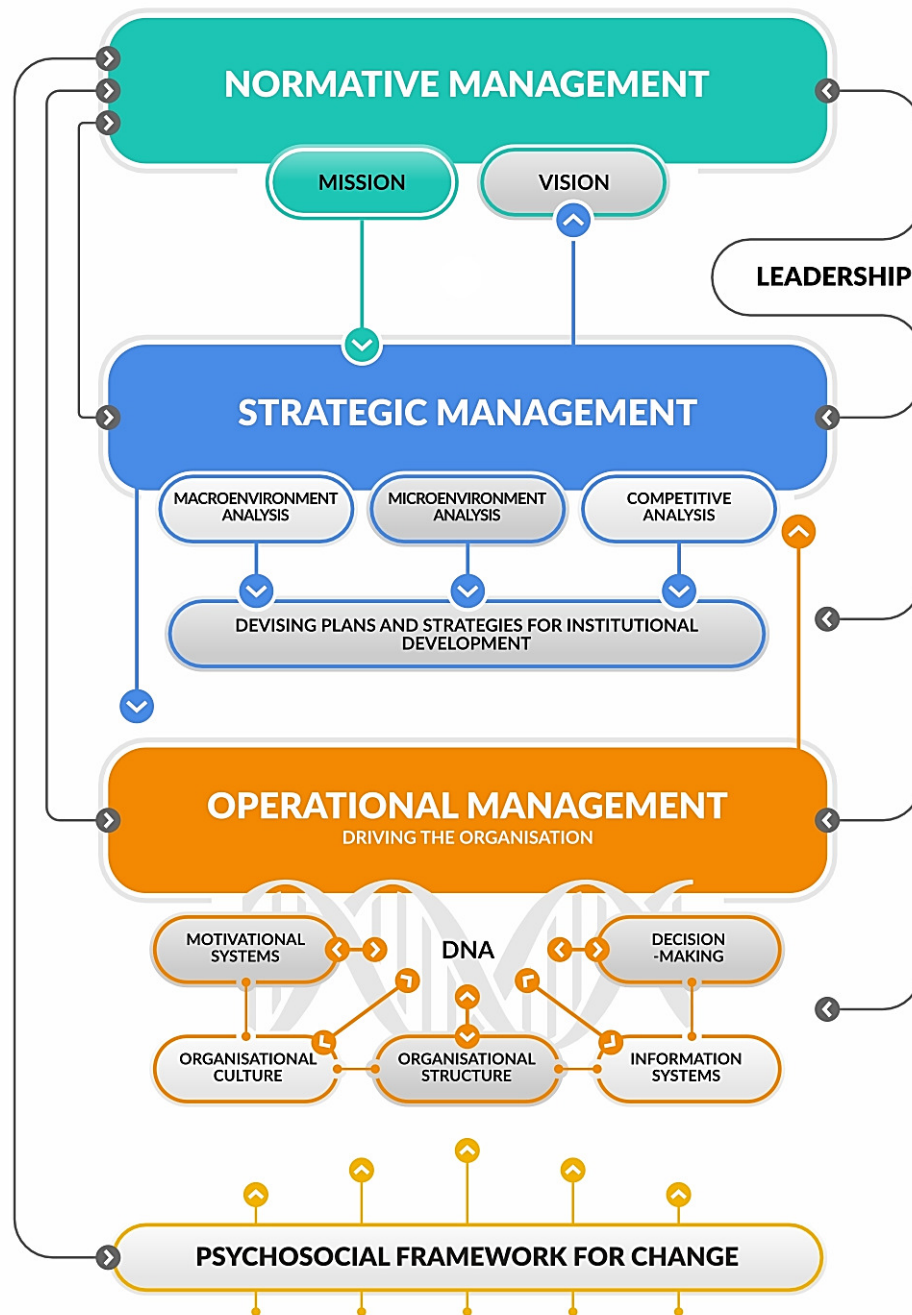


Figure 13. Conceptual model of integrated management in public administration.

Source: original work.

As shown in Figure 13, integrated management is based on three tiers. The mission defines the organisation's purpose, while vision sets the development vector. The next highly relevant aspect is organisational policy, comprising principles and guidelines for public administration office operations consistent with the mission and vision. The mission, vision, and organisation policy make up the normative tier of management. The next tier, strategic management, involves environmental analysis, planning, and strategising. The study encompasses both the microenvironment, including local constraints and stakeholders, and the macroenvironment,

comprising external factors such as regulations and social trends. Competitive analysis can identify opportunities and threats. Using these analyses, the public administration office can develop plans and strategies that align with its mission and vision. The strategy is the cornerstone guiding how the office intends to attain its objectives. The last tier of integrated management is the operational level. It includes motivational systems designed to enhance staff engagement and job satisfaction. Motivation is central to operational efficiency. The next component of this tier is organisational culture. It influences how employees cooperate and pursue the office's goals. Good leadership is necessary to promote a positive culture conducive to change. The DNA code, which is theoretically located at the operational tier, is linked to the strategic and normative tiers. The strategy must consider the potential of the subsystems and identify areas that require change. However, any changes require proper organisation and assets. Leaders and managers must ensure a motivational system and effective internal communication, focusing on understanding the causes of reluctance towards change, rather than merely eliminating resistance (Centkowska, 2015). The role of leadership and the psychosocial framework for change that support innovative processes when building material, institutional, and intellectual infrastructure of regions was discussed by Gorzelany and colleagues (2019). To summarise this part of the study, IPM is crucial for creating new public services that focus on citizens and civil society, where civil servants provide support rather than control.

5. Conclusions and recommendations

To summarize, this section presents the main findings of the study along with practical recommendations aimed at enhancing management practices within public administration offices. The analysis reveals shortcomings in strategic planning and the application of integrated management tools, emphasizing the importance of developing comprehensive strategies and leadership styles that promote flexibility and efficiency. The conclusions and recommendations that follow are intended to assist policymakers and administrators in improving the effectiveness and responsiveness of public sector organizations.

1. **Official development strategies for offices are rare.** Most of the investigated offices do not have dedicated, comprehensive strategic documents for organisational development, indicating a gap in strategic planning within public administration.
2. **Operational documents and quality policies guide the functioning of public administration offices.** They often pursue their tasks in accordance with internal regulations, operational plans, and quality policies. However, these are not strategic development documents, which may be detrimental to long-term and efficient management.

3. **Office development strategies are necessary.** It is recommended to devise and deploy public administration office development strategies that improve efficiency, adaptability, and functional transparency of public administration.
4. **The soft components of management and the integrated management system are important.** The results indicate that comprehensive managerial tools, such as a diagnosis of soft management components and integrated management systems, are seldom used, despite being critical for improving the operational efficiency of offices.
5. **Change and an appropriate leadership style need to be supported.** The deployment of an integrated management system requires that managers employ a participatory and consultative management style and provide organisational and training support necessary for the effective implementation of innovative solutions.
6. **Efficiency can be improved thanks to a conceptual model of integrated management.** The proposed model, based on three tiers of management (normative, strategic, and operational), may serve as a foundation for a public administration management system design that promotes aligning office efforts with citizens' needs and enhancing their efficiency.

In summary, the study reveals the need for the development of formal development strategies and the implementation of integrated management systems within public administration offices. Emphasizing the importance of both hard and soft management elements, the proposed conceptual model provides a structured framework to support management within the office. The adoption of participatory leadership styles and the provision of adequate organizational support are crucial for the successful implementation of change. Ultimately, these measures can significantly improve the efficiency, transparency, and citizen-centeredness of public administration, contributing to more effective governance.

It is worth noting that, the present study does not encompass an analysis of political factors such as resistance to reforms, power asymmetries, and stakeholder conflicts, which frequently accompany organizational change processes within the public sector. Incorporating these dimensions constitutes a significant avenue for future research, facilitating a more comprehensive understanding of the complexities and challenges inherent in the implementation of reforms in public administration.

Acknowledgements

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References

1. Bevir, M. (2007). *Public Governance*. London: Sage Publications, 3.
2. Bleicher, K. (1992). *Das konzept integriertes management*. Frankfurt/New York: Campus Verlag.
3. Bleicher, K. (2004). *Normatives management: politik, verfassung und philosophie des unternehmens*. Frankfurt/New York: Campus Verlag.
4. Bleicher, K. (2011). *Das Konzept Integriertes Management: Visionen – Missionen – Programme*. Frankfurt/New York: Campus Verlag.
5. Bogacz-Wojtanowska, E., Jung-Konstanty, S., Kożuch, A., Kożuch, B., Lewandowski, M., Sułkowski, Ł., Szczudlińska-Kanoś, A., Sienkiewicz-Małyjurek, K. (2016). Obszary zarządzania publicznego. *Monografie i Studia Instytutu Spraw Publicznych Uniwersytetu Jagiellońskiego*. Kraków, p. 7.
6. Bourgon, J. (2007). Responsive, Responsible and Respected Government: Towards a New Public Administration Theory. *International Review of Administrative Sciences*, 73, 1, pp. 7-26.
7. Centkowska, M. (2015). Podstawy teoretyczne oporu wobec zmian w organizacji. *Zeszyty Naukowe. Organizacja i Zarządzanie*, z. 77. Politechnika Śląska, pp. 9-18.
8. Crozier, M. (1973). *The Bureaucratic Phenomenon*. Chicago: University of Chicago Press.
9. Denhardt, R.B., Denhardt, J.V. (2000). The New Public Service: Serving Rather Than Steering. *Public Administration Review*, 60, 6, 549-559.
10. Dziurbejko, T. (2006). *Planowanie rozwoju gminy jako instrument pozyskiwania funduszy pomocowych Unii Europejskiej*. Warszawa: Difin.
11. Gawroński, H. (2010). *Zarządzanie strategiczne w samorządach lokalnych*. Warszawa: Oficyna a Wolters Kluwer business, p. 39.
12. Glińska, B., Kuc, B.R., Szczepankowski, P. (1996). *Zarządzanie strategiczne – geneza, rozwój, priorytety*. Warszawa: Key Text, p.170.
13. Gorzelany-Dziadkowiec, M., Smutek, H. (2020). *Zintegrowane zarządzanie we współczesnych organizacjach*. Warszawa: Scholar, pp. 7-112.
14. Gorzelany-Dziadkowiec, M., Gorzelany, J., Stauskis, G., Hernik, J., Van Assche, K., Noszczyk, T. (2019). The innovation process in local development – the material, institutional, and intellectual infrastructure shaping and shaped by innovation. *Technological and Economic Development of Economy*, 25(6), 1232-1258.
15. Harrow, J. (2000). Public Management Reform: A Comparative Analysis: by Christopher Pollitt and Geert Bouckaert. *Long Range Planning*, Vol. 33, Iss. 6. Oxford University Press, pp. 881-884.
16. Hausner, J. (2008). *Zarządzanie publiczne*. Warszawa: Scholar, pp. 9-16, 31.

17. Hood, Ch. (1991). A Public Management for All Seasons? *Public Administration*, 69, 1, pp. 3-19.
18. Izdebski, H. (2001). *Samorząd terytorialny – Podstawy ustroju i działalności*. Warszawa: LexisNexis, p. 150.
19. Izdebski, H., Kulesza, M. (2004). *Administracja publiczna – zagadnienia ogólne*. Warszawa: Liber, p. 93.
20. Koźuch, B. (2004). *Zarządzanie publiczne*. Warszawa: Placet, p. 75.
21. Koźuch, B. (2005). Zarządzanie publiczne jako dyscyplina naukowa. *Zeszyty Naukowe Instytutu Spraw Publicznych Uniwersytetu Jagiellońskiego, Zarządzanie Publiczne*, 1, p. 16.
22. Koźuch, B., Sienkiewicz-Małyjurek, K., Sułkowski, Ł. (2021). *Zarządzanie publiczne oparte na wartościach*. Łódź: Wydawnictwo Społecznej Akademii Nauk.
23. Kudłacz, M., Mazur-Kurach, P. (2015). Formy zarządzania publicznego w kontekście rozwoju miast w Polsce. *Zarządzanie Publiczne*, 4, 34, 50-65.
24. Lynn, L.E. (2007). Public management. A concise history of the field. In: E. Ferlie, L.E. Lynn, C. Pollitt (eds.), *The Oxford Handbook of Public Management* (p. 27). New York: Oxford University Press.
25. Marchewka-Bartkowiak, K. (2014). Nowe zarządzanie publiczne. *Biuro Analiz Sejmowych*, 18, 178. Warszawa, pp. 1-4.
26. Mazur, S. (2002). Od tradycyjnej administracji do zarządzania publicznego. *Zeszyty naukowe, Akademia Ekonomiczna w Krakowie*, 598, pp. 15-28.
27. Merton, R.K. (1957). Bureaucratic structure and personality. *Social Forces*, 18, 4, pp. 195-206.
28. Mijał, M. (2016). M. Weber i kontynuatorzy w badaniach nad organizacjami. In: K. Klincewicz (ed.), *Zarządzanie, organizacje i organizowanie – przegląd perspektyw teoretycznych*. Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego.
29. Mises, L. (1944). *Bureaucracy*. USA: Yale University Press.
30. Morgan, G. (1997). *Obrazy organizacji*. Warszawa: PWN.
31. Nawojczyk, M. (2015). Nowoczesne formy zarządzania w administracji publicznej. *ZN WSH Zarządzanie*, 2, pp. 169-181.
32. Osborne, S.P. (2006). The New Public Governance? *Public Management Review*, 8(3), pp. 377-387.
33. Parsons, T., Shils, E.A. (1951). *Toward a General Theory of Action*. Cambridge, Mass.: Harvard University Press.
34. Perry, J.L. (2005). *Democracy and the new public service*. Columbia: University of Missouri-Columbia, pp. 11-12.
35. Piotrowska, M. (2011). Model administracji publicznej, a jakość obsługi obywateli w urzędach gminnych. *Nierówności Społeczne a Wzrost Gospodarczy*, 18, 258-267.

36. Prokopowicz, D., Kwasek, A. (2017). Rozwój koncepcji good governance w instytucjach administracji państwowej. *Zeszyty Naukowe Uczelni Vistula*, 55(4), *Ekonomia*, XIV, pp. 176-188.
37. Raczkowski, K. (2015). *Zarządzanie publiczne - teoria i praktyka*. Warszawa: PWN.
38. Rhodes, R. (1996). The new governance. Governing without government. *Political Studies* 64, pp. 652-667.
39. Romaniuk, P. (2010). Pojęcie zarządzania publicznego w samorządzie terytorialnym. *Studia Prawnoustrojowe*, 11. Olsztyn: UWM, pp. 162-165.
40. Rudolf, W. (2010). Koncepcja governance i jej zastosowanie – od instytucji międzynarodowych do niższych szczebli władzy. *Acta Universitatis Lodziensis, Folia Oeconomica*, 245. Łódź, pp. 73-82.
41. Rudolf, W. <https://thinklodz.eu/ewolucja-zarzadzania-publicznego/>, 21.06.2025.
42. Stawasz, D., Banachowicz, B. (2013). Zarządzanie publiczne - wyzwania dla procesu kształcenia na poziomie wyższym - przykład Wydziału Zarządzania Uniwersytetu Łódzkiego, Efektywność zarządzania organizacjami publicznymi i jej pomiar. *Studia Ekonomiczne*, 161. Uniwersytet Ekonomiczny w Katowicach, p. 271.
43. Steurer, R. (2007). From government strategies to strategic public management: an exploratory outlook on the pursuit of cross-sectoral policy integration. *Eur. Env.*, 17, pp. 201-214.
44. Svara, J. (2008). Beyond dichotomy: Dwight Waldo and the intertwined politics-administration relationship. *Public Administration Review*, 68, 1, pp. 46-52.
45. Szumowski, W. (2012), Koncepcja good governance w doskonaleniu systemu zarządzania urzędu administracji samorządowej. *Nauki o Zarządzaniu/Uniwersytet Ekonomiczny we Wrocławiu*, 4, 13, pp. 75-84.
46. Wawrzyniec, R. (2011). Rozwój zarządzania publicznego. *Acta Universitatis lodziensis – Folia Oeconomica Łódź*, 261, 407-418.
47. Weber, M. (1965). *The Theory of Social and Economic Organization*. New York: the Free Pres.
48. Zalewski, A. (2006). Nowe zarządzanie publiczne jako instrument poprawy efektywności sektora publicznego. In: K. Krukowski (ed.), *Zarządzanie organizacjami publicznymi*. Olsztyn: Uniwersytet Warmińsko-Mazurski.
49. Zawicki, M., Mazur, S., Bober, J. (2014). *Zarządzanie w samorządzie terytorialnym – najlepsze praktyki*. Kraków: Małopolska Szkoła Administracji Publicznej, p. 15.

BRAND PERSONALIZATION IN MARKETING – BIBLIOMETRIC ANALYSIS

Hanna GÓRSKA-WARSEWICZ

Management Institute, Warsaw University of Life Sciences; hanna_gorska-warsewicz@sggw.edu.pl,
ORCID: 0000-0002-5110-7583

Purpose: The purpose of this study was to assess the current state of research on brand personalization through bibliometric analysis. The main focus was on identifying key thematic areas in the field.

Design/methodology/approach: A bibliometric analysis's design, compilation, analysis, visualization, and interpretation stages were all applied. A comprehensive search of the Scopus database yielded a total of 261 publications. Science mapping and performance metrics related to publications and citations were used in the studied research.

Findings: There have been 261 papers indexed in the Scopus database since the first article on brand personalization was published in 2001. These articles have received 4,790 citations, which is equivalent to 200 citations a year on average. The United States had the most affiliations, followed by India, the United Kingdom, and China. The related studies provided 1055 keywords in 8 clusters related to technology, customer experience and behavior, social media and advertising, consumer data and marketing strategies as well as customer relationship management and online marketing.

Research limitations/implications: The bibliometric analysis uses mainly academic articles, which may not adequately reflect developments in business and practical applications of brand personalization. The study does not take into account how the methodology of different research articles may affect the way the results are interpreted. In addition, the study does not analyse specific cultural or regional differences in the perception and application of brand personalization.

Practical implications: Companies should tailor brand messages, designs, and interactions, to individual consumer preferences. Engagement and loyalty increase when personalization is incorporated into every stage of the consumer journey. Brands can use social media platforms to display ads to users tailored to their interests and behaviors. In this context, companies should build long-term brand relationship and consumer engagement through personalized content.

Originality/value: No previous studies have provided a comprehensive assessment of the current state of development in this field. Therefore, this bibliometric analysis of brand personalization addresses this research gap. The uniqueness of this study lies in its identification of analytical clusters that highlight the key thematic areas currently explored within brand personalization research.

Keywords: brand personalization, brand experience, social media, bibliometric analysis.

Category of the paper: literature review.

1. Introduction

In today's competitive business world, brand personalization has emerged as a key tactic for companies looking to build stronger and more meaningful relationships with their clients. Companies are putting more of an emphasis on customizing their brand experiences—from goods and services to communication tactics—to each individual customer's particular requirements, preferences, and desires as a result of the ongoing evolution of consumer expectations (Khorrami et al., 2023; Yadav et al., 2024). The trend toward brand personalization reflects a growing realization that conventional, one-size-fits-all marketing strategies are ineffective in gaining the interest and loyalty of today's increasingly demanding customers. Brands today aim to provide highly tailored interactions that connect with each client personally rather than providing generic experiences (Cai et al., 2023; Coelho, Henseler, 2012).

Consumer behavior has changed, and as a result, consumers increasingly demand companies to recognize and cater to their unique needs and preferences in a way that seems relevant and unique. Personalized brand experiences are now considered a necessity for contemporary marketing tactics rather than a luxury (Bunster, Bustamante, 2019; Casaca, Miguel, 2024). In order to generate comprehensive customer profiles and acquire important insights into consumer behavior, brands are spending more and more in cutting-edge technology like artificial intelligence and big data analytics. Brands can use this information to create customized marketing campaigns and provide individualized goods and services that cater to the distinct preferences and needs of each customer (Cordova, 2024; Sheng, Subramanian, 2019).

The field of brand personalization has a research gap. Despite significant interest in the topic, there are not many studies that show the various aspects of brand personalization. The challenge is to identify the most studied topics or areas that need further research, because despite the growing body of literature, there is no clear mapping of the main thematic areas in this field. Based on the above insights, the purpose of this study was to assess the current state of research on brand personalization through bibliometric analysis. The main focus was on identifying key thematic areas in the field. To guide the analysis, three research questions were formulated:

1. What is current level of advancement in the field of brand personalization?
2. Which countries are most prominent in the research on the geographic diversity of brand personalization?
3. What are the main thematic areas being studied in relation to brand personalization?

The answers to these questions will contribute to a deeper understanding of the current state of knowledge in the field of brand personalization. The findings of this study may also serve as a foundation for future research and the development of more effective, customer-centered marketing strategies.

This study makes an original and timely contribution by providing a comprehensive bibliometric analysis focused specifically on the emerging field of brand personalization research from 2001 to 2024. While previous bibliometric reviews have examined related topics such as personalized marketing or digital branding, this study stands out for its exclusive focus on brand personalization as a distinct field.

This study makes an original and timely contribution by providing a comprehensive bibliometric analysis focused on the emerging field of brand personalization research from 2001 to 2024. While previous bibliometric analyses have examined related topics such as digital branding, this study stands out for its exclusive focus on brand personalization as a single domain. It synthesizes the current data source in Scopus, providing a detailed mapping of thematic clusters, geographical distribution, and established contributions. Furthermore, the study integrates the scope of new technologies, media usage, and social media, thus bridging the gaps between marketing theory, technology implementation, and practical applications. This not only focuses on the trajectory of limiting brand personalization research but also identifies references for practitioners interested in tailored marketing strategies.

This article is organized into six main sections. Following this introduction, the second section provides a comprehensive literature review that synthesizes existing research on brand personalization, highlighting key themes and gaps in the current knowledge. The third section outlines the research methodology, detailing the bibliometric techniques and data sources used to conduct the analysis. The fourth section presents the results of the study, including thematic clusters, geographic distribution, and publication trends. In the fifth section, the findings are discussed in relation to existing literature, emphasizing their theoretical and practical implications. Finally, the article concludes with a summary of the main contributions, limitations, and directions for future research.

2. Literature review

Personalization is a strategy for recognizing and meeting the unique emotional, psychological, and practical needs of each customer. Companies can customize their goods, services, and communication tactics to provide customers with relevant and meaningful experiences by having a thorough understanding of their preferences, behaviors, and desires. Beyond basic customization, this strategy seeks to establish a close relationship with every client, creating a feeling of worth and significance (Khorrami et al., 2023; Yadav et al., 2024). Customers can receive a unique product and service through personalization, which increases their buying intent and fosters brand loyalty by knowing their emotional requirements (Khorrami et al., 2023). By allowing customers to customize goods and services to meet their unique requirements and tastes, personalization raises the perceived value of goods and

services. By improving customer experiences, personalization promotes customer loyalty (Yadav et al., 2024).

Big data analytics is unquestionably revolutionizing personalization in contemporary commercial activities. Companies can gain profound insights into customer behavior, tastes, and demographic data by utilizing large and varied datasets. This knowledge enables companies to create individualized experiences and highly targeted marketing strategies, both of which are essential for increasing customer pleasure, loyalty, and engagement (Cordova, 2024). Companies can now customize their marketing tactics at the individual or segment level, giving each customer a personalized and relevant experience, thanks to big data analytics' capacity to handle massive amounts of data and identify complex patterns (Cordova, 2024; Sheng, Subramanian, 2019).

Brand personalization has wide-ranging and significant advantages that go beyond long-term company performance and basic customer delight. Beyond just providing specialized goods or services, personalizing a brand's approach to its customers entails crafting unique, meaningful experiences that deepen the connection between the customer and the company. This strategy has a number of noteworthy advantages, such as better brand equity, more customer loyalty, and an improved customer experience (Bunster, Bustamante, 2019; Casaca, Miguel, 2024; Dash et al., 2021).

Personalization is perceived as the effective strategy for improving the general consumer experience. Customers feel appreciated, acknowledged, and understood when brand interactions are customized to each person's preferences, needs, and behaviors. Customers are more likely to return to that brand as a result of more interesting and relevant interactions (Bilgihan et al., 2016; Timimi et al., 2025; Casaca, Miguel, 2024; Oumaima, Lamari, 2024). Companies can make sure that customers have experiences that connect with them more deeply by offering individualized offers, product recommendations, and content based on past behavior or preferences. Customers who feel genuinely cared for and understood by a brand are more likely to develop greater emotional attachments to it (Casaca, Miguel, 2024; Khorrami et al., 2023).

The potential of brand personalization to boost consumer loyalty is among its most important benefits. Companies gain credibility and dependability when they successfully address each client's unique needs. Personalized interactions demonstrate to consumers that a company respects their individual requirements and preferences. Because they believe their relationship with the brand has value, customers are more likely to stay with the brand for a long time (Cai et al., 2023; Coelho, Henseler, 2012). Brands provide a sense of exclusivity and care that strengthens relationships by providing relevant services, customized messages, and personalized product recommendations. Customers are more inclined to return for more purchases as a result of the convenience this individualized attention provides. Customers become brand advocates and regular customers as a result of this loyalty, which gradually

creates a personal bond. Ultimately, personalization results in a more dedicated customer base and sustained economic success (Cai et al., 2023; Coelho, Henseler, 2012; Tong et al., 2012).

In addition to raising the possibility of returning consumers, this type of focused interaction fortifies the brand loyalty of the consumer. Additionally, buyers view choosing a product to be less difficult when they receive personalized offers and material, which makes it easier for them to stick with the brand. Customers are more likely to establish an ongoing relationship with a company when they receive a consistent, personalized experience, which ultimately promotes repeat transactions and lowers churn rates (Yadav et al., 2024).

Based on how consumers view a brand, brand equity is the value that a brand brings to a good or service. By strengthening the psychological connection between customers and the company, personalized marketing techniques can greatly increase brand equity. Customers are better able to relate to a brand's identity, mission, and values when it personalizes its offers (Tran et al., 2022). Consumer brand identification, or the extent to which consumers believe their values, beliefs, and personalities fit with a brand, can be improved by personalization. (Gong, 2025; Tran et al., 2020, 2023). Additionally, personalization improves the self-brand connection, which measures how well customers identify the brand with their own identity. Customers are more inclined to integrate a brand into their self-concept when they feel that it specifically meets their requirements and preferences. This relationship can increase advocacy and brand loyalty, raising the brand's perceived worth even more (Tran et al., 2022).

3. Methods

This study used bibliometric analysis to determine the current state of research in the field of brand personalization. The identification of thematic countries received special consideration. The use of bibliometric analysis to demonstrate the evolution of a certain area over a given time period is growing in popularity (Donthu et al., 2021; Gan et al., 2022; Moral-Muñoz et al., 2020). Design, compilation, analysis, visualization, and interpretation were the five steps of this bibliometric approach (Zupic, Čater, 2015).

The study's design, the research gap, and the research questions were developed in the first phase. The Scopus database was searched in the second phase. In the context of data on authors, nations, and institutions (Fernández Bellver et al., 2023; Zhang, Eichmann-Kalwara, 2019), Scopus was selected due to its size as the largest citation index database with a variety of metrics and extra information about publications (Fernández Bellver et al., 2023; Nascimento, Rodrigues, 2015; Toker, Emir, 2023). Using the status as of December 31, 2024, the search was conducted at the end of February. The following search path was used: (TITLE-ABS-KEY (brand AND personalization) OR TITLE-ABS-KEY (brand AND personalization)) AND PUBYEAR > 2000 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA, "BUSI")) AND

(LIMIT-TO (LANGUAGE, "English")). The limitation was applied to the subject area of business, management and accounting due to the wide range of topics that do not fit into the problem area of marketing.

The final data analysis process included science mapping and performance analysis. Citation-related measures, such as the total number of citations and the average number of citations each year, as well as publication-related indicators, such as the number of publications and lead authors, were employed (Donthu et al., 2021). By source, the bibliometric analysis looked at the topics covered in brand personalization and Scopus publications. Science mapping using the bibliometric counting method included charts showing the quantity of items and categories. The authors with the highest number of publications were listed. A study of keyword co-occurrence was found using mapping techniques. At least three keyword occurrences were covered by a counting method. VOSviewer was used to perform co-occurrence analysis and bibliometric counts.

4. Results

4.1. Number of publications and citations related to brand personalization

As of December 31, 2024, 261 publications on brand personalization were indexed in the Scopus database, taking into consideration the chosen inclusion criteria. Twenty were published between 2000 and 2010, 89 between 2011 and 2020, and 152 between 2021 and 2024. This amounted to 10.9 publications annually on average (Figure 1). To generate a trend line for the number of publications, $R^2 = 0,8858$ was utilized.

The first article to be indexed in the Scopus database based on the recognized criteria was the 2001 paper "Customer participation in creating site brand" (Holland, Baker, 2001). This article explored the development of an e-business marketing model focused on customer engagement and how it affected website brand loyalty. The conceptual model illustrated how website features like community and personalization, as well as users' goals (task- or experience-based), influence their loyalty. It also demonstrated that brand loyalty leads to favorable opinions of the companies, frequent purchases, and a lower propensity to switch websites. A case study of corporate websites supports this concept. The paper claims that through interactive methods, producers and customers collaborate to build brands in e-business.

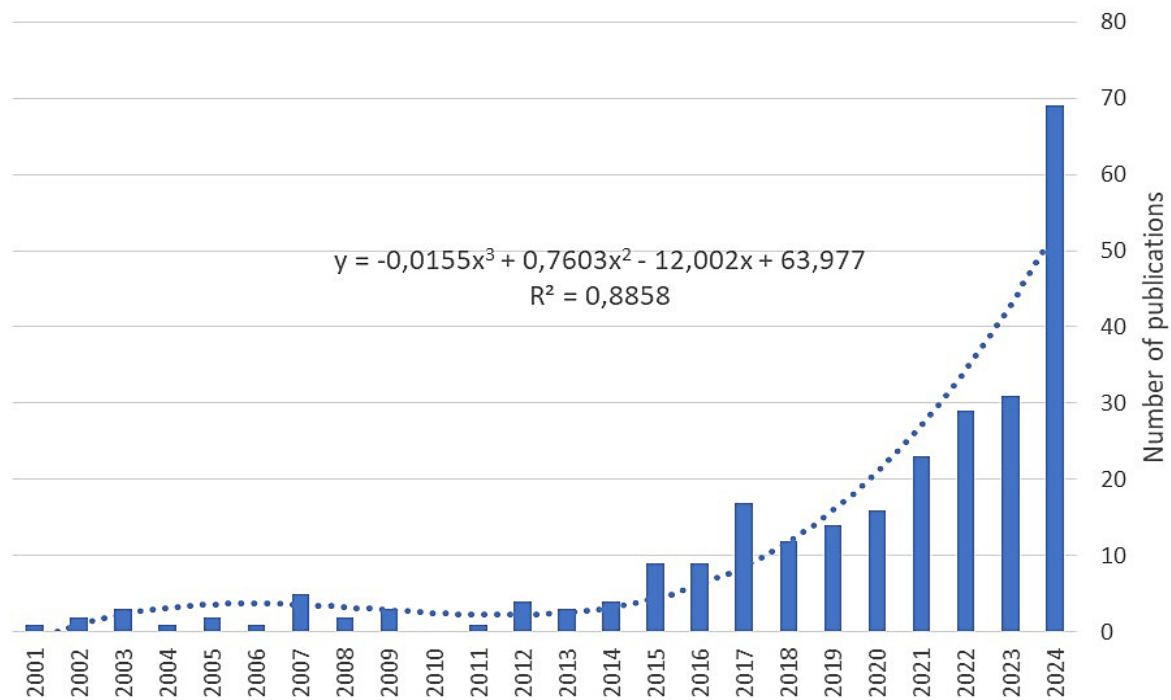


Figure 1. Number of publications related to brand personalization in business, management and subject business area between 2001 and 2024.

Source: Scopus data with trend line, as of 31.12.2024.

A total of 4790 citations were found in the examined papers, indicating an average of 200 citations annually. There were more than 50 citations in 2013, 100 in 2017, and 500 in 2022. A total of 1436 citations were found in the most recent analysis, making up 30% of all citations (Figure 2). For the number of citations, a trend line was obtained with $R^2 = 0,9605$.

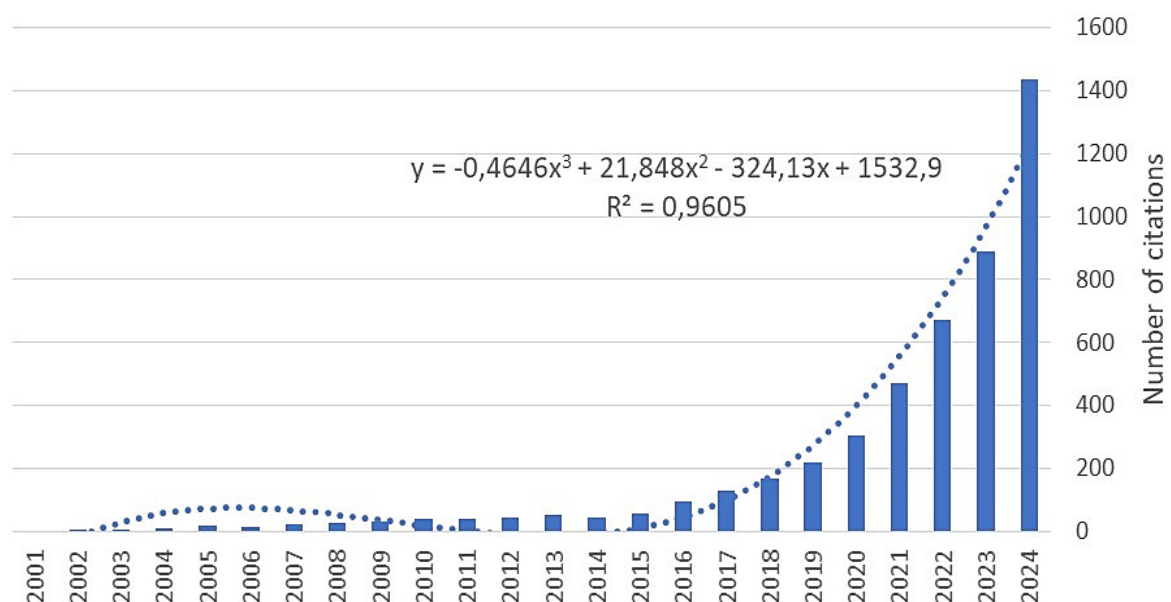


Figure 2. Number of citations related to brand personalization in business, management and subject business area between 2001 and 2024.

Source: Scopus data with trend line, as of 31.12.2024.

The article that received the most citations was "Customer loyalty: A review and future directions with a special focus on the hospitality industry," which was published in the *International Journal of Contemporary Hospitality Management* in 2015 (Kandampully et al., 2015). By the end of 2024, there were 395 citations (Table 1). By synthesizing the existing literature on customer loyalty, this paper aimed to understand loyalty and identify priorities for ongoing loyalty research. Using conceptual models, this study provided a framework designed to expand the understanding of customer loyalty and the impact of the evolving role of engaged customers. As practical implications, companies were advised to create emotionally engaged, loyal brand ambassadors by focusing on new areas such as customer engagement, brand citizenship behavior, mass personalization, employee engagement, brand ambassadors (both employees and customers), value co-creation, co-design, co-consumption and customer-employee relationships.

Table 1.

Most cited publications related to brand personalization in business, management and subject business area

No.	Title	Authors	Source	Year	Number of citations
1.	Customer loyalty: A review and future directions with a special focus on the hospitality industry	Kandampully, J., Zhang, T.C., Bilgihan, A.	<i>International Journal of Contemporary Hospitality Management</i> , 27(3), pp. 379-414	2015	395
2.	Towards a unified customer experience in online shopping environments: Antecedents and outcomes	Bilgihan, A., Kandampully, J., Zhang, T.	<i>International Journal of Quality and Service Sciences</i> , 8(1), pp. 102-119	2016	270
3.	Getting to know you: Social media personalization as a means of enhancing brand loyalty and perceived quality	Shanahan, T., Tran, T.P., Taylor, E.C.	<i>Journal of Retailing and Consumer Services</i> , 47, pp. 57-65	2019	185
4.	Unreal influence: leveraging AI in influencer marketing	Sands, S., Campbell, C.L., Plangger, K., Ferraro, C.	<i>European Journal of Marketing</i> , 56(6), pp. 1721-1747	2022	183
5.	Shopping in augmented reality: The effects of spatial presence, personalization and intrusiveness on app and brand responses	Smink, A.R., van Reijmersdal, E.A., van Noort, G., Neijens, P.C.	<i>Journal of Business Research</i> , 118, pp. 474-485	2020	179
6.	The construct "lifestyle" in market segmentation: The behaviour of tourist consumers	González, A.M., Bello, L.	<i>European Journal of Marketing</i> , 36(1-2), pp. 51-85	2002	175
7.	Customer participation in creating site brand loyalty	Holland, J., Baker, S.M.	<i>Journal of Interactive Marketing</i> , 15(4), pp. 34-45	2001	170
8.	The influences of advertisement attitude and brand attitude on purchase intention of smartphone advertising	Lee, E.-B., Lee, S.-G., Yang, C.-G.	<i>Industrial Management and Data Systems</i> , 117(6), pp. 1011-1036	2017	125

Cont. table 1.

9.	Why young consumers are not open to mobile marketing communication	Grant, I., O'Donohoe, S.	International Journal of Advertising, 26(2), pp. 223-246	2007	115
10.	Engagement platforms: The role of emotions in fostering customer engagement and brand image in interactive media	Blasco-Arcas, L., Hernandez-Ortega, B.I., Jimenez-Martinez, J.	Journal of Service Theory and Practice, 26(5), pp. 559-589	2016	113

Source: Scopus data, as of 31.12.2024.

4.2. Authors, countries and sources of publications related to brand personalization

With seven papers, T.P. Tran is the most frequently appearing author and has made a substantial contribution to the field of brand personalization research. Additionally, there are four cases of the "Undefined" category, which may indicate publications with missing or unclear author information. Subsequently, F. Kropp and C.M. Segijn, each appear as authors in three publications. Many authors, including M. van Solt, G. van Noort, T. Zhang, J.E. Zemanek, L.T. Wright, H.A.M. Voorveld, M. Vernuccio, and others, appear in two publications each, totaling 27. This implies that while a large number of researchers have made contributions to the subject, very few have published more than once.

An analysis of the countries of affiliation of authors of publications on personalization, along with the frequency of their appearance, is important because it provides insight into the academic contributions of research efforts in this field. With 73 authors, the US leads, demonstrating its dominance in the field of personalization research. The United Kingdom (31) and India (36) come next, demonstrating significant contributions from both countries. Twelve instances fall under the "undefined" category, which most likely refers to situations in which the author's country was not mentioned. A moderate number of contributing authors from a variety of different countries, such as China (12), Portugal (11), the Netherlands (10), Italy (10), and Canada (10), demonstrate their participation in the subject. Other countries that contribute, although with fewer authors, include Malaysia (9), Spain (8), France (6), Mexico (5), Germany (5), Finland (5), Australia (5), Iran (4), Greece (4), Egypt (4), and Belgium (4).

By emphasizing their significance and involvement in the subject, this study of author affiliations aids in identifying the top universities advancing brand personalization research. With eight authors contributing to personalization research, East Carolina University is the university that appears the most frequently. In accordance with its active engagement in this field, Instituto Politécnico do Porto has five writers. A number of academic institutions, such as Symbiosis International (Deemed University), the University of Strathclyde, and the Universiteit van Amsterdam, are listed four times each. Three authors each are associated with a sizable number of universities, such as Tilburg University, Universidad de Zaragoza, Universidade do Porto, Middlebury Institute of International Studies at Monterey, University of SS Cyril and Methodius, Trnava, University of North Texas, University of Minnesota Twin Cities, Sapienza Università di Roma, University of Jyväskylä, Amity

University, Chitkara University, Punjab, Symbiosis Institute of Business Management, Pune, Centro de Estudos Organizacionais e Sociais do Politécnico do Porto, and University Institute of Maia. With universities from various countries actively engaging, this standard demonstrates the global aspect of brand personalization research.

Academic journals are the main source of information about brand personalization, as evidenced by the fact that "journal" is the most frequently occurring source type (165 occurrences). The term "books" then appears 47 times, indicating that books, though to a smaller degree than journals, also make a substantial contribution to these theme areas. The 24 mentions for "conference proceedings" indicate that conference-presented research contributes moderately to the scientific discussion. Twenty instances of "book series" suggest that the dataset includes several volumes or book collections. Lastly, with only 5 cases, "Trade journals" is the least common source type, indicating that publications with an industry focus are the least used source in this analysis.

An examination of the source names of publications related to brand personalization and the frequency of their appearances provide valuable information about the major academic sources that influence this field of study. With 18 appearances, "Developments in Marketing Science Proceedings of the Academy of Marketing Science" is the most frequently occurring source, demonstrating its popularity in publishing brand personalization research. A number of publications, such as "Journal of Retailing and Consumer Services", "Journal of Research in Interactive Marketing", and "Journal of Marketing Communications", each appear five times, demonstrating their relevance in the subject, while "Journal of Business Research" is mentioned seven times. Additional noteworthy sources that appear four times each include "Springer Proceedings in Business and Economics", "Psychology and Marketing", "Journal of Digital and Social Media Marketing", "Journal of Brand Strategy", "Innovative Marketing", "European Journal of Marketing", "Cogent Business and Management", and "Asia Pacific Journal of Marketing and Logistics", indicating a wide variety of scholarly and business-oriented publications that support brand personalization research.

4.3. Thematic areas of publications related to brand personalization

More than 1000 (1055) keywords were identified in research about brand personalization that were indexed in the Scopus database. With 86 appearances, "personalization(s)" or "personalization" is the most frequently occurring keyword, suggesting that personalization is the most popular topic in the dataset. With 23 occurrences, "sales" follows in second, emphasizing its important position in this scientific environment. Similar frequencies are found for other keywords, including "social media" (17), "artificial intelligence" (14), "marketing" (13), "e-commerce" (13), and "consumer behavior" (13), indicating that they are related in the analysis. "Customer experience" is the least used keyword on the list, appearing 11 times, yet it is still relevant when discussing important subjects.

Table 4.*The most frequently occurring keywords in publications related to brand personalization*

Keywords	Frequencies
Personalization(s) or personalisation	86
Sales	23
Social media	17
Artificial intelligence	14
Marketing	13
E-commerce	13
Consumer behavior	13
Customer experience	11
Digital marketing	9
Customer satisfaction	9
Commerce	9
Brand loyalty	9
Experience	8
Customer loyalty	8
Brand equity	8
Social media marketing	7
Purchase intention	7
Personalized advertising	7
Machine learning	7
Facebook	7
Electronic commerce	7
Customer relationship management	7
Augmented reality	7
Trust	6
Purchasing	6
Consumer behavior	6
Brand image	6
Brand awareness	6
Brand attitude	6
Brand	6
Advertising	6
Websites	5
Social medium	5
Relationship marketing	5
Privacy	5
PLS-SEM	5
Customer journey	5
Customer engagement	5
Co-creation	5

Table does not include keywords that have been mentioned 4 times or less.

Source: Scopus data, as of 31.12.2024.

Using the full counting approach, the analysis of keyword co-occurrence found eight clusters with a minimum of three occurrences. This criterion was met by 86 keywords (Figure 3). The number of clusters varied from 5 to 16 keywords.

Cluster No. 1 "Brand and consumer experience" (16 keywords) directly addresses brand personalization by emphasizing how brands influence consumer perceptions and interactions through tailored experiences, Brand image, brand awareness, and brand experience all influence consumer engagement and brand identification. Customizing these components to each customer's specific requirements makes brand personalization crucial for increasing customer

a powerful tool for customer retention, as it can increase engagement, purchase decisions, and brand loyalty for brands that customize the consumer experience.

Cluster No. 3 “E-commerce and loyalty” (12 keywords) refers to the digital era, in which e-commerce plays an important role in providing personalized brand experiences. Relationship marketing and loyalty programs were essential to adapting the way companies communicate with customers online. This cluster highlights the importance of understanding customer behavior in the context of e-commerce and using this knowledge to build long-lasting partnerships. The publications emphasized that more and more loyalty programs are being tailored to customer preferences and behavior. Each consumer feels valued and connected to the company through personalized incentives and offers. Based on previous interactions, brands are using data from e-commerce platforms to provide product recommendations, customize offers and even change the shopping experience by creating personalized landing pages. This cluster highlights how personalization helps build brand loyalty by creating unique shopping experiences that draw customers back, especially in the challenging world of e-commerce.

Cluster No. 4 “Technology and Personalization” (12 keywords) indicates that technology is a key driver of brand personalization. This cluster explores its role in transforming the way brands communicate with and engage consumers. Brands can provide highly personalized experiences based on real-time data and predictive analytics through technologies such as artificial intelligence, augmented reality, and machine learning. Brands can communicate with consumers in real time and offer advice or information that is specifically tailored to them through AI-based chatbots and personalized advertising. Brands are using augmented reality to create personalized experiences, creating a special connection to the brand. Modern technology allows companies to deliver highly personalized experiences that help customers feel valued and understood, strengthening their bond with the brand.

Cluster No. 5 “Social media and advertising” (11 keywords) analyzes the issue of social media. Customizing brand messaging requires the use of social media platforms like Facebook, Instagram, and others. Based on user activity, hobbies, and demographic profiles, this cluster demonstrates how marketers use social media to develop tailored advertisements and campaigns that captivate customers. One of the simplest methods for companies to interact with customers is through personalized social media advertisements. Customers' online activity, including past searches, purchases, and likes, is used to tailor advertisements. By offering content that speaks to a person's interests and promoting active participation through comments, shares or user-generated content, brand engagement can be tailored to each individual. This cluster emphasizes how crucial social media is as a channel for individualized communication, allowing companies to connect with customers through messages that are specific to their needs and interests.

Cluster No. 6 “Consumer data and marketing strategies” (10 keywords) addresses the issue of consumer data in the context of marketing strategies. The basis for brand personalization is consumer data. Brands may develop highly focused marketing strategies that address individual demands by evaluating data from several consumer touchpoints. By employing insights from consumer behavior to promote more relevant interactions, this cluster highlights how data-driven marketing improves personalization. Brands utilize consumer data to create customized marketing messages, offers, and promotions. Machine learning enhances the customer experience by assisting brands in forecasting future consumer behavior and providing tailored recommendations based on previous behavior. Brands may anticipate customer requirements, produce more engaging experiences, and eventually forge closer bonds with their audience by using consumer data to inform tailored marketing strategies.

Cluster No. 7 “Personalization and branding” (7 keywords) indicates that customization is another important aspect of brand personalization. Customization and branding are closely related in this cluster since companies aim to let customers personalize goods and services to suit their tastes. Options for customization enable customers to tailor goods or services to meet their unique requirements, strengthening their relationship with the brand. Customized experiences that make customers feel unique are frequently offered by the fashion and hospitality industries, strengthening their relationship with the company. This cluster demonstrates how customized products or experiences may foster a deeper, more meaningful relationship between customers and brands, increasing satisfaction and engagement.

Cluster No. 8 “Customer relationship management and online marketing” (5 keywords) defines customer relationship management in personalization, as it includes using consumer data to build stronger relationships through targeted marketing. Delivering tailored messages and experiences that connect with customers is made possible in large part by internet marketing, especially when it involves online advertising and content. Customer relationship systems give companies the ability to monitor consumer behavior and adjust communications, resulting in a more individualized marketing strategy. Retargeting advertisements and customized email campaigns are examples of internet marketing tactics that guarantee customers receive pertinent content at the appropriate point in their journey. This cluster demonstrates how online marketing and customer relationship systems assist brands in personalizing experiences, enhancing customer loyalty, and enhancing the general consumer-brand relationship.

5. Discussion

The purpose of this study was to assess the current state of research on brand personalization through bibliometric analysis. The main focus was on identifying key thematic areas in this field. To guide the analysis, three research questions were formulated:

The first research question aimed to determine the current level of advancement in the field of brand personalization. It focused on understanding how the topic has evolved over time and what progress has been made in this area. The findings of the literature review on brand personalization clearly show that interest in this subject has grown over time. This tendency can be a result of the customer's shifting dynamics, the expanding significance of digital technology, and the growing need on companies to customize their products to meet the needs of specific customers. Although there were just 20 articles published between 2000 and 2010, that number rose to 89 in the following ten years, and then to 152 in 2021-2024. This trend indicates that brand personalization has drawn a lot of attention, and studies have started investigating into more general aspects of the phenomena, such as shifting consumer preferences and technology (Singh, Kalotra, Kaur, 2023). Bibliometric analysis conducted by Singh et al. (2023) on personalized marketing research reported a rapid growth in publications between 2003 and 2023, with notable acceleration from around 2018 and a spike during the COVID-19 pandemic period (Singh et al., 2023). That research analyzed 1836 documents indexed in Scopus and highlighted the surge in interest—especially in recent years. More broadly, bibliometric reviews across marketing domains confirm similar trajectories: marketing-related research experiences exponential growth especially since the 2000s, with works showing a climb from very low initial publication counts to tens or hundreds annually across disciplines (Nicolas-Escuela, Valenzuela-Fernández, Merigó, 2020; Gökerik, Aktaş, 2024).

The second research question aimed to identify the countries that play the most significant role in research on the geographic diversity of brand personalization. The goal was to analyze which regions are contributing the most to the research and how the topic is being disseminated around the world. Previous bibliometric studies have shown that countries such as the United States, India, the United Kingdom, and China are leading contributors to the marketing research field, including brand personalization (Nicolas, et al., 2020; Singh et al., 2023). These countries' substantial output reflects their strong academic infrastructure and emphasis on marketing innovation.

There is a global interest in brand personalization, as seen by the institutional and geographic dispersion of research on the subject. Countries such as the United States, India, the United Kingdom and China have made significant contributions to the academic discussion, emphasizing their leadership in marketing research and the importance of brand personalization on a global scale. It's interesting to note that this research is not exclusive to highly developed

countries. China and India are two emerging markets that have made substantial contributions to the literature, indicating that brand personalization is an international trend rather than a regional one (Nicolas et al., 2020). This trend reflects the increasing globalization of marketing strategies and the adaptation of personalized brand tactics in diverse cultural and economic contexts.

Research on brand personalization is being carried out by academic institutions and research centers throughout multiple countries. This field is dominated by prestigious academic journals rather than trade ones, indicating that the subject is primarily seen from an academic perspective. (Singh et al., 2023). This dominance suggests an emphasis on developing theoretical frameworks to better understand the long-term effects of brand personalization on consumer behavior and marketing tactics, alongside practical applications for businesses. Moreover, the growing body of academic work highlights the interdisciplinary nature of the field, integrating insights from marketing, psychology, and data analytics (Nicolas et al., 2020).

The third research question explored the main thematic areas studied in relation to brand personalization. This involved identifying key topics, trends, and research directions within the field. The research's keyword analysis offers a thorough examination of the main ideas and areas of concentration in the domain of brand personalization. The analysis indicated eight clusters in three unique topic thematic areas that each provided insight into the main elements influencing the creation of tailored marketing plans. Similar bibliometric studies in marketing have mentioned thematic areas that reflect evolving priorities such as consumer experience, technological innovation, and social media engagement (Nicolas, Valenzuela, Merigó, 2020; Singh, Kalotra, Kaur, 2023).

One important topic area is the relationship between brand and consumer experience and loyalty. This thematic area emphasizes how companies create customer experiences through personalization. It demonstrates how customized marketing affects the entire client experience in addition to suggesting specific products. Research indicates that personalized marketing enhances customer loyalty by strengthening emotional bonds through tailored experiences (Singh, Kalotra, Kaur, 2023). Brands can increase the relevance and effect of their messaging by utilizing personalized advertising, for instance, by creating narratives that are specifically designed to appeal to particular consumer categories. Customers' emotional bond with a brand is strengthened when they see that it understands their particular requirements and preferences thanks to personalization. Nowadays, loyalty programs are a crucial part of brand personalization. Contemporary loyalty programs employ data to generate customized incentives that cater to individual preferences, going beyond merely providing discounts. Loyalty programs using personalization strategies have been shown to increase customer retention by aligning rewards with individual consumer behavior (Nicolas et al., 2020).

The second topic area in the context of brand personalization is e-commerce and technology. One of the most important things the literature has shown is how technology is increasingly being used to personalize brands. Brands can personalize customer experiences on

a never-before-seen scale because to technological breakthroughs like augmented reality, machine learning, big data analytics, and artificial intelligence. These technologies allow companies to analyze large datasets to deliver highly targeted marketing, resulting in improved customer satisfaction and loyalty (Nicolas et al., 2020). Thanks to these advancements, businesses can now analyze enormous volumes of data from a variety of sources, including social media, online browsing habits, and past purchases, to develop highly customized marketing campaigns and client experiences. These developments demonstrate a significant shift from conventional, one-size-fits-all marketing tactics in favor of a more customer-focused strategy. Companies may create customized offers, messaging, and experiences that cater to each customer's particular demands by utilizing technology. According to the literature's findings, technology-enabled customization increases customer happiness and fortifies brand loyalty by offering meaningful and customized experiences that connect with customers more deeply.

The third topic area for brand personalization is social media and advertising. The keyword analysis highlights the crucial impact social media plays in personalization. Platforms like Facebook, Instagram, and Twitter are being used by brands to interact with customers in a tailored manner. Brands may produce highly relevant advertisements and content that appeal to specific consumers by using social media to target users based on their behavior, interests, and preferences. Studies emphasize the role of social media personalization in enhancing customer engagement and building stronger brand relationships (Singh et al., 2023). By providing material that feels customized to the user's unique needs, personalized advertising on social media platforms not only raises the possibility of interaction but also aids firms in creating enduring relationships with their audience.

Based on the results obtained, practical implications can be formulated. Companies should adjust brand messaging, appearance, and interactions to meet the needs of certain customers in order to improve brand personalization. Making use of social media advertising and electronic word-of-mouth contributes to the development of pertinent and captivating brand experiences. Personalized offers, stories, and recommendations help customers feel more emotionally connected. Engagement and loyalty are increased when personalization is incorporated into each phase of the consumer journey. For target groups, personalization is crucial since they demand highly personalized experiences. Customized shopping experiences and personalized loyalty programs increase consumer retention in e-commerce. Real-time data analysis for highly customized interactions is made possible by artificial intelligence, augmented reality, and machine learning. Brands may utilize social media platforms to show users ads that are tailored to their interests and behavior. Long-term brand relationships and consumer engagement are fostered by personalized content.

6. Summary: conclusions, limitations, and future research

Brand personalization is becoming more and more popular among academics, as shown by the rise in publications over time. The changing market environment, where digital technologies are essential in influencing consumer expectations, is reflected in this trend. The results show that brand personalization has emerged as a key component of marketing strategy, especially in the areas of social media, e-commerce, and customer interaction. Additionally, the geographical distribution of study indicates that both developed and emerging economies contribute to the worldwide phenomena of brand personalization. The study's theme clusters highlight the importance of advertising, technology, consumer experience, and loyalty in building tailored marketing activities.

This study has several limitations in spite of its contributions. First, the bibliometric analysis mostly uses academic papers, which might not adequately represent developments in the business and practical uses of brand personalization. Insights from industry white papers, case studies, and company reports may be incorporated into future research. Second, the study does not take into consideration how different research articles' methodology may affect how the results are interpreted. Lastly, this study does not examine the particular cultural or regional variations in the perception and application of brand personalization, even if it offers a general review of worldwide research trends.

The finding opens up a number of research directions. First, more research on the practical applications of brand personalization in different sectors, including healthcare, education, and finance, could indicate how different industries use personalization tactics. Second, research can focus on the moral implications of tailored advertising, particularly with regard to customer privacy, data security, and openness in data use. Third, closer examination of regional differences in brand personalization may reveal cultural elements that influence how customers respond to tailored experiences. Finally, future research should explore how new developments in artificial intelligence, big data, and augmented reality technologies are changing customization tactics and affecting customer-brand interactions.

References

1. Bilgihan, A., Kandampully, J., Zhang, T. (Christina) (2016). Towards a unified customer experience in online shopping environments: Antecedents and outcomes. *International Journal of Quality and Service Sciences*, Vol. 8, Iss. 1, pp. 102-119. <https://doi.org/10.1108/IJQSS-07-2015-0054/FULL/XML>
2. Bunster, V., Bustamante, W. (2019). Structuring a residential satisfaction model for predictive personalization in mass social housing. *Sustainability*, Vol. 11, Iss. 14, pp. 1-30. <https://doi.org/10.3390/SU11143943>
3. Cai, S.J., Yu, J., Li, C., Ewuzie, C., Benneth Iloka, C. (2023). Influence of artificial intelligence (AI) on customer experience and loyalty: mediating role of personalization. *Journal of Data Acquisition and Processing*, Vol. 38, Iss. 3, pp. 1936-1959. <https://doi.org/10.5281/zenodo.98549423>
4. Casaca, J.A., Miguel, L.P. (2024). The influence of personalization on consumer satisfaction: Trends and challenges. *Data-Driven Marketing for Strategic Success*, 256-292. <https://doi.org/10.4018/979-8-3693-3455-3.CH010>
5. Coelho, P.S., Henseler, J. (2012). Creating customer loyalty through service customization. *European Journal of Marketing*, Vol. 46, Iss. 3-4, pp. 331-356. <https://doi.org/10.1108/03090561211202503/FULL/XML>
6. Cordova, R.S. (2024). Customer segmentation in the online retail industry using big data analytics. *Journal of Theoretical and Applied Information Technology*, Vol. 102, Iss. 22, pp. 8312-8324.
7. Dash, A., Zhang, D., Zhou, L. (2021). Personalized Ranking of Online Reviews Based on Consumer Preferences in Product Features. *International Journal of Electronic Commerce*, Vol. 25, Iss. 1, pp. 29-50. <https://doi.org/10.1080/10864415.2021.1846852>
8. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, Vol. 133, Iss. 3, pp. 285-296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
9. Fernández Bellver, D., Prados-Peña, M.B., García-López, A.M., Molina-Moreno, V. (2023). Crafts as a key factor in local development: Bibliometric analysis. *Heliyon*, Vol. 9, Iss. 1, 13039. pp. 1-11. <https://doi.org/10.1016/J.HELİYON.2023.E13039>
10. Gan, Y., Li, D., Robinson, N., Liu, J. (2022). Practical guidance on bibliometric analysis and mapping knowledge domains methodology – A summary. *European Journal of Integrative Medicine*, Vol. 56, Iss. 12, pp. 1-15. <https://doi.org/10.1016/J.EUJIM.2022.102203>
11. Gökerik, M., Aktaş, Ö. (2024). Digital marketing trends reshaped by artificial intelligence: A bibliometric approach. *Journal of Emerging Economies and Policy*, Vol. 9, Iss. 1, pp. 75-90.

12. Gong, T. (2025). Bridging the gap: Exploring the nexus of service robot personalization, customer identification, and citizenship behaviors. *Journal of Retailing and Consumer Services*, Vol. 82, 104105. <https://doi.org/10.1016/J.JRETCONSER.2024.104105>
13. Holland, J., Baker, S.M. (2001). Customer participation in creating site brand loyalty. *Journal of Interactive Marketing*, Vol. 15, Iss. 4, pp. 34-45. <https://doi.org/10.1002/DIR.1021>
14. Kandampully, J., Zhang, T. (Christina), Bilgihan, A. (2015). Customer loyalty: A review and future directions with a special focus on the hospitality industry. *International Journal of Contemporary Hospitality Management*, Vol. 27, Iss. 3, pp. 379-414. <https://doi.org/10.1108/IJCHM-03-2014-0151/FULL/XML>
15. Khorrami, M., Foroudi, P., Nasab, M.H. (2023). Personalisation: The construct and its dimensions. *Business Digitalization: Corporate Identity and Reputation*, 126-143. <https://doi.org/10.4324/9781003401285-9/PERSONALISATION-MOJGAN-KHORRAMI-PANTEA-FOROUDI-MANIJEH-HAGHIGHI-NASAB>
16. Moral-Muñoz, J.A., Herrera-Viedma, E., Santisteban-Espejo, A., Cobo, M.J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review. *Profesional de La Información*, Vol. 29, Iss. 1, pp. 1699-2407. <https://doi.org/10.3145/EPI.2020.ENE.03>
17. Nascimento, F. de A., Rodrigues, F.M. (2015). Growth trend of scientific literature on genetic improvement through the database Scopus. *Scientometrics*, Vol. 105, Iss. 2, pp. 805-816. <https://doi.org/10.1007/S11192-015-1733-0/METRICS>
18. Nicolas, C., Valenzuela, L., Merigó, J.M. (2020). Research trends of marketing: A bibliometric study 1990-2017. *Journal of Promotion Management*, Vol. 26, Iss. 1, pp. 1-30. <https://doi.org/10.1080/10496491.2020.1729315>
19. Oumaima, J., Lamari, S. (2024). Customer Experience in the Digital Transformation Era: Insights on Personalization, Digital Marketing, and Customer Relationship Management. *International Journal of Economics, Management and Finance (IJEMF)*, Vol. 3, Iss. 2, pp. 352-69. <https://doi.org/10.5281/ZENODO.14109688>
20. Sheng, T.K., Subramanian, P. (2019). Proposition of rank-based stepwise interactive visualization for customer segmentation in E-commerce. *ACM International Conference Proceeding Series*, 244-248. <https://doi.org/10.1145/3305160.3305207>
21. Singh, K.J., Kalotra, A., Kaur, I. (2023). Mapping personalized marketing: A bibliometric analysis. *International Council for Education Research and Training*, Vol. 2, Iss. 3, pp. 372-386. <https://doi.org/10.59231/SARI7613>
22. Timimi, H., Baaddi, M., Bennouna, A. (2025). Impact of artificial intelligence on the personalization of the customer experience: A systematic literature review. *Multidisciplinary Reviews*, Vol. 8, Iss. 7, pp. 8(7), 2025224-2025224. <https://doi.org/10.31893/MULTIREV.2025224>

23. Toker, A., Emir, O. (2023). Safety and security research in tourism: A bibliometric mapping. *European Journal of Tourism Research*, Vol. 34, pp. 1-25. <https://doi.org/10.54055/ejtr.v34i.2871>
24. Tong, C., Wong, S.K.-S., Lui, K.P.-H. (2012). The Influences of Service Personalization, Customer Satisfaction and Switching Costs on E-Loyalty. *International Journal of Economics and Finance*, Vol. 4, Iss. 3, pp. 105-114. <https://doi.org/10.5539/ijef.v4n3p105>
25. Tran, T.P., Blanchflower, T.M., Lin, C.W. (2022). Examining the effects of Facebook's personalized advertisements on brand love. *Journal of Marketing Theory and Practice*, Vol. 32, Iss. 1, pp. 61-80. <https://doi.org/10.1080/10696679.2022.2096637>
26. Tran, T.P., Sen, S., Van Steenburg, E. (2023). This ad's for you: how personalized SNS advertisements affect the consumer-brand relationship. *Journal of Consumer Marketing*, Vol. 40, Iss. 4, pp. 458-469. <https://doi.org/10.1108/JCM-12-2021-5070/FULL/XML>
27. Tran, T.P., van Solt, M., Zemanek, J.E. (2020). How does personalization affect brand relationship in social commerce? A mediation perspective. *Journal of Consumer Marketing*, Vol. 37, Iss. 5, pp. 473-486. <https://doi.org/10.1108/JCM-12-2017-2499/FULL/XML>
28. Yadav, S., Gupta, O.J., Darda, P., Chaudhary, P. (2024). The Role of Big Data in Modern Markets for Personalizing and Tailoring Products and Services. *Augmenting Customer Retention Through Big Data Analytics*, 37-53. <https://doi.org/10.1201/9781003538486-3>
29. Zhang, L., Eichmann-Kalwara, N. (2019). Mapping the Scholarly Literature Found in Scopus on "Research Data Management": A Bibliometric and Data Visualization Approach. *Journal of Librarianship and Scholarly Communication*, Vol. 7, Iss. 1, pp. 7(1), 2226. <https://doi.org/10.7710/2162-3309.2266>
30. Zupic, I., Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, Vol. 18, Iss. 3, pp. 429-472. <https://doi.org/10.1177/1094428114562629>

ENVIRONMENTAL CSR INITIATIVES IN FOOD PRODUCING ENTERPRISES AND RELATIONS WITH CONSUMERS ON THE POLISH MARKET

Anna JAKUBCZAK

Bydgoszcz University of Science and Technology; ajakubczak@pbs.edu.pl, ORCID: 0000-0001-9140-8658

Purpose: The aim of the article is to examine how corporate social responsibility (CSR) initiatives, in particular environmental ones, implemented by companies from the food production industry, affect the perception, intentions and purchasing behavior of consumers in Poland. The study focuses on the growing importance of CSR in the context of sustainable development and increasing consumer awareness.

Design/methodology/approach: The study focuses on CSR activities in B2C relations in the area of the environment. The analysis is based on a literature review and empirical research with the participation of Polish consumers. The study examines consumer reactions to CSR activities and their role in shaping purchasing decisions.

Findings: The results partially confirm the impact of companies' environmental activities on consumers' purchasing intentions, although it is not clear. Purchasing decisions are more often motivated by personal benefits than by the idea of sustainability itself.

Research limitations/implications: The study is limited to the food production industry and the Polish market. Future research could extend its scope to other sectors and countries. It is also worth examining how long-term exposure to CSR activities affects brand perception and consumer loyalty.

Recital implications: The survey provides guidance for companies that want to align their CSR strategies with consumer expectations. Identifying and implementing actions that resonate with consumers can improve brand reputation and support sustainability.

Social implications: The survey contributes to the understanding of growing societal expectations of business. He draws attention to the potential of CSR activities in terms of influencing positive social and environmental changes and shaping social attitudes towards responsible consumption.

Originality/value: This article provides new information on the perception of CSR by consumers in the food production industry in Poland. stresses the importance of CSR categorisation and stresses the need to adapt CSR strategies to consumer values and expectations.

Keywords: corporate social responsibility, sustainable development, consumer behavior, company reputation, B2C.

Category of the paper: Research paper.

1. Introduction

Corporate Social Responsibility (ang. CSR) plays an increasingly important role in shaping the competitiveness of companies (Igorową et al., 2023). Much of the research done so far has been devoted to the analysis of the impact of corporate social responsibility practices on the financial performance of companies, based mainly on economic, legal and entrepreneurial aspects. Indicating as the main reasons for the stimulation of efficiency as a result of increased motivation and loyalty of employees, trust and loyalty of customers, attracting investors and business partners. Relationships with key stakeholders such as employees and customers remain relatively less studied (Rodríguez-Gomez, Arc-Castro, Lopez-Perez, Rodríguez-Ariza, 2020; Tli, 2016; Ullmann, 1985).

The turbulent environment changes the context in which companies operate. This results in the emergence of new categories of stakeholders and their changing expectations of companies. Society is becoming more aware and socially responsible and is starting to demand the same from business. The world is moving towards the realization of values such as social justice and care for the natural environment (González-Rodríguez, Díaz-Fernández, Biagio, 2019). The concept of corporate and consumer social responsibility influences the development of civilization in a sustainable way. There is an exchange between consumers and producers in the market. Consumers meet their needs through this exchange process, and manufacturers make profits and grow their businesses. In this context, customers are identified as key stakeholders of the organization. In the context of the changes taking place in today's social, economic and natural environment and the expectations that these changes will not harm future generations in meeting their needs, corporate social responsibility is becoming an increasingly necessary standard in business strategies, and consumer behavior in the context of sustainable development requirements is increasingly becoming interdependent on the relationship with business. Buyers' behaviour results from many conditions, but it is those related to social responsibility that are becoming an increasingly important factor in purchasing decisions, and thus in the design and implementation of corporate social responsibility strategies.

Growing consumer awareness is a significant challenge for companies that strive to remain competitive and stand out on the market in a way that meets the expectations of their customers. Organizations operating in different sectors and markets are trying to develop strategies that maximize the effectiveness of their corporate social responsibility activities. The key in this process is to understand consumer expectations, which significantly affect the perception of the company, and thus their consumer attitudes and behaviors. Consequently, particular importance should be attached to identifying the activities that generate the greatest benefits for both consumers and the organisation itself in a given market context, while supporting the SDGs.

Corporate social responsibility has become an important goal for companies striving to implement the principles of sustainable development, improve their image and support positive consumer behavior. This study examines how CSR initiatives, especially pro-environmental ones, of food companies affect the perception, intentions and purchasing behaviour of consumers in Poland.

In connection with the problem undertaken, it is also possible to draw specific objectives of the work:

1. Examining the relationship between the purchasing intention of buyers of food products and their perception of CSR activity in the environmental area shown by food product producers.
2. Determining the role of consumer environmental awareness in shaping the relationship between CSR activities and purchase intention.

The following hypotheses were formulated for such purposes:

Hypothesis 1: Manufacturers' CSR environmental activity has a positive impact on purchase intentions.

Hypothesis 2: Consumer environmental awareness has a moderating effect on purchase intent (Figure 1).

The novelty of this research lies in providing new information on the perception of CSR by consumers in the food production industry in Poland. The importance of CSR categorization and the need to adapt the CSR strategy to the values and expectations of consumers were emphasized. Thus highlighting the role of the consumer and their social responsibility in sustainable development.

2. Literature Review

2.1. Selected aspects of the relationship between CSR and consumers

CSR activities also play a key role in shaping the company's relationship with its stakeholders. Economic and legal CSR initiatives have a direct positive impact on corporate reputation, while ethical and philanthropic initiatives affect consumer confidence, which in turn affects reputation. Different types of consumer trust, such as expert trust, honesty, and trust in social charity, mediate the relationship between CSR activities and corporate reputation (Park, Lee, Kim, 2014).

Corporate social responsibility programs are increasingly popular corporate marketing strategies. CSR activities can fall on a continuum between two endpoints: institutionalised programmes and promotion programmes. Institutionalized CSR programs are believed to be the most effective in increasing customer loyalty, improving attitudes toward the company,

and reducing consumer skepticism. Promotional CSR programs are believed to be more effective in generating purchase intent (Pirsch, Gupta, Grau, 2007). Many of these programs are made up of divergent, uncoordinated initiatives that do not maximize their impact. A more cohesive strategy is recommended, which divides CSR activities into three categories, including those related to philanthropy, operational effectiveness, and shaping the company's business model to better create shared value.

Consumers' perception of CSR is multifaceted and complex. Research shows that consumers evaluate CSR initiatives through a hierarchical structure, distinguishing between basic, central and peripheral factors (Öberseder et al., 2011). In addition, a conceptual model was developed to measure these perceptions, helping companies assess their CSR performance and identify areas for improvement (Oberseder, Schlegelmilch, Murphy, 2013).

The alignment between consumers' moral foundations and CSR domains plays a crucial role in driving positive consumer behavior. When there is a consensus between consumer values and a company's CSR activities, pro-company behavior increases (Baskentli et al., 2019). This effect is mediated by the consumer's identification with the firm, highlighting the importance of a perceived alignment between consumer values and corporate actions (Baskentli et al., 2019). Based on the results of the research presented in this subchapter, a research gap is visible regarding the relationship between the consumer's perceived values in terms of sustainable development and his behavior on the market in response to the socially responsible activities of enterprises.

2.2. CSR areas and categories

The foundations of corporate social responsibility are based on the idea that requires companies to take into account the consequences of their actions throughout the production process of goods and services, without harming other entities. The origins of the concept date back to the encyclical *Rerum Novarum* from 1891 and the book "The Fundamentals of Business Ethics" from 1926. The key development of this concept took place in the 1970s, mainly in the United States, when ethics began to be an integral part of business activity, and the actions of companies began to include responsibility towards consumers and society.

The 1970s also brought an increase in environmental awareness, initiated by the publication of "Silent Spring", which pointed out the dangers associated with pesticides. The UN established UNEP in 1972 to support environmental activities, which contributed to the growing importance of sustainable development as an integral element of economic activity, combining the well-being of society, the environment and the economy.

The literature distinguishes several categories of socially responsible activities in business. First of all, CSR initiatives can be divided into several pillars, also known as domains. A common framework divides CSR into economic, legal, and ethical responsibilities, often presented in the Venn model, which emphasizes the overlap and interaction between these domains (González-Rodríguez et al., 2019; Schwartz, Carroll, 2003). Carroll and others stress

that all levels are interconnected and should be pursued simultaneously. Economic responsibility is the basis of a company's operation, but its activities must be legal, ethical and, where possible, socially beneficial (Wartick, Cochran, 1985). The Carroll model is useful in assessing companies' commitment to CSR activities because it sets out a clear hierarchy and framework that companies can apply to strategic social responsibility management. The literature also mentions additional dimensions of CSR that develop the above categories in various cultural and industry contexts.

One of them is the Triple Bottom Line (TBL) concept, which distinguishes three dimensions of business activity in the sphere of responsibility: economic, environmental and social. The social dimension focuses on protecting human rights, supporting developing countries, training employees, improving the quality of life in the regions where the company operates, eliminating discrimination, and supporting social and cultural initiatives in cooperation with NGOs. The environmental dimension includes measures to improve product quality and safety, transparency regarding composition and origin, minimise waste of resources, protect biodiversity, reduce toxin emissions, promote recycling and publish environmental reports. The economic dimension emphasizes the need to achieve financial success and profitability, integrating them with other CSR objectives as a foundation for long-term business sustainability. Sustainable development requires a balance between three aspects: economic, environmental and social. Elkington argues that companies that effectively manage these three areas will be better prepared for future challenges and will be able to earn the trust and loyalty of stakeholders (Hammer, Pivo, 2016).

Broad overview of definitions (Dahlsrud, 2008), made it possible to distinguish five key dimensions of CSR: environmental, social, economic, including interactions with stakeholders and voluntariness. These dimensions are widely used in defining CSR, but they vary in popularity. The most common references are to stakeholders (88%), and the least often to the environmental dimension (59%), which may be due to its subsequent inclusion in the literature (Carroll, 1999). In view of this "underestimation" of environmental aspects in the CSR activities of enterprises, the question arises as to how this area is perceived by consumers and whether and how it affects their relations with producers of food products on the market. CSR activity in the environmental area focuses on direct interactions between companies and the social and natural environment (González-Rodríguez et al., 2019) therefore, they are of direct importance in B2C relations. According to the presented literature review on the CSR category, indicating insufficient research, especially the impact of the pro-environmental dimension in B2C relations, this aspect is another element of the research gap, which is supplemented by this study.

3. Methods

The main objective of the study is to examine the importance of corporate social responsibility in the environmental area in consumer purchasing decisions on the food industry market in Poland. It was assumed that for an environmentally conscious consumer, the highest value that should guide them when shopping is sustainable development. This means that the consumer recognizes, expects and takes into account the company's pro-environmental activity when making purchasing decisions.

It was assumed that the growing awareness of consumers, also in the field of corporate social responsibility, has an impact on purchase intentions. The type of CSR activities carried out by food producers is of particular importance.

In connection with the problem undertaken, the main objectives of the work can also be drawn:

1. Examining the relationship between the purchasing intention of buyers of food products and their perception of CSR activity in the environmental area shown by food product producers.
2. Determining the role of consumer environmental awareness in shaping the relationship between CSR activities and purchase intention.

The following hypotheses were formulated:

Hypothesis 1: Manufacturers' CSR environmental activity has a positive impact on purchase intentions.

Hypothesis 2: Consumer environmental awareness has a moderating effect on purchase intent (Figure 1).

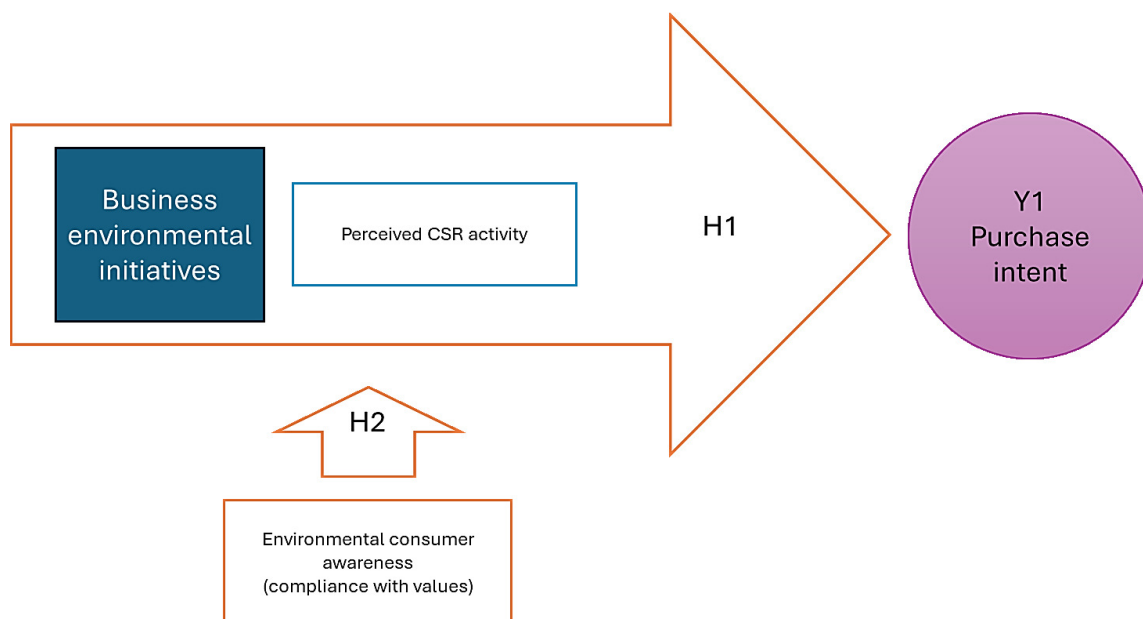


Figure 1. Research model.

Source: own study.

After operationalising the objectives of the study, data collection was set out. The research was carried out in the 4th quarter of 2024. The selection of the sample was accidental and deliberate. The main selection criterion was the purchase of groceries. The data was collected by an interview using an online questionnaire shared via *social media*. Then, the data were analyzed according to the procedure presented in Figure 2.

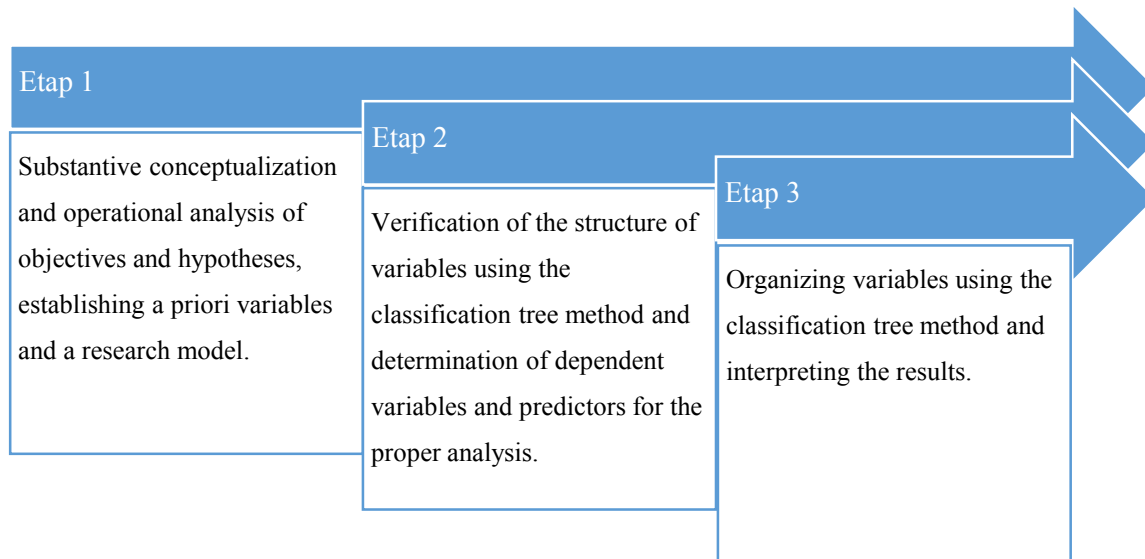


Figure 2. Research procedure.

Source: own study.

In the first stage, 27 questions were determined, including 5 characterizing the respondents. The independent variables were to reflect consumers' purchasing intentions in relation to organic products or environmentally friendly companies and social activities. The dependent variables measured the level of purchase intention for products from companies operating in the area of the natural environment or social activities. In the 2nd stage, the structure of the variables and their predictive capacity were analyzed, rejecting some of them, both dependent and independent variables, which did not contribute information to the analysis of the results, e.g. due to covariance with other variables.

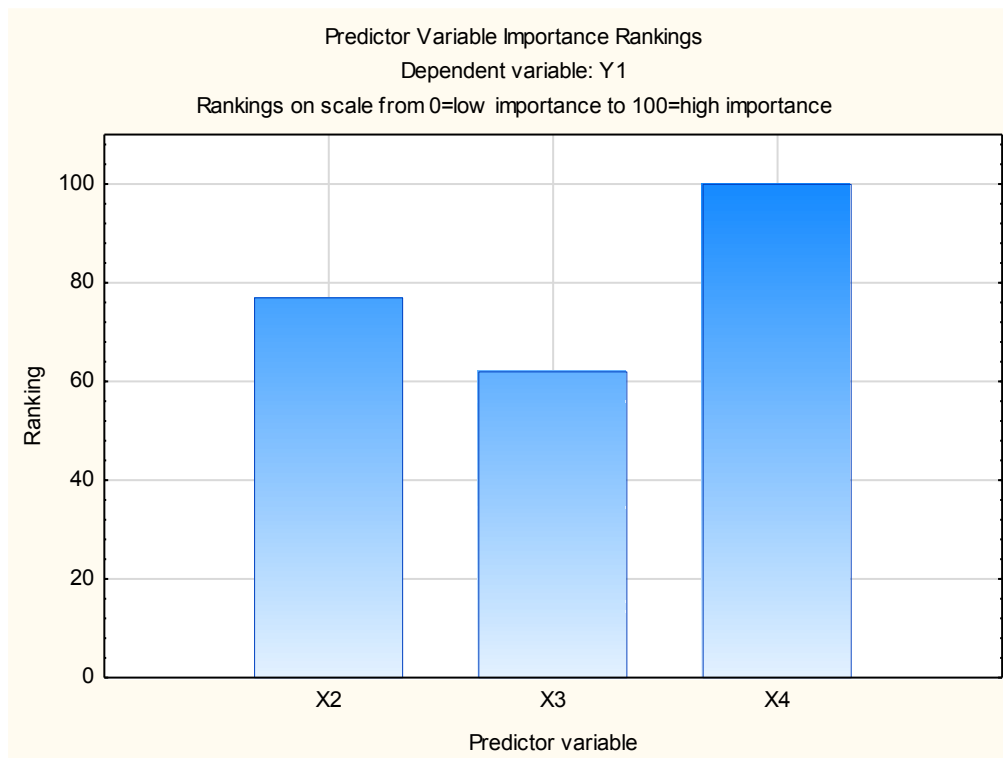


Figure 3. Ranking of Predictive Variables for Purchase Intent Measured by Y1.

Source: own research.

In the process of analyzing the independent variable Y1, the most important predictor variable turned out to be X4 (Fig. 3).

The research variables selected after stage 2 are presented in Table 1.

Tabela 1.
Research variables

Symbol	Description
Dependent variables	
Y1	Purchase intention of eco products or products from pro-environmental companies
Independent variables	
Awareness of pro-environmental CSR activities and values important to the consumer	
X2	A belief in the higher quality of packaging and sustainable products
X3	Advocating for an environmentally friendly product – minimising plastic waste
X4	Support for pro-environmental action – use of secondary raw materials

Source: own research.

For further analysis of variables, the classification tree method was used, which is used to predict the affiliation of cases or objects to the classes of a qualitative dependent variable based on measurements of one or more predictor variables. This method, thanks to its hierarchical nature, allows for effective categorization of the dependent variable using many nominal predictors. The flexibility of this method lies in analyzing the impact of predictor variables one at a time, rather than all at once. Once univariate divisions are obtained, the predictor variables can be ranked on a scale from zero to one hundred depending on how important they are in terms of influencing the values of the dependent variable. Probability a priori proportional to the size of the classes and equal costs of misclassifications for all classes were adopted.

The division method was used: C&RT (Classification And Regression Trees), pruning based on minimizing the cost and complexity of the tree.

4. Results

4.1. Characteristics of the study group

Table 2.
Summary of respondents' characteristics

Variable	Category	Percentage (%)
		N = 150
Gender	Female	70.0
	Male	28.8
	No answer	1.2
Age	18-26	55.2
	27-35	26.4
	>35	18.4
Education	Higher	52.0
	Secondary	48.0
Domicile	Big city	50.0
	Rural areas	25.6
	Small or medium city	24.4
Net monthly earnings per capita	0-2000	12.4
	2001-3500	22.0
	3501-4500	26.8
	4501-6000	22.4
	> 6001	16.4

Source: own research.

250 people were examined, mainly from the Kuyavian-Pomeranian Voivodeship. Most of the respondents are women, who make up a significant part of the sample. Men are also well represented, while a very small percentage of respondents did not specify their gender.

The largest group are young people aged 18-26, which may indicate a large share of students or young workers. Other groups are people aged 27-35 and over 35. Therefore, the respondents of Generation Z have the main share in expressing their opinions. Most respondents have higher education, which may indicate high educational awareness among the respondents. Half of the respondents live in large cities. The rest are distributed almost evenly between rural and medium-sized areas and small towns. The average net earnings per capita in a household is in the range of PLN 3501-45000, which indicates a moderate level of income among the respondents.

4.2. Data analysis results

Variables were analysed to determine the relationship between the location of the sources of motivation for the consumer to express the purchase intention (environmental awareness), taking into account the role of pro-environmental activity of business organizations in the field of CSR.

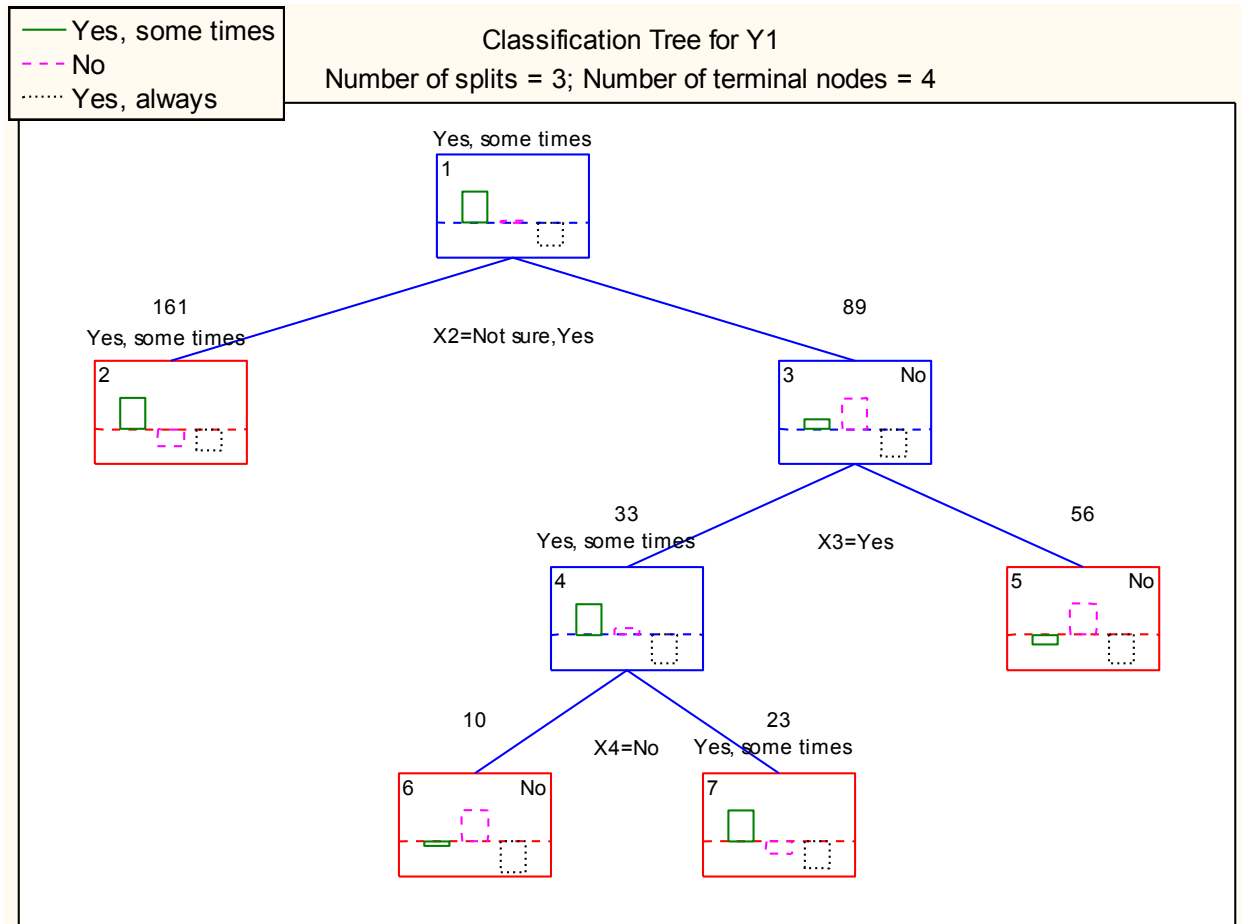


Figure 4. Classification of purchase intentions and CSR environmental activities.

Source: own research.

After classifying consumers in terms of purchase intentions and awareness of pro-environmental activities of enterprises, 4 consumer profiles were created:

Profile 1.Y1 (end node 2): Consumers who are most likely to express moderate purchase intentions for environmental products or from companies that act for the environment and are most likely to consider the quality of packaging and green products as better or unsure of it (consumer benefits).

Profile 2.Y1 (end node 5): Consumers, who most often do not express an unconditional purchase intention in relation to pro-environmental products or companies acting for the environment, at the same time do not perceive ecological packaging as better quality, are also not aware of the importance of pro-environmental activities, but support pro-ecological products.

Profile 3.Y1 (End Node 6): Consumers who do not express an unconditional purchase intention towards environmentally friendly products or companies acting for the environment.

Profile 4.Y1 (end node 7): Consumers who are most likely to express an unconditional intention to buy environmentally friendly products or from environmentally active companies and at the same time are not guided by the perceived higher quality of ecological packaging, but show support for environmentally friendly activities and products (Fig. 3).

Profiles 1 and 4 and 2 and 3 share the same interpretation of the independent variable. In the first case (profiles 1 and 4), consumers express an unconditional intention to buy products produced by environmentally friendly companies, and in the second case to a lesser extent or not (profiles 2 and 3). Profiles 1 and 4 together constitute the largest group of respondents, about 64% and 22%, respectively (Fig. 3). In Profile 1, consumers link their purchasing intentions to the perceived higher quality of environmentally friendly packaging, while in Profile 4, an important aspect in making purchasing decisions is: the use of pro-environmental activities by the company or a pro-ecological product.

5. Discussion

The first hypothesis about the impact of CSR environmental activity of food producers on purchasing intentions should be considered partially confirmed. For about 86% of respondents, the pro-environmental activity of producers on the food market is important, but they are not so determined to use it in every case. Although the majority of respondents report a positive attitude towards the environmental activities of manufacturers, their actual purchasing decisions are often influenced by additional factors such as price, availability or personal benefits (Al-Haddad et al., 2022). These results are consistent with previous research that indicates that environmental awareness influences purchase intentions mainly indirectly – through attitudes, social norms and a sense of control over behavior (Li, Shan, 2025). Moreover, younger generations, such as Generation Z, show greater sensitivity to sustainability issues; however, their declarations do not always translate into consistent purchasing choices (Zhou, Wang, 2024).

The second hypothesis assumes that the consumer's environmental awareness, reflected in their sharing of the values of sustainable development, is a motivator for them to choose products from companies operating in the area of CSR in the area of the natural environment. Consumers from Profile 1 pay attention to the higher quality of ecological products and their packaging, supporting the environmental activities of companies. Producing products and packaging in an environmentally friendly way is the implementation of the principles of sustainable development. At the same time, consumers, noticing the impact of higher quality of these products and their packaging on their purchasing decisions, realize their own benefit.

Therefore, this group (64%) cannot be unequivocally attributed to purchase intention resulting from the shared value of sustainability, but rather from the perceived benefit for the consumer in the form of a higher quality product or packaging. Therefore, there is no certainty as to the direct relationship between purchasing intentions towards ecological products and packaging and the environmental activity of CSR companies. Consumers' purchase intentions are more strongly related to personal benefits than to pro-ecological awareness. These results are in line with previous research that indicates that consumers often perceive organic products as of higher quality, which influences their purchasing decisions more than the environmental values themselves (Petkowicz et al., 2024). Although environmental and health awareness plays an important role in shaping attitudes, purchase intentions are largely mediated by personal benefits such as quality, health or social prestige (Li, Shan, 2025). In addition, consumers expect eco-friendly packaging to be not only environmentally friendly, but also functional and aesthetically pleasing, which reinforces their purchasing decisions regardless of pro-ecological motivation (Silva et al., 2020).

Profile 4 (22%) included consumers who shared purchasing intentions for products from companies operating in the field of the environment and at the same time a high degree of sharing the values of sustainable development. It cannot be ruled out that CSR activities in the environmental area will have a moderating impact on purchasing decisions in selected consumer groups. The results also indicate that the environmental activity of enterprises is not the only factor determining the behavior of food consumers on the modern market. Scientists from Slovakia (2023) came to similar conclusions. The team's research aimed to find out whether corporate social responsibility (CSR) activities are perceived as a marketing tool by consumers in the food market in Slovakia. Most respondents declared that they were familiar with the term CSR, but many of them did not fully understand its meaning or notice the CSR activities of food companies. A significant number of consumers perceived CSR activities as a way to build a positive image of the company. According to the author, CSR has little impact on consumers' purchasing decisions, although younger generations are more socially aware and more open to supporting socially responsible companies. The key factor for the effectiveness of CSR activities is their credibility and appropriate communication with consumers. Research suggests that while CSR is an important element in building a company's competitiveness and image, it requires more intensive communication and consumer education to increase its impact on the market (Igarová et al., 2023)

The authors of the study on young Chinese noted that they have a negative perception of socially responsible business activities in Chinese corporations, especially in terms of the natural environment. Personal values had a significant impact on the perception of CSR by the respondents. The practical contribution of this study is to suggest that cultivating values is a good way to develop ethical behavior and responsibility, which in turn influence the development of CSR in China.

The research by Joana Araújo and team (2023) analyzed the impact of three types of CSR-related activities: economic, social, and environmental on brand image, brand value, and consumer satisfaction. The authors of the article emphasize that these categories affect the perception of the brand by consumers. Green initiatives can significantly improve a company's image, while social investment supports customer loyalty and building positive brand associations (Araújo, Pereira, Santos, 2023).

CSR should be seen as a socially constructed concept that must be adapted to the specific contexts in which it is applied. The challenge for companies is not so much to define CSR as to understand how it is perceived in a given social environment and how to incorporate it into their business strategies. CSR is a growing concept that requires appropriate management tools in the changing realities of globalization (Dahlsrud, 2008). Companies should align their CSR strategies with consumer perceptions, product type, and relevant CSR dimensions to maximize benefits. In conclusion, CSR is becoming an increasingly important factor in creating competitive strategies and in building trust and loyalty among some consumers, but it requires intensification of activities on the part of both business and consumers. For both groups of entities, the key challenge is to shape awareness of their impact and role in sustainable development.

6. Conclusions

The study provided valuable empirical data, but several important limitations should be identified. Firstly, the use of the interview method is based on the respondents' declarations, which do not always translate into actual behaviour. Second, while 86% of respondents consider corporate environmental performance to be important, this does not translate into consistent consumer choices, indicating the limited predictive power of CSR awareness alone. Additionally, consumer profiling revealed that only a fraction of consumers (22%) show consistency between sustainability values and purchase intent, which limits the possibility of generalizing the results.

The study confirmed that environmental CSR activity can influence purchasing decisions, but its effectiveness depends on perceived personal benefits, such as product or packaging quality. Consumers in Profile 1 (64%) support CSR activities, but their choices are mainly motivated by their subjective assessment of quality, and not solely by environmental values. Consumers in Profile 4 (22%), on the other hand, show a clear link between sustainability values and purchase intent, suggesting a market segment more susceptible to CSR activities. These results enrich the knowledge about the complexity of consumer motivations and confirm that CSR works more effectively when it combines social values with real benefits for the consumer.

From a theoretical perspective, the study contributes to the literature on consumer behavior and CSR, pointing to the need to take into account pragmatic factors in models explaining purchase intentions. In practice, the results suggest that companies should design CSR strategies in an integrated way – combining the communication of environmental values with the emphasis on the quality, functionality and aesthetics of products. In addition, the survey confirms the need to intensify educational and communication activities to increase consumer awareness and trust in CSR activities. It also points to the need to segment the market and adapt the CSR message to different groups of recipients – especially younger generations, who are more open to sustainability issues, but require authenticity and transparency of companies' activities.

References

1. Al-Haddad, S., Sharabati, A.-A. A., Al-Khasawneh, M., Maraqa, R., Hashem, R. (2022). The Influence of Corporate Social Responsibility on Consumer Purchase Intention: *The Mediating Role of Consumer Engagement via Social Media*. *Sustainability*, 14(11), 6771. <https://doi.org/10.3390/su14116771>.
2. Araújo, J., Pereira, I.V., Santos, J.D. (2023). The Effect of Corporate Social Responsibility on Brand Image and Brand Equity and Its Impact on Consumer Satisfaction. *Administrative Sciences*, 13(5), 118. doi:10.3390/admsci13050118
3. Carroll, A.B. (1999). Corporate Social Responsibility: Evolution of a Definitional Construct. *Business & Society*, 38(3), 268-295. doi:10.1177/000765039903800303
4. Dahlsrud, A. (2008). How corporate social responsibility is defined: an analysis of 37 definitions. *Corporate Social Responsibility and Environmental Management*, 15(1), 1-13. doi:10.1002/csr.132
5. González-Rodríguez, M.R., Díaz-Fernández, M.C., Biagio, S. (2019). The perception of socially and environmentally responsible practices based on values and cultural environment from a customer perspective. *Journal of Cleaner Production*, 216, 88-98. doi:<https://doi.org/10.1016/j.jclepro.2019.01.189>
6. Hammer, J., Pivo, G. (2016). The Triple Bottom Line and Sustainable Economic Development Theory and Practice. *Economic Development Quarterly*, 31(1), 25-36. doi:10.1177/0891242416674808
7. Hossain, M., Momin, M., Rowe, A., Quaddus, M. (2017). Corporate social and environmental reporting practices: A case of listed companies in Bangladesh. *Sustainability Accounting, Management and Policy Journal*, 8, 138-165. doi:10.1108/SAMPJ-04-2015-0027

8. Igarová, K., Kádeková, Z., Košičiarová, I., Džupina, M., Dvořák, M., Smutka, L. (2023). Is Corporate Social Responsibility Considered a Marketing Tool? Case Study from Customers' Point of View in the Slovak Food Market. *Foods*, 12(14), 2770. doi:10.3390/foods12142770
9. Jeurissen, R. (2000). John Elkington, Cannibals With Forks: The Triple Bottom Line of 21st Century Business. *Journal of Business Ethics*, 23, 229-231. doi:10.1023/A:1006129603978
10. Khanchel, I., Lassoued, N., Khiari, C. (2023). The Reactive Strategy During the COVID-19 Crisis: A New String to the Bow of CSR. *Global Business Review*. doi:10.1177/09721509231157562
11. Li, Y., Shan, B. (2025). Exploring the role of health consciousness and environmental awareness in purchase intentions for green-packaged organic foods: an extended TPB model. *Frontiers in Nutrition*, 12, 1528016. <https://doi.org/10.3389/fnut.2025.1528016>
12. Oberseder, M., Schlegelmilch, B.B., Murphy, P.E. (2013). CSR practices and consumer perceptions. *Journal of Business Research*, 66(10), 1839-1851. doi:10.1016/j.jbusres.2013.02.005
13. Park, J., Lee, H., Kim, C. (2014). Corporate social responsibilities, consumer trust and corporate reputation: South Korean consumers' perspectives. *Journal of Business Research*, 67, 295-302. doi:10.1016/J.JBUSRES.2013.05.016
14. Petkowicz, A.C., Pelegri, T., Bodah, B.W. et al. (2024). Purchasing Intention of Products with Sustainable Packaging. *Sustainability*, 16(7), 2914. <https://www.mdpi.com/2071-1050/16/7/2914>
15. Pirsch, J., Gupta, S., Grau, S.L. (2007). A Framework for Understanding Corporate Social Responsibility Programs as a Continuum: An Exploratory Study. *Journal of Business Ethics*, 70(2), 125-140. doi:10.1007/s10551-006-9100-y
16. Ribeiro, A.C., Catalão-Lopes, M., Costa, A.S. (2022). Corporate Social Responsibility and Consumers' Reaction: An Experiment. *Journal of Sustainable Business and Economics*, 5(3), 1-11. doi:10.30564/jsbe.v5i3.13
17. Rim, H., Ferguson, M. (2020). Proactive Versus Reactive CSR in a Crisis: An Impression Management Perspective. *International Journal of Business Communication*, 57, 545-568. doi:10.1177/2329488417719835
18. Rodríguez-Gomez, S., Arco-Castro, M.L., Lopez-Perez, M.V., Rodríguez-Ariza, L. (2020). Where Does CSR Come from and Where Does It Go? A Review of the State of the Art. *Administrative Sciences*, 10(3), 60. doi:10.3390/admsci10030060
19. Schwartz, M.S., Carroll, A.B. (2003). Corporate Social Responsibility: A Three-Domain Approach. *Business Ethics Quarterly*, 13(4), 503-530. doi:10.5840/beq200313435
20. Silva, A.L., de Oliveira, M.C. (2020). Consumer Considerations for the Implementation of Sustainable Packaging in the Food Industry. *Sustainability*, 12(6), 2192. <https://www.mdpi.com/2071-1050/12/6/2192>

21. Tarnovskaya, V., Tolstoy, D., Melén Hånell, S. (2022). Drivers or passengers? A taxonomy of multinationals' approaches to corporate social responsibility implementation in developing markets. *International Marketing Review*, 39(7), 1-24. doi:10.1108/imr-05-2021-0161
22. Tilt, C.A. (2016). Corporate social responsibility research: the importance of context. *International Journal of Corporate Social Responsibility*, 1(1). doi:10.1186/s40991-016-0003-7
23. Ullmann, A.A. (1985). Data in Search of a Theory: A Critical Examination of the Relationships among Social Performance, Social Disclosure, and Economic Performance of U. S. Firms. *The Academy of Management Review*, 10(3), 540-557. doi:10.2307/258135
24. Wartick, S.L., Cochran, P.L. (1985). The Evolution of the Corporate Social Performance Model. *Academy of Management Review*, 10(4), 758-769. doi:10.5465/amr.1985.4279099
25. Zhou, Y., Wang, L. (2024). Behavioral Intention to Purchase Sustainable Food: Generation Z's Perspective Based on the Theory of Planned Behavior. *Sustainability*, 16(17), 7284. <https://www.mdpi.com/2071-1050/16/17/7284>

PROPERTY TAX SYSTEM ON THE CASE OF RESIDENTAL PROPERTIES IN THE COOK COUNTY (ILLINOIS, THE USA)

Magdalena JASINIAK

Corporate Finance Department, University of Lodz; magdalena.jasiniak@uni.lodz.pl,
ORCID: 0000-0002-1658-320X

Purpose: The main aim of this article is to analyze the property tax system in the USA on the Cook County example as a sample of solutions for establishing property tax value.

Design/methodology/approach: This article adopts a conceptual perspective, using the property tax calculation model employed in Cook County as a case of a systemic policy design. As one of the largest and most complex local jurisdictions in the U.S., Cook County provides a valuable case for illustrating how systemic rules, equalization procedures, exemptions, and reassessment cycles interact within a local tax structure.

Findings: The presented property tax system may be characterized as transparent and designed with the objective of establishing a fair market value for taxation purposes. It is strongly depended on the fiscal needs of local jurisdictions, particularly in financing public services. It also provides homeowners the opportunity to appeal the assessed value of their property thereby introducing an element of procedural fairness and accountability into the assessment process.

Social implications: This article presents the systemic solutions implemented in Cook County, which may serve as a source of inspiration for national-level tax system design. Of particular note is the transparency of the property tax system and the institutional recognition of its imperfections, as reflected in the availability of formal appeal procedures.

Originality/value: This article responds to the growing interest in the topic of property taxation in Poland. Although the system in the United States operates under distinct economic and institutional conditions, it is worthwhile to highlight certain features that make it transparent and comprehensible to taxpayers, as well as perceived as fair. By examining these structural elements, the article aims to inform ongoing discussions on the design of equitable and accessible property tax systems in other national contexts.

Keywords: property tax system, property tax evaluation, the US property tax.

Category of the paper: Case study.

1. Introduction

Poland is one of the few EU countries where the amount of property tax is based on the area of the property, rather than its value. In Poland, taxes imposed on real estate ownership play a crucial role in financing municipal budgets. In general, it is calculated on the usable area of the property and the tax rate set by the municipality. Discussions about changing this system have been ongoing in Poland for several decades, but social concerns about increased tax payments have primarily hindered progress. The Polish property tax system is still based on legal solutions from the 1980s and 1990s and existing regulations fail to reflect economic realities, such as current property market values (Dowgier, 2021).

The changes introduced in property tax from January 1, 2025, indicate that the topic is still relevant. This system is often criticized for its low efficiency and injustice.

One of the main flaws of the Polish system is the lack of connection between the taxpayer's financial situation and the amount of tax. Tax rates are limited by law and indexed only by the inflation rate, which means they do not keep up with the dynamics of changes in property prices.

However, Polish taxpayers are subject to a broad spectrum of fiscal obligations, encompassing various forms of direct and indirect taxation. Among these, the value-added tax (VAT) constitutes a particularly significant component of public revenues, with its economic burden predominantly borne by consumers. In addition, individuals and businesses contribute substantial amounts to the public finance system through personal and corporate income taxes, as well as social security contributions and other public levies.

Against this backdrop, any prospective reforms concerning property taxation—which represents an additional form of wealth-based taxation—should be approached with caution and careful deliberation. It is essential to balance the fiscal needs of local government units with the aggregate tax burden already borne by taxpayers. Ill-considered or abrupt modifications to the property tax framework may not only provoke public opposition but also disrupt the overall equilibrium between different sources of public revenues and the distribution of tax liabilities across the economy.

In this context, any modifications to the property tax system in Poland carry the potential risk of reducing household disposable income, thereby diminishing the purchasing power of taxpayers. Such outcomes may, in turn, generate unintended adverse economic and social effects, ultimately undermining the initial objectives of the reform, such as increasing local government revenues or enhancing fiscal efficiency. Therefore, the design and implementation of property tax reforms should be carefully calibrated to avoid exacerbating the overall tax burden and to ensure an equitable balance between revenue generation and taxpayers' financial capacity.

Accordingly, it becomes imperative to undertake systematic empirical research and comparative policy analyses aimed at examining property tax frameworks applied in other jurisdictions. Such inquiry facilitates not only the critical appraisal of alternative institutional arrangements and legal constructs, but also allows for an *ex ante* evaluation of the potential economic, distributive, and fiscal implications that the implementation of these models may produce within the specific institutional, economic, and social context of Poland. This evidence-based approach is essential to ensure that prospective reforms are both effective and sustainable over the long term.

Within the framework of this article, the property tax system implemented in Cook County (Illinois, the USA) will be examined and presented as a case study offering potential reference points for the discussion on property tax reform in Poland. To the best of the author's knowledge, the existing literature has not yet addressed in detail the mechanisms for determining property tax liability at the municipal or county level in the United States. While many studies examine the economic effects of property taxation, its regressivity, or its role in local government finance, relatively few provide an in-depth analysis of how tax assessments are calculated in practice, particularly at the sub-state level.

This article seeks to fill that gap by offering a conceptual exploration of the property tax assessment framework used in Cook County, Illinois. As one of the largest and most complex local jurisdictions in the U.S., Cook County provides a valuable case for illustrating how systemic rules, equalization procedures, exemptions, and reassessment cycles interact within a local tax structure.

The analysis will focus in particular on the systemic solutions, administrative structures, and valuation methodologies applied in this jurisdiction. By exploring the institutional arrangements functioning in Cook County, the study aims to identify elements that could inform the design of more effective, equitable, and administratively feasible property tax policies in the Polish context, while simultaneously acknowledging the need for careful adaptation to local legal, economic, and social conditions.

Following paper aims to put into discussion solutions provided by the property tax system in the Cook County and highlights good practices in this area. The Author acknowledges the significant systemic differences between Poland and the United States, particularly in the areas of legal, administrative, and cultural frameworks, which undoubtedly affect the feasibility of practically implementing the solutions presented herein. At this point, the article aims to emphasize the importance of transparency in the tax system, while the question of whether certain solutions can be implemented in the Polish context—given the existing institutional framework—remains a subject for separate and more detailed consideration.

2. Research Method

To conduct an in-depth analysis of the property tax system in the United States, this study adopts a case study methodology, focusing on Cook County, Illinois. As one of the largest and most administratively complex local government units in the United States, Cook County offers a robust framework for analyzing both the institutional and practical dimensions of property taxation.

Cook County comprises over 130 municipalities, including Chicago, the third-largest city in the United States. The county government is responsible for a wide range of public services, including education, transportation, judicial administration, and public health. This governance structure requires a highly adaptable property tax system capable of addressing socio-economic disparities across distinct neighborhoods, from wealthy suburbs such as Wilmette and Oak Park to underprivileged areas within the metropolitan core.

Moreover, Cook County is frequently cited in academic and policy discussions surrounding key challenges in property taxation, such as:

- the regressivity of property taxes in economically disadvantaged districts,
- the equity and accessibility of the appeals process,
- economic disincentives for commercial investment,
- and the systematic undervaluation of properties among specific social groups.

These challenges are not exclusive to the United States; they are equally relevant for post-socialist and transitioning economies, such as Poland, which are in the process of designing or reforming their own local tax systems.

The empirical analysis in this article draws on data and official publications from the Cook County Treasurer's Office and the Cook County Assessor's Office—the institutions tasked with administering property valuations, enforcing tax collection, and managing appeals procedures. Their documentation and operational transparency provide a valuable foundation for evaluating the functional characteristics and institutional logic of a mature property tax system.

3. The US Tax System

Property taxation holds substantial potential for enhancing public revenue generation and improving tax equity, particularly in transitional and developing countries. It is proved that property tax revenues are perceived as being spent most effectively and delivering the greatest value compared to other taxes (such as federal income, state income, or sales taxes), however individuals consistently express the highest level of aversion toward the property tax (Cabral, Hoxby, 2012).

One of the primary constraints on property tax reform in transitional and developing countries is weak administrative capacity, often rooted in political, institutional, and human resource limitations. Effective reforms must be designed with careful consideration of these constraints, including the existing reform context, legal and institutional frameworks, the administrative capabilities of government agencies, and the presence—or absence—of political will. Any property tax reform must be tailored to local conditions, adapting international best practices to the specific institutional, legal, and socio-economic context of the country in question (Kelly, 2013).

Property taxation constitutes a significant revenue source for local governments in the United States, funding essential services such as public education, law enforcement, emergency response, and infrastructure development. Municipalities, counties, school districts, and special-purpose districts collectively generate approximately \$500 billion annually through property taxation, constituting approximately 72% of total local tax revenue and 47% of local own-source general revenue across the United States (Berry, 2021).

Among these, its stability over economic cycles is particularly noteworthy, as it is less susceptible to fluctuations compared to sales or income taxes. This stability facilitates predictable revenue streams, enabling municipalities to mitigate fiscal shortfalls during periods of economic contraction. Additionally, property taxes are relatively progressive compared to alternative revenue sources, as they are more closely aligned with wealth accumulation. Unlike sales taxes, which disproportionately burden lower-income households due to their regressive nature, property taxes promote fiscal equity. Furthermore, the decentralized nature of property tax administration supports local autonomy, allowing municipalities to tailor tax rates to their specific fiscal needs (Lincoln Institute..., 2023).

The property tax is, by design, an *ad valorem* tax, implying that the tax liability is proportional to the assessed market value of the property. In contrast to transaction-based taxes such as sales taxes or value-added taxes (VAT), the property tax is levied at regular intervals—typically on an annual basis—regardless of whether a sale has occurred.

Since the majority of real estate assets are infrequently traded, their market value must be estimated for each taxation period. This task is delegated to the local assessor's office, whose valuations serve as the foundation for determining tax obligations. Consequently, the accuracy and equity of the property tax system are critically dependent on the reliability and objectivity of these assessments.

Given the extensive body of academic research devoted to property taxation, it is notable—and somewhat paradoxical—that the process of property assessment, which plays a central role in shaping both tax incidence and fairness, has received comparatively limited scholarly attention (Berry, 2021).

The following table presents the share of property tax revenues in 50 states in general revenues from own sources (local government amount) in 2022 (Tab. 1).

Table 1.

The share of property tax revenues in general revenues from own sources in 50 US states in 2022 (ths USD)

State	General revenue from own sources (USD)	Revenue from Total Taxes (USD)	Revenue from Property Tax (USD)	Sales and gross receipts (USD)	Total taxes in general revenues (%)	Property tax in total taxes (%)
US Total	1 361 090,43	894 128,02	627 437,31	165 801,67	66	70
District of Columbia	12 078,96	10 077,57	2 908,14	2 121,93	83	29
Arkansas	5 076,38	3 295,94	1 303,15	1 941,10	65	40
Alabama	15 946,23	7 579,52	3 040,04	3 645,92	48	40
Louisiana	17 137,03	10 859,42	4 670,74	5 877,25	63	43
Nevada	9 813,39	5 774,57	2 873,47	2 336,69	59	50
Washington	37 325,98	21 661,95	11 129,97	8 440,75	58	51
Maryland	25 916,29	20 425,76	10 615,03	797,22	79	52
New Mexico	5 840,85	4 211,55	2 220,85	1 913,48	72	53
Oklahoma	11 187,61	7 011,34	3 776,76	3 078,84	63	54
New York	153 630,01	118 785,82	65 301,66	22 971,25	77	55
Kentucky	10 163,50	7 028,80	3 879,46	889,94	69	55
Arizona	19 975,49	13 915,45	8 019,74	5 285,90	70	58
Utah	12 772,31	7 632,66	4 555,71	2 814,10	60	60
Missouri	20 927,52	13 859,42	8 374,72	4 234,44	66	60
Colorado	31 043,66	20 270,83	12 402,27	7 149,81	65	61
Ohio	43 944,77	30 196,49	19 004,81	3 465,16	69	63
Tennessee	20 001,06	10 532,15	6 845,81	3 194,03	53	65
Georgia	39 555,95	23 225,31	15 157,44	7 362,20	59	65
California	208 614,80	120 629,38	80 438,76	28 631,90	58	67
Hawaii	4 649,17	3 439,76	2 312,58	806,11	74	67
Pennsylvania	43 448,34	32 670,09	22 258,37	1 527,42	75	68
North Carolina	35 481,33	18 271,50	12 507,08	5 060,02	51	68
South Dakota	2 868,18	2 122,62	1 530,92	502,09	74	72
South Carolina	19 996,22	10 329,82	7 480,91	1 934,84	52	72
Kansas	9 827,45	5 993,28	4 449,69	1 410,71	61	74
Florida	88 317,84	49 372,70	37 261,66	8 982,30	56	75
Oregon	16 235,68	10 530,84	7 987,54	809,43	65	76
Alaska	3 529,36	2 137,53	1 626,90	471,73	61	76
North Dakota	2 844,93	1 634,57	1 257,40	342,70	57	77
Virginia	30 323,99	22 595,47	17 453,20	3 453,45	75	77
Nebraska	9 579,50	5 774,48	4 470,29	595,74	60	77
Delaware	2 212,51	1 480,41	1 178,44	23,56	67	80
West Virginia	4 062,14	2 445,67	1 955,04	203,20	60	80
Illinois	54 667,82	40 594,10	32 784,63	6 747,14	74	81
Wyoming	3 371,43	1 197,15	981,56	148,23	36	82
Texas	117 072,11	81 428,41	67 076,59	12 934,89	70	82
Indiana	21 589,63	10 301,61	8 583,78	194,76	48	83
Iowa	13 300,11	7 494,94	6 393,53	893,22	56	85
Michigan	27 255,49	15 997,88	14 562,43	344,75	59	91
Minnesota	19 837,83	11 133,76	10 172,61	631,52	56	91
Wisconsin	17 039,89	11 714,06	10 702,92	692,02	69	91
Idaho	4 793,11	2 245,65	2 087,30	82,16	47	93
Mississippi	8 357,75	3 819,20	3 578,75	130,15	46	94
Vermont	1 230,73	867,59	824,77	29,92	70	95
Massachusetts	26 868,56	22 004,07	20 919,90	508,42	82	95
Montana	2 940,99	1 871,76	1 798,15	29,23	64	96
Rhode Island	3 530,08	2 855,55	2 767,52	36,56	81	97

Cont. table 1.

New Hampshire	5 505,78	4 770,98	4 689,26	9,49	87	98
New Jersey	41 047,92	34 176,19	33 617,23	108,64	83	98
Connecticut	13 931,95	12 328,56	12 140,92	0,00	88	98
Maine	4 420,89	3 553,90	3 506,93	5,39	80	99

Source: own elaboration on the basis of data – Census.gov, <https://www.census.gov/data/datasets/2022/econ/local/public-use-datasets.html>, 08.07.2025.

The share of taxes in general revenue varies widely from 36% to 88%. The national average shows that approximately 70% of taxes come from property taxes, and the dependency from property tax ranges from very low (below 30%) to almost full dependency (close to 100%). It mostly depends on the municipalities financial needs. The Illinois operates under a property-tax-centered model of local finance, typical for Northeastern states. Unlike many other US states that balance between income taxes, sales taxes, and property taxes, Illinois heavily relies on property taxation to fund both municipal services and school districts. This model offers stable and predictable revenues for local governments, involves high tax burdens for property owners, is increasingly politically sensitive due to rising housing prices and tax bills and requires sophisticated property valuation systems and appeals processes.

Simultaneously, the implementation of such a model for financing public tasks is feasible due to the absence of significant additional tax burdens on residents. It is important to recognize that excessive taxation may produce counterproductive outcomes, potentially leading to household impoverishment and, consequently, to reduced tax compliance and enforcement efficiency.

As demonstrated in a study by Wong (Wong, 2024), increases in property taxes are associated with a higher likelihood of financial distress among homeowners. This effect is observable through delayed mortgage payments, increased credit card debt, and an elevated risk of home foreclosure. Specifically, the study found that a \$100 increase in property tax correlates with an approximately 1% increase in mortgage delinquency rates.

Moreover, property tax hikes were found to reduce consumption expenditures among homeowners, suggesting broader macroeconomic implications. In the long term, elevated property tax burdens may force displacement, particularly among low-income or liquidity-constrained homeowners.

The research also revealed that while rising home values increase owners' net wealth, this does not necessarily translate into increased borrowing against that equity. Many homeowners do not leverage the additional value, which may be attributable to factors such as reluctance to incur debt, preference for savings, or limited access to home equity loans or credit markets.

Also for many aging American households, housing wealth represents the primary component of their retirement asset portfolios. Combined with limited access to liquid assets and current income, this concentration renders elderly households particularly vulnerable to unexpected shocks in home values (Zhao, Burge, 2017).

A particularly illustrative case of low property tax system efficiency is the city of Detroit, where ongoing discussions are focused on transitioning from a traditional property value tax to a Land Value Tax (LVT) system (Hunter, Bograd, Boddupalli, 2023). The proposed reform involves increasing taxes on vacant land while simultaneously reducing taxes on buildings by 30%. The primary objective of this initiative is to address some of the city's chronic economic issues, such as urban blight and the disincentivizing effect of high property taxes on redevelopment.

Current taxation practices in Detroit impose significant burdens on property improvements: any construction, renovation, or maintenance activities increase the assessed property value and, in turn, the tax liability. This discourages investment and contributes to the deterioration of neighborhoods.

According to municipal estimates, the implementation of an LVT would reduce property tax bills for approximately 97% of homeowners and 70% of small businesses in the city. A typical multifamily residential building would save around 20% on its tax bill. Conversely, owners of vacant lots and scrap yards could experience a tax increase exceeding 100%, reflecting the reform's intent to promote productive land use and penalize speculative or underutilized holdings.

4. The Evaluation of Property Tax on the Cook County Example

Property taxes are collected on a county level, and each county in Illinois has its own method of assessing and collecting taxes. As a result, it's not possible to provide a single property tax rate that applies uniformly to all properties in Illinois. The Cook County is characterized by a strong role of local government financing through property taxes and limited reliance on alternative taxes (e.g., sales tax, personal income tax, corporate tax at state level) and it is also an extremely large and diverse housing market. It spans millions of properties that vary widely in type, age, location, and quality. In some regions of the county, sales are common; in other regions, sales are sparse. Accurately estimating the price of such different properties and regions is a complicated, challenging task.

The complexity of property assessment is particularly pronounced in areas characterized by substantial heterogeneity in housing attributes and market values. A notable example is Hyde Park, a Chicago neighborhood that hosts the University of Chicago, where high-value, multi-million-dollar properties are located near the campus. However, market values decline sharply within short distances, particularly south of 63rd Street or west of I-90, creating abrupt price discontinuities. Such spatial volatility poses serious challenges for mass appraisal models, which tend to smooth over sharp breaks unless explicit geographic segmentation is incorporated into the modeling process. The central challenge lies in expanding revenue for schools in low-

income districts, whose own-source fiscal capacity is insufficient to provide adequate education, even when they impose significantly higher property tax rates than wealthier jurisdictions (Youngman, 2016).

While Hyde Park exemplifies this phenomenon, similar valuation complexities are observed across numerous jurisdictions within Cook County. Although the employed appraisal model incorporates neighborhood fixed effects and other locational covariates, effectively capturing high-resolution spatial heterogeneity remains a persistent methodological challenge.

Mass appraisal models rely on sufficient volumes of transaction data to generate accurate price predictions. However, sales data are sparse at both ends of the price spectrum, complicating model calibration for outlier properties. In Cook County, over 90% of transactions occur within the \$50,000 to \$2.5 million range. Properties priced outside this interval are underrepresented in the dataset, limiting the model's predictive accuracy and increasing the likelihood of systematic valuation errors (www.cookcountyassessor.com).

This issue is especially evident in geographically segmented markets with skewed value distributions. For instance, in New Trier Township, the average sale price in 2021 exceeded \$1.2 million, substantially above the county-wide average of approximately \$400,000. Sales at or near the county average are rare in such affluent areas, which increases the risk of overvaluation for lower-value properties located within those same geographic units. The inverse effect is observed in lower-income neighborhoods, where high-value properties may be undervalued due to insufficient comparable sales (www.cookcountyassessor.com).

The Cook County Assessor's Office (www.cookcountyassessor.com) is responsible to calculate a fair market value of the property and on its basis set the amount of property tax required. A fair market value is based on two things: home characteristics and patterns between how other homes' characteristics affected their sale values. To estimate the home value, sales of the similar homes are used, in and around the neighborhood. Because sale values of homes are affected by their characteristics - such as its square footage, age, and location - the system uses statistical modeling to use those characteristics to produce property values for each home. The assessment models consider several different characteristics of homes including, but not limited to building square footage, number of bedrooms, construction type etc. and additional factors such as location, environmental variables (flood risk, noise) and market trends. However, some data might be missed like property condition, lot frontage, land slope, percentage of property above grade, quality of finishes, electrical and utility systems, interior characteristics like finish quality, recent remodeling or kitchen quality, any information about pools, information about location desirability of views. These characteristics are difficult to distinguish between individual properties and may cause larger errors when modelling. For example, an extremely run-down mansion with otherwise high-value characteristics (good location, large number of bedrooms) may be significantly over-assessed, due to our model not accounting for property condition. In case that particular property was under - or over - evaluated, homeowner has a possibility to appeal. This is an important part of procedure

because all the mistakes in the assessment will influence not only the particular property but also have negative consequences for neighbors and similar properties.

For the purpose of assessment, Cook County is divided into three sections. Each triad contains multiple townships. All properties in each triad are reassessed every three years in a triennial cycle. The reports on all assessments are published. Each residential township report shows home sale trends and assessment changes for every neighborhood. This makes the property valuation system transparent and verifiable by individual homeowners.

Residential properties are assessed as of January 1st of the current year, using three to five years of prior sales information. By using multiple sale years, this increases the stability of market value estimates. The Cook County Assessor's Office uses mass appraisal to produce property values. Instead of appraising property one-by-one, mass appraisal looks to the real estate market to detect local trends in property values based on location and characteristics. Those trends are used to estimate the fair market value of each property based on its location and characteristics. Mass appraisal is a way to put fairness into the assessment system.

However, in some cases it may appear that proposed property value is assessed inadequately. Thus property owners have a right to challenge the accuracy of those updated values by filing an appeal. If an appeal seeking a lower fair market value is granted, the property's assessed value is lowered as well.

The property homeowners may appeal to Assessor's Office at first stage. If the date of appeal is missed or the result of appeal is not satisfactory, the next step is to appeal with the Cook County Board of Review. The third and last institution to appeal the property reassessment is the Property Tax Appeal Board.

Property owners receive Reassessment Notices in the mail. The Reassessment Notice contains the updated estimated Market Value of a property, property characteristics, and the deadline date to file an appeal if the property reassessed value is not accurate.

The overall amount of real estate taxes to be collected in particular community is determined, by all local taxing bodies providing services in your community, such as schools, parks, pensions, and library districts. The assessed valuation of the property does determine the share of those taxes.

After the assessor determines the Fair Market Value of the property, the Assessed Value of home is calculated. For residential property owners, the assessed value equals 10% of the fair market value of the home. For most commercial property owners, the assessed value is 25% of the fair market value. This level of assessed value is the taxable amount of the property, as determined by Cook County ordinance.

Then the State Equalization Factor/Multiplier ("State Equalizer") is applied to the assessed value and this creates the Equalized Assessed Value (EAV) for the property.

The State Equalizer is provided by the Illinois Department of Revenue. It utilizes assessed property values as a foundational element for the distribution of state funds across essential public services, including education, infrastructure, and public assistance. In this model,

jurisdictions with higher local property tax revenues receive proportionally less state support, aligning with equity-based fiscal redistribution principles.

Moreover, assessed values are pivotal for determining legal tax and debt limitations within taxing districts, since these caps are partially determined by aggregate assessed property values (Illinois Department of Revenue, n.d.).

To maintain consistency in property taxation across the state, the Department enforces assessment equalization. This process standardizes assessments at 33⅓% of fair cash (market) value by conducting assessment/sales ratio studies, which compare a sample of assessed values with corresponding sales prices. Discrepancies between assessed and market values lead to the calculation of equalization factors, which are then applied uniformly within each jurisdiction.

In non-Cook counties, where assessors aim to meet the 33⅓% standard directly, equalization factors are applied only when assessments deviate from the norm. For instance, in DuPage County, the 2021 equalization factor was 1034, indicating a moderate underassessment. In rare cases of overassessment, a factor below 1 would be used, though this is uncommon.

The Cook County, by contrast, operates under a classified assessment system, where residential properties are assessed at 10% and commercial/industrial at 25% of fair market value. As a result, the aggregate assessment level falls substantially below the statewide benchmark. To achieve parity, Cook County requires an equalization factor significantly greater than 1—historically above 2.0, and occasionally exceeding 3.0 (Illinois Department of Revenue, n.d.). This upward adjustment compensates for both structural classification and chronic underassessment of property (Pappas, 2024).

The Equalization Factor for the Cook County is fluctuating. As it is presented on chart below (Figure 1), the value in 2002 was 2,5% and achieved the maximum level in 2009 (3,4%). Since 2021 it has been rather stable, about 2,9% - 3,0%.

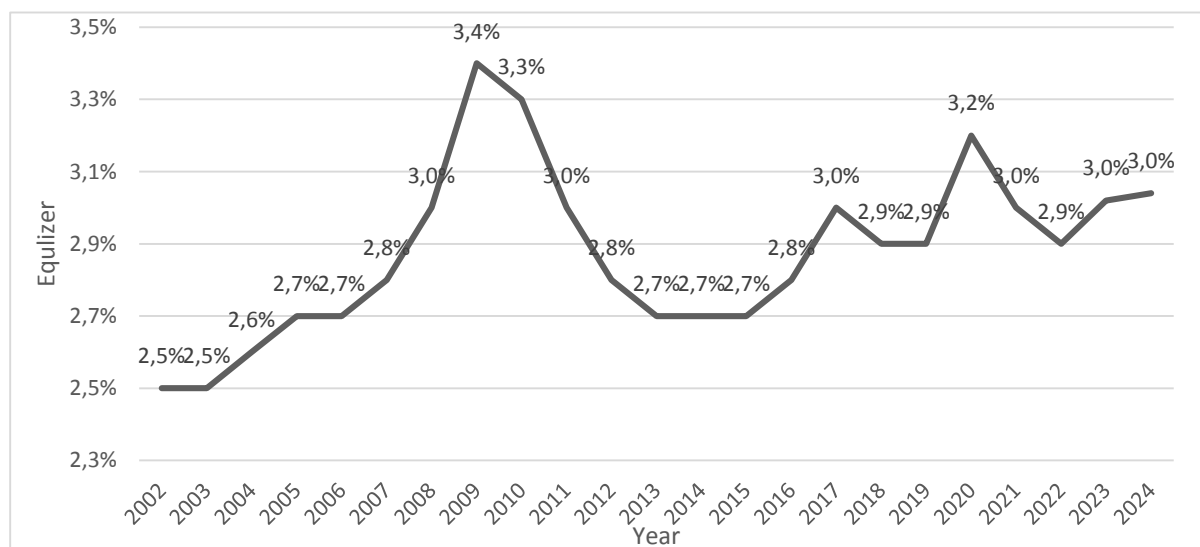


Figure 1. Cook County Equalization.

Source: Pappas, 2024, p. 16.

After the Equalized Assessed Value (EAV) for the property is evaluated, the next step is to calculate the Property Tax Exemptions. Any Exemptions earned by the home are then subtracted from the EAV. Possible exemptions are presented in the table below (Table 2).

Table 2.

The property tax exemptions, benefits and eligibility

Exemption	Benefit	Eligibility
Homeowner (Homestead)	-\$10,000 EAV	Owner-occupied primary residence
Senior Citizen Homestead	-\$8,000 EAV	Age 65+, owner-occupied residence year-round
Senior Assessment Freeze (Senior Freeze)	Freezes EAV at base year	Age 65+, income $\leq$ \$65,000, must qualify for certain benefits
Home Improvement	Up to \$75,000 improvement tax-free for 4 years	For eligible property improvements
Returning Veterans	-\$5,000 EAV	Recently returned active-duty veteran
Disabled Veterans	-\$2,500 / \$5,000 / 100% exemption (based on disability)	Veterans with service-connected disability (30%+)
Disabled Persons	-\$2,000 EAV	Medically verifiable disability
Long-Time Occupant (LOHE)	Caps EAV growth (7-10%) based on income	Lived in home 10+ years, income $\leq$ \$100,000
Senior Citizen Tax Deferral	Loan up to \$7,500, repaid upon sale/death	Age 65+, income $\leq$ \$65,000

Source: own elaboration on the basis Pappas, 2024.

What is worth notice, the Homeowner (Homestead) and Senior Citizen Homestead exemptions offer baseline relief to owner-occupants, with the latter specifically addressing age-related income sensitivity. These serve as foundational mechanisms for preserving housing affordability and residential stability, particularly for aging populations. The Senior Assessment Freeze reflects a shift from one-time relief to long-term stabilization, ensuring that EAV—and thus tax burden—remains fixed for qualifying low-income seniors. This is particularly impactful in gentrifying neighborhoods, where assessment increases may otherwise displace elderly residents.

After any qualified property tax exemptions are deducted from the EAV, the Local Tax Rate is applied to the tax levies for the community. Once those levies are added up, the total is the amount of property taxes that is owed.

In the table below, the example how a tax bill could be calculated is presented. The estimated fair market value is 100.000 USD and a local tax rate is 8%. The Homeowner Exemption values 10.000 USD.

Table 3.

The property tax exemptions, benefits and eligibility

2024 Estimated Fair Market Value	100 000 USD
Assessment Level (10% for residential properties)	x 0,10
2024 Assessed Value	10 000 USD
2024 State Equalizer	x 3,0355
2024 Equalized Assessed Value (EAV)	30 355 USD
2024 Tax Exemptions (f.e. Homeowner Exemption)	-10 000 USD
2024 Adjusted Equalized Assessed Value	20 355 USD
2024 Tax Rate	x 0,08
Estimated Tax Bill in dollars	1 628,40 USD

Source: own elaboration on the basis: Pappas, 2024.

As presented above, in case of property worth 100.000 USD, assuming exemptions valued at 10.000 USD, we may expect 1.628,40 USD property tax. The final value of property tax is determined mostly by the Estimated Fair Market Value which is the basis for the calculation and the State Equalizer.

5. Conclusions and Discussion

The development of a property value-based taxation system presents a significant methodological and administrative challenge. In real estate markets characterized by high heterogeneity, properties often vary widely in terms of type, age, location, and quality of construction. Moreover, spatial variation in locational desirability implies that the volume of property sales—upon which market value estimations are typically based—may be limited in certain areas. As a result, establishing a reliable and equitable fair market value (FMV) becomes particularly complex. These difficulties are further compounded in contexts where the market exhibits considerable structural and transactional diversity, limiting the effectiveness of standard valuation models and necessitating more refined, regionally adaptive assessment methodologies.

The presented property tax system is not without its shortcomings; however, several design features merit particular attention. Although the US property tax system operates under different economic and institutional conditions, it is worth highlighting certain features that make it transparent and understandable to taxpayers.

First and foremost, the system is characterized by a high degree of transparency and specificity, allowing homeowners to access comprehensive information regarding the valuation of their property. Importantly, it includes a clearly defined appeals process in cases where the assessment conducted by the Assessor's Office—applied uniformly across all properties within a given jurisdiction—significantly deviates from the market value of an individual property.

Moreover, the reassessment process is carried out in administrative groups corresponding to specific townships, which facilitates the efficient handling of assessments and appeals and contributes to the smooth functioning of the entire system.

Another noteworthy aspect is the system's capacity to reflect the fiscal needs of local jurisdictions, particularly in financing public services by including the State Equalizer in the tax evaluation process. Additionally, it incorporates a range of tax exemptions, enabling certain taxpayer groups to reduce their effective property tax base and promoting vertical and horizontal tax equity.

Finally, the system promotes public accountability by ensuring that information regarding the tax liability of individual properties is made publicly available through online housing platforms, thus reinforcing both transparency and citizen engagement in the fiscal process.

References

1. Berry, C.R. (2021). *Reassessing the property tax*. The University of Chicago, Available at: SSRN 3800536.
2. Cabral, M., Hoxby, C. (2012). *The hated property tax: salience, tax rates, and tax revolts* (No. w18514). National Bureau of Economic Research.
3. Census.gov, <https://www.census.gov/data/datasets/2022/econ/local/public-use-datasets.html>
4. Dowgier, R. (2021). The Polish system of property taxation. *Prawo Budżetowe Państwa i Samorządu*, no. 3(9), DOI: <http://dx.doi.org/10.12775/PBPS.2021.014>
5. Hunter, L., Bograd, S., Boddupali, A. (2023). *Detroit Considers Shift From Property To Land Value Taxation*. Tax Policy Center, <https://taxpolicycenter.org/taxvox/detroit-considers-shift-property-land-value-taxation>
6. Kelly, R. (2013). Making the Property Tax Work. *ICEPP Working Papers*, 42. <https://scholarworks.gsu.edu/icepp/42>
7. Lincoln Institute of Land Policy and Minnesota Center for Fiscal Excellence (2023). *50-State Property Tax Comparison Study For Taxes Paid in 2022*.
8. Pappas, M. (2024). *How the Illinois Property Tax System Works*. Illinois.
9. The Cook County Assessor Office, <https://www.cookcountyassessor.com/>
10. Wong, F. (2023). *Taxing homeowners who won't borrow*. Available at: SSRN: <https://ssrn.com/abstract=4584189> or <http://dx.doi.org/10.2139/ssrn.4584189>
11. Youngman, J.M. (2016). *A good tax: Legal and policy issues for the property tax in the United States*. Cambridge, MA: Lincoln Institute of Land Policy.
12. Zhao, L., Burge, G. (2016). Housing Wealth, Property Taxes and Labor Supply among Elderly. *Journal of Labor Economics*, vol. 35, no. 1.

ECO-INNOVATION IN PACKAGING: TRENDS AND CHALLENGES IN THE CIRCULAR ECONOMY

Dominik JEZIERSKI

Kielce University of Technology; djezierski@tu.kielce.pl, ORCID: 0009-0002-6344-4939

Purpose: Amid growing concerns over climate change, resource scarcity and plastic waste, the packaging industry faces mounting pressure to transition towards more sustainable solutions. This paper aims to explore the role of eco-innovation in driving this transformation, with a particular focus on its integration into the circular economy framework.

Design/ methodology/ approach: This study is based on a systematic review of the literature, drawing on peer-reviewed academic publications, industry reports, and policy documents. The analysis focuses on identifying the main trends, challenges and opportunities relating to eco-innovation in the packaging sector, and its links with the principles of the Circular Economy (CE), eco-design and Life Cycle Assessment (LCA).

Findings: The review reveals dynamic growth in eco-innovation initiatives within the packaging industry, driven by regulatory pressure, consumer awareness, and technological advancement. Key areas of innovation include biodegradable and recyclable materials, active and intelligent packaging, and circular business models. However, challenges remain, particularly with regard to implementation, standardisation and cost-effectiveness.

Research limitations/ implications: The scope of this study is limited by its reliance on secondary data and available literature, which may overlook some emerging industry practices. Future research could involve quantitative assessments of eco-innovations, or case studies could be conducted to evaluate their real-world application and effectiveness.

Practical implications: The findings could help packaging companies, designers and policymakers to identify areas for innovation and investment. The study highlights practical ways to implement circular principles in packaging design and materials management.

Social implications: Eco-innovation promotes sustainable packaging solutions that reduce environmental pollution and the depletion of resources. It has the power to influence both consumer behaviour and regulatory frameworks. It also supports broader sustainability goals and corporate responsibility initiatives.

Originality/ value: This article contributes a comprehensive overview of eco-innovation in the packaging industry within the context of the circular economy. It offers value to researchers, practitioners and decision-makers seeking to understand and implement sustainable packaging strategies.

Keywords: eco-innovation, packaging, circular economy, life cycle assessment, eco-design.

Category of the paper: Literature review.

1. Introduction

The world today is facing environmental challenges such as climate change, the depletion of natural resources and a sharp increase in waste, particularly plastic waste. The packaging industry is a major contributor to these problems, generating almost a third of the world's plastic waste (Baranski et al., 2011; Miller, 2022).

In response to mounting environmental challenges, including climate change, the depletion of natural resources and excessive waste production and management, particularly of plastics, the concept of eco-innovation emerged in literature in the early 1990s (Dostatni, Rybaczewska-Błażejowska, 2020). Initially, eco-innovation was primarily viewed as a means of reducing environmental risks, but its definition has since broadened to include wider economic advantages and business competitiveness (Fatma, Haleem, 2023; Kemp, Pearson, 2007). Today, it is defined as a strategic enabler of firms' competitiveness and sustainable development goals (Dostatni, Rybaczewska-Błażejowska, 2020).

The concept of eco-innovation is closely linked to the idea of the circular economy (CE), which involves moving away from the traditional 'take-make-waste' model towards regenerative approaches that prioritise reusing, repairing, renewing and recycling materials and products (Baranski et al., 2011; Padilla-Rivera et al., 2024). Eco-innovations are a key driver of this transformation, with the aim of creating closed packaging circuits and addressing the causes of excessive waste production (Dostatni, Rybaczewska-Błażejowska, 2020). The integration of eco-innovations into global sustainability frameworks, such as the UN Sustainable Development Goals (SDGs), demonstrates a worldwide consensus on environmental priorities (Hollanders, Es-Sadki, 2021; Fatma, Haleem, 2023).

Dynamic developments in packaging eco-innovation, the rapid pace of new regulations (e.g. Extended Producer Responsibility – EPR – legislation), evolving consumer preferences for sustainable products and ongoing technological advances in materials and processes, creates a unique environment for accelerated transformation (Pokharel et al., 2023; Versino et al., 2023; Cordeiro et al., 2025; Ahmed, 2018; Kachook, 2025).

This article aims to conduct a comprehensive and systematic literature review of recent trends and advances in eco-innovation within the packaging industry. It will focus on innovations in materials and eco-design principles, the role of Life Cycle Assessment (LCA) and the challenges and opportunities presented by the CE model.

This article is based on a systematic literature review methodology to identify, analyse and synthesise recent trends in eco-innovation in the packaging industry (NCCMT, 2014; Phillips, Barker, 2021; Duke University, 2025). The review process was designed to be transparent, rigorous and replicable, following standards for developing systematic literature reviews, including PRISMA and PRISMA-S guidelines (NCCMT, 2014).

The review process began with the formulation of the following research question: What are the current developments in eco-innovation in the packaging industry, focusing on material innovation, eco-design principles, life cycle assessment applications, and the challenges and opportunities of the circular economy? A comprehensive scientific literature search strategy was then developed based on this question, involving searching multiple databases such as Web of Science, Scopus and ResearchGate (NCCMT, 2014). Sources of scientific publications, such as the repositories of academic publishers Springer Nature and Elsevier, were also searched. Combinations of keywords and terms from the fields of eco-innovation, sustainable packaging, the CE, LCA and eco-design were used to maximise the coverage and relevance of the results (Page et al., 2021; Rethlefsen et al., 2019). The search was limited to English and Polish publications from 2010 onwards (Pokharel et al., 2023; Versino et al., 2023; Cordeiro et al., 2025; Ahmed, 2018; Kachook, 2025). The reference lists of the included articles were manually reviewed to identify additional studies. The websites of key organisations such as the Sustainable Packaging Coalition,ecoinvent, and the European Commission were also consulted. The search strategy was documented according to the PRISMA-S guidelines (Page et al., 2021; Rethlefsen et al., 2019).

Clear inclusion and exclusion criteria were defined to ensure the consistency and relevance of the included studies. The review included peer-reviewed scientific articles, conference papers and credible reports focusing on eco-innovation in the packaging industry; advances in materials; eco-design principles; the application of LCA or CE; and challenges and opportunities. Studies not directly related to packaging, opinion articles, and duplicates were excluded (NCCMT, 2014; Duke University, 2025). The selection process consisted of two phases: first, titles and abstracts were reviewed to eliminate publications that did not meet the criteria; then, a detailed analysis of the full texts of the remaining publications was conducted. A standardised data collection form was developed to gather information on authors, year of publication, study type, and key eco-innovation findings, as well as advances in materials, eco-design principles, LCA applications, and CE challenges and opportunities. The quality of each study was assessed qualitatively, taking into account methodological rigour and relevance. The data were synthesised narratively to allow recurring themes to be extracted and areas for further research to be identified (NCCMT, 2014).

2. Key areas of eco-innovation in packaging

The concept of eco-innovation is rooted in the broader concept of innovation, first defined by Joseph Schumpeter in 1911 (Drucker, 1992). The term began to permeate environmental research in the mid-1990s (Fussler, James, 1996). Initially, eco-innovation was defined as innovation aimed at reducing environmental damage (Yap et al., 2023; Dostatni, Rybaczevska-

Błażejowska, 2020). Rennings (2000) subsequently expanded this definition to include the introduction of new ideas, products and processes that mitigate negative environmental impacts. Over time, the definition has evolved to become more comprehensive, encompassing the production, assimilation or operation of a product, process, service or business method that is new to the organisation and leads to a reduction in environmental risk throughout the lifecycle (Kemp, Pearson, 2007). The European Commission (2013) defined eco-innovation as any innovation that leads to sustainable development by reducing negative environmental impacts or increasing resource efficiency. More recent approaches emphasise that eco-innovation promotes sustainable economic growth while mitigating environmental impacts, making it a key tool for companies aiming to achieve the Sustainable Development Goals (Fatma, Haleem, 2023). Eco-innovation can be classified in various ways, including product, process, and business eco-innovation (OECD, 2018), as well as marketing, organisational (European Commission, 2009), technological, social, and institutional (Dostatni, Rybaczewska-Błażejowska, 2020). Measuring eco-innovation, especially on a national or regional scale, poses many challenges (Smol et al., 2017). At the macro and meso levels, indicators such as the Global Innovation Index (GII) and the European Innovation Scoreboard (EIS) are employed, whereas the Community Innovation Survey (CIS) and LCA are used at the micro level. The latter is a key tool for measuring eco-efficiency (Dostatni, Rybaczewska-Błażejowska, 2020; Rybaczewska-Błażejowska, 2019).

In the field of environmentally friendly packaging materials, the main focus is on finding alternative sources, primarily from renewable resources (Dostatni, Rybaczewska-Błażejowska, 2020). Plant-based bioplastics are developing rapidly, including biodegradable options such as polylactic acid (PLA), polyhydroxybutyrate (PHB) and polyhydroxyalkanoates (PHA), as well as non-biodegradable bio-polyolefins such as bio-polyethylene (bio-PE), bio-polypropylene (bio-PP) and bio-polyethylene terephthalate (bio-PET). These materials have the potential to reduce our dependence on fossil fuels (Cordeiro et al., 2025; Ahmed, 2018; Miller, 2022). Algae-based bioplastics (Yap et al., 2023) and the use of natural materials such as cellulose and bamboo are also advancing (Kędzia, Turek, 2022). The growing interest in biodegradable packaging that meets compostability criteria is a response to the huge amount of waste that does not undergo natural decomposition processes (Dostatni, Rybaczewska-Błażejowska, 2020; Kędzia, Turek, 2022). However, the adoption of these materials is hindered by high prices, limited functional properties, a lack of regulatory support, insufficient consumer knowledge and inadequate infrastructure for industrial composting (Kędzia, Turek, 2022). The use of recycled materials such as rPET and recycled HDPE is also increasing (Kachook, 2025). Around 84% of total PET recycling is accounted for by mechanical recycling of PET (Sadeghi et al., 2021). There is a strong trend towards fibre-based solutions (paper and cardboard) for different types of packaging. There is also a growing demand for mono-material packaging, which is simpler to collect, sort, and recycle. Significant barriers include challenges in sourcing recycled materials and declining consumer confidence in the recycling system. Extended

Producer Responsibility legislation aims to encourage the use of packaging containing a higher proportion of recycled or renewable materials by introducing eco-modulation fees. Multi-material packaging is difficult to separate, posing a challenge to sustainability and leading to a shift towards mono-material packaging and the emergence of specialised recyclers (Kachook, 2025, Dostatni, Rybaczewska-Błażejowska, 2020).

Eco-design is a key strategy for incorporating environmental considerations into product development, with the aim of reducing greenhouse gas emissions and optimising environmental performance throughout a product's life cycle (Pogačar, Gregor-Svetec, 2025; Wei Lun Lee et al., 2023). Key principles include reducing the use of energy and materials, reusing materials, improving product design, and recycling and recovering energy and raw materials (Dostatni, Rybaczewska-Błażejowska, 2020). In practice, material reduction can be achieved by optimising consumption, eliminating unnecessary printing and employing glueless assembly techniques (Pogačar, Gregor-Svetec, 2025). There is also a growing trend towards reuse and refill systems, particularly in the alcohol and cosmetics sectors (Kachook, 2025). Innovative packaging systems, such as active (AP) and intelligent (IP) packaging, play a pivotal role in eco-design. AP interacts with food to extend its shelf life, while IP provides real-time information about the quality and condition of packaged food. These systems promote sustainability by enhancing food safety, extending shelf life and reducing food waste, which is a significant contributor to greenhouse gas emissions (Pokharel et al., 2023; Hemachandra et al., 2024).

Life cycle assessment is a standardised, quantitative management method in line with the international environmental standards ISO 14040:2006 and ISO 14044:2006. It is used to evaluate the potential environmental impact of products and processes throughout their life cycles (Stramarkou et al., 2022; ISO, 2006). LCA is used to evaluate the environmental performance of products and processes, particularly in packaging (Stramarkou et al., 2022). It can be used to compare materials, identify key environmental factors and evaluate trade-offs (Miller, 2022; Cappiello et al., 2022; Paiano et al., 2021; Wei Lun Lee et al., 2023). LCA is also employed in eco-design and to support green procurement (Wei Lun Lee et al., 2023; Rybaczewska-Błażejowska, 2019). It plays a pivotal role in ecodesign evaluation and material selection, facilitating the identification of environmental critical points and suggesting enhancements throughout the packaging lifecycle (Dostatni, Rybaczewska-Błażejowska, 2020). Adopting a comprehensive approach to environmental impact assessment can help to prevent the transfer of environmental issues (Stramarkou et al., 2022; Wei Lun Lee et al., 2023). However, the reliability of LCA results depends on the specificity of local variables and data availability (Miller, 2022; Jezierski, Rybaczewska-Błażejowska, 2022).

The transition to a CE in the packaging industry poses a number of challenges. These include economic issues such as high investment costs and higher prices for CE products; regulatory issues such as inadequate policies; awareness issues such as a lack of education and consumer reluctance to change; and implementation issues such as difficulties in

implementation (Padilla-Rivera et al., 2024; Kędzia, Turek, 2022). A widespread lack of education and awareness of the CE hinders both consumer demand and manufacturers' ability to provide solutions. The CE is perceived as a challenging theoretical concept to implement in practice. Despite these challenges, however, most stakeholders remain optimistic about the future of the CE. Innovation and technology are seen as key drivers of the CE model, and cross-sector collaboration and investment in research and development are essential. There is a clear opportunity for policymakers to create a more comprehensive regulatory framework that includes business incentives and regulations to ensure sustainability (Padilla-Rivera et al., 2024). EPR schemes incorporating an eco-modulation mechanism can effectively encourage the design of more sustainable packaging by levying fees according to environmental impact (Kachook, 2025).

3. Results

A systematic review of the literature confirms that eco-innovation in the packaging industry is developing rapidly in response to global environmental challenges and the need for a transition to a CE. Table 1 summarises the key characteristics, potential environmental benefits and challenges of implementing eco-innovation in the packaging sector.

Table 1.
Eco-innovation in packaging – key areas, benefits and challenges

Eco-innovation	Characteristics/examples	Environmental benefits	Implementation challenges
Evolution and typology	Extended definitions (economic, competitive). Typologies (product, process, social, institutional). Regional CE indicators.	Integration with the SDGs. Holistic approach. Monitorable transformation	Complexity of measurement. Need for a multidisciplinary approach.
Packaging materials	Bioplastics (PLA, PHB, bio-PE, algae). Recycled materials (rPET, rHDPE). Fibrous solutions. Monomaterials.	Reducing the use of fossil raw materials. Closing the material cycle. Improving recycling efficiency.	High costs. Limited functionality. Lack of infrastructure. Low consumer confidence in recycling.
Eco-design	Optimisation of material consumption. Glueless constructions. Refillable systems. Active and intelligent packaging.	Minimise resource consumption. Extend product life cycle. Reduce food waste.	Complexity of the design process. Need to change consumer behaviour.
Life Cycle Assessment	ISO 14040/ 44 methods. Comparison of material alternatives. Identification of key factors. Avoidance of burden shifting.	Quantitative impact assessment. Support for design decisions. Increasing the precision of environmental analyses.	High dependence on local data. Complexity of analysis. Need for contextual interpretation.

Cont. table 1.

Circular economy	Moving away from a linear model. Investment in technology. Sector cooperation; EPR regulation and eco-modulation.	New business models. Resource efficiency. Promoting sustainability.	High initial costs. Inadequate regulation. Lack of consumer awareness. Implementation difficulties. Social issues.

Source: Own study.

As shown in Table 1, eco-innovation in packaging emerges as a complex and multidimensional process. While innovative solutions offer clear environmental benefits, their practical implementation is frequently hindered by technical, economic, and behavioural barriers. These findings form the basis for the subsequent discussion on how such challenges may be addressed through systemic and cross-sectoral efforts.

4. Discussion

The findings of the literature review indicate that the packaging industry is undergoing a complex and dynamic transformation driven by a shift towards sustainability and the CE. Key trends such as the development of bio-based and recycled materials, eco-design and LCA are closely linked and reinforce each other, indicating systemic change rather than individual developments.

Expanding the definition of eco-innovation to include economic and competitive benefits turns sustainability from an ethical duty into a business goal (Kemp, Pearson, 2007; Fatma, Haleem, 2023). Including social and institutional classifications alongside traditional technological and organisational categories recognises that transitioning to sustainability necessitates systemic behavioural, governance and collaborative changes, as well as technological advances. The increasing complexity and multi-level nature of eco-innovation measurement frameworks, which range from macro-level indicators to micro-level LCA and regional CE economy indicators, reflects the maturation of the field and the need for context-specific data that goes beyond general trends.

In the field of materials, a dual-track development strategy encompassing both ‘drop-in’ bio-based plastics and entirely new biodegradable polymers strikes a pragmatic balance between utilising existing infrastructure and achieving radical circularity (Ahmed, 2018). However, the high cost and limited properties of biodegradable materials, coupled with a lack of infrastructure and consumer awareness, suggest that technological advances in materials must be accompanied by investments in education and infrastructure (Kędzia, Turek, 2022). Rather than expecting a single disruptive innovation, the industry is adopting differentiated material strategies, focusing particularly on monomaterials and fibre-based solutions, which are better suited to the limitations of the current recycling infrastructure. The trend towards fibre-

based solutions and the emphasis on monomaterial packaging directly addresses the challenges associated with recycling multi-material packaging (Kachook, 2025). Simplifying the material composition of packaging makes it easier to sort and process, which is essential for increasing recycling efficiency and closing the material cycle.

Eco-design principles extend beyond material selection to prioritise reduction, reuse, and multifunctionality. The growing popularity of refill systems and multifunctional packaging signifies a substantial paradigm shift, shifting the focus from single-use products to maximising their lifespan and minimising the demand for new production (Pogačar, Gregor-Svetec, 2025; Kachook, 2025). The integration of active and smart packaging into eco-design principles shows how advanced technologies can promote sustainability and reduce environmental impact by minimising food waste throughout the supply chain (Pokharel et al., 2023; Hemachandra et al., 2024). Despite the potential material footprint of active and smart packaging, the growing emphasis on these technologies represents a significant change in eco-design thinking, shifting the focus from the environmental impact of the packaging itself to that of the packaged product (e.g. food waste).

Life cycle assessment is an indispensable tool in this process. It provides comprehensive data for environmental impact assessment and supports informed design decisions (Stramarkou et al., 2022; Wei Lun Lee et al., 2023). However, it is important to bear in mind that the reliability of LCA results depends heavily on the specificity of local variables and the availability of data. This means that generalised, global studies may only be illustrative and require contextual verification (Rybczewska-Błazejowska, Jezierski, 2024; Jezierski, Rybczewska-Błazejowska, 2022; Miller, 2022). The plastic bottle versus paper bottle case study clearly demonstrates the risk of transferring environmental problems in LCA. It shows that improving sustainability is often about optimising complex systems rather than identifying simple ‘good versus bad’ material choices. This requires constant re-evaluation and context-specific solutions (Jezierski, Rybczewska-Błazejowska, 2022).

The challenges of transitioning to a CE are multidimensional and include economic, regulatory, awareness-related and implementation-related barriers (Padilla-Rivera et al., 2024; Kędzia, Turek, 2022). These challenges demonstrate that the transition to a CE is a complex socio-economic and political issue rather than a purely technological one. This means that technological innovation alone will be insufficient; coordinated action in terms of policy, education and market incentives is also required. The multifaceted barriers to implementing the CE reveal a fundamental gap between theoretical aspirations and practical realities. This strongly suggests that technological solutions alone are insufficient, and that systemic, behavioural, and policy changes are also required. Nevertheless, the general optimism and opportunities arising from innovation, policy reinforcement (e.g. extended producer responsibility), cross-sectoral collaboration, and local adaptation point to real prospects for success. Adopting existing informal practices (e.g. repair) to implement the CE suggests

a culturally integrated, bottom-up approach that can complement top-down policies and technological advancements (Padilla-Rivera et al., 2024).

Although advances in packaging technologies and regulatory frameworks encourage the implementation of eco-innovation, consumer behaviour plays a significant role in this process. Studies show that many consumers are reluctant to use eco-friendly packaging due to higher costs, a lack of information, attachment to familiar solutions, scepticism towards ‘eco’ labels and concerns about product aesthetics (Kędzia, Turek, 2022; Padilla-Rivera et al., 2024). Conversely, certain groups of consumers (e.g. younger generations and those with higher levels of education) are more likely to make pro-environmental choices (Fatma, Haleem, 2023; Jarzabek, Stolarska-Szeląg, 2024). Understanding the social and psychological factors that influence purchasing decisions is crucial for the successful implementation of CE packaging solutions. A sociological perspective also emphasises the importance of ‘social consent’ and group norms in determining the acceptance of new solutions (Stolarska-Szeląg, 2022).

5. Conclusion and recommendations

The results of the systematic literature review indicate that eco-innovation in the packaging industry is a dynamic and multifaceted field that is crucial for the transition to CE. Significant progress has been made in developing sustainable materials, applying eco-design principles and using environmental assessment methods such as LCA. However, the full implementation of these innovations faces major economic, regulatory and behavioural barriers. This suggests that the transformation involves not only technology, but also complex socio-economic and political dimensions, requiring coordinated action at multiple levels.

In order to increase the practical relevance of this study and address the identified challenges, the recommendations set out in Table 2 should be implemented. These recommendations have been ranked according to their expected impact and feasibility.

Table 2.
Priority actions for accelerating eco-innovation in packaging

Priority level	Recommended action	Rationale
High impact/ high feasibility	Integrate eco-design principles into standard packaging development processes	Reduces environmental impact and resource use across the life cycle
	Enforce EPR schemes with eco-modulation	Provides economic incentives aligned with sustainability goals
	Launch consumer education and awareness campaigns	Addresses resistance due to knowledge gaps, trust issues, and habitual behaviour
High impact/ medium feasibility	Develop standardised sustainability metrics and harmonised LCA databases	Improves comparability and credibility of eco-innovation efforts
	Invest in scalable infrastructure for recycling and composting bio-based materials	Enables practical implementation of new packaging materials

Cont. table 2.

Medium impact/ high feasibility	Promote industry-wide collaboration and best practice sharing through cross-sectoral platforms	Accelerates the diffusion of innovation and avoids duplication of effort
	Conduct targeted empirical studies on consumer behaviour and preferences regarding eco-packaging	Provides evidence for policy, design, and communication strategies
High impact/ low feasibility	Integrate CE principles into national and EU-level packaging legislation with measurable targets	Provides systemic change, but requires strong political will and stakeholder alignment

Source: Own study.

Implementing these recommendations could significantly improve the uptake and impact of eco-innovation in the packaging sector. Further research should examine the socio-economic factors influencing adoption and evaluate the long-term environmental performance of new materials. The effectiveness of policy instruments and behavioural interventions in different contexts should also be assessed.

References

1. Ahmed, S. (Ed.). (2018). *Bio-based materials for food packaging: Green and sustainable advanced packaging materials*. Singapore: Springer. <https://doi.org/10.1007/978-981-13-1909-9>.
2. Barański, A., Gworek, B., Bojanowicz-Bablok, A. (2011). *Ocena cyklu życia: Teoria i praktyka* [In Polish]. Publishing house of the Institute of Environmental Protection.
3. Cappiello, G., Aversa, C., Genovesi, A., Barletta, M. (2022). Life cycle assessment (LCA) of bio-based packaging solutions for extended shelf-life (ESL) milk. *Environmental Science and Pollution Research*, 29, 18617-18628. <https://doi.org/10.1007/s11356-021-17094-1>.
4. Cordeiro, A., Hussain, M., Ramachandran, T., Beemkumar, N., Kumar, R., Karthikeyan, A., Bupesh Raja, V.K., Thatoi, D.N., Mahapatro, A., Nanda, J., Prakash, C., Patil, A.Y. (2025). Advancements in packaging materials: Trends, sustainability, and future prospects. *Circular Economy and Sustainability*. <https://doi.org/10.1007/s43615-025-00586-4>.
5. Dostatni, E., Rybaczewska-Błazejowska, M. (2020). *Tworzenie ekoinnowacji* [In Polish]. Polish Economic Publishing House.
6. Drucker, P.F. (1992). *Innowacja i przedsiębiorczość: Praktyka i zasady* [In Polish]. Polish Economic Publishing House.
7. Duke University (2025). *Systematic reviews: Manuals and reporting guidelines*. Duke University Medical Center Library. Retrieved from: <https://guides.mclibrary.duke.edu/sysreview/manuals>, July 5, 2025.
8. European Commission (2009). *Eco-innovation*. Retrieved from: https://ec.europa.eu/environment/pubs/pdf/factsheets/eco_innovation/pl.pdf, May 26, 2021.

9. European Commission (2013). *Ekoinnowacje, klucz do przyszłej konkurencyjności Europy* [In Polish]. Retrieved from: <https://ec.europa.eu/environment/pubs/pdf/factsheets/ecoinnovation/pl.pdf>, May 29, 2021.
10. Fatma, N., Haleem, A. (2023). Exploring the nexus of eco-innovation and sustainable development: A bibliometric review and analysis. *Sustainability*, 15(16), 12281. <https://doi.org/10.3390/su151612281>.
11. Fussler, C., James, P. (1996). *Driving eco-innovation: A breakthrough discipline for innovation and sustainability*. Pitman Publishing.
12. Hemachandra, S., Hadjikakou, M., Pettigrew, S. (2024). A scoping review of food packaging life cycle assessments that account for packaging-related food waste. *The International Journal of Life Cycle Assessment*, 29(10), 1899-1915. <https://doi.org/10.1007/s11367-024-02349-z>.
13. Hollanders, H., Es-Sadki, N. (2021). *European Innovation Scoreboard 2021*. Publications Office of the European Union.
14. ISO (2006). *Environmental management – Life cycle assessment – Principles and framework (ISO Standard No. 14040:2006)*. International Organization for Standardization.
15. Jarząbek, K., Stolarska-Szeląg, E. (2024). Influence of education on improving the employment prospects of individuals with disabilities. *Journal of International Studies*, 17(3), 38–50. <https://doi.org/10.14254/2071-8330.2024/17-3/2>.
16. Jezierski, D., Rybaczewska-Błazejowska, M. (2022). Assessment of new trends in product packaging using the LCA method: A case study of a conventional plastic bottle versus an eco-innovative paper bottle. *Communications of International Proceedings*, 5, Article 4051422.
17. Kachook, O. (2025). *2025 sustainable packaging trends report (Version 1.0) [Report]*. Sustainable Packaging Coalition and GreenBlue. https://sustainablepackaging.org/wp-content/uploads/2025/04/2025-Packaging-Innovations-Trends-Report_SPC_03_compressed.pdf
18. Kędzia, G., Turek, J. (2022). What hinders the development of a sustainable compostable packaging market? *European Journal of Sustainable Development*, 11(4), 180. <https://doi.org/10.14207/ejsd.2022.v11n4p180>.
19. Kemp, R., Pearson, P. (2007). *Final report MEI project about measuring eco-innovation (Deliverable 15, Project No. 044513)*. UM-MERIT. <https://lab.unu-merit.nl/wp-content/uploads/2021/05/Final-report-MEI-project-about-measuring-eco-innovation-1.pdf>
20. Miller, S.A. (2022). The capabilities and deficiencies of life cycle assessment to address the plastic problem. *Frontiers in Sustainability*, 3, 1007060. <https://doi.org/10.3389/frsus.2022.1007060>
21. NCCMT (2014). *Anatomy of a systematic review*. National Collaborating Centre for Methods and Tools. http://www.nccmt.ca/pubs/FactSheet_AnatomySR_EN_WEB.pdf

22. OECD, Eurostat (2018). *Oslo Manual 2018: Guidelines for collecting, reporting and using data on innovation*. OECD Publ. <https://doi.org/10.1787/9789264304604-en>.
23. Padilla-Rivera, A., Morales Brizard, M., Merveille, N., Güereca-Hernandez, L.P. (2024). Barriers, challenges, and opportunities in the adoption of the circular economy in Mexico: An analysis through social perception. *Recycling*, 9(5), 71. <https://doi.org/10.3390/recycling9050071>.
24. Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>.
25. Paiano, A., Gallucci, T., Pontrandolfo, A., Crovella, T., Lagioia, G. (2021). The environmental performance of glass and PET mineral water bottles in Italy. In: S.S. Muthu (Ed.), *Sustainable packaging* (pp. 1-30). Springer. https://doi.org/10.1007/978-981-16-4609-6_1
26. Phillips, V., Barker, E. (2021). Systematic reviews: Structure, form and content. *J. of Perioperative Practice*, 31(9), 349-353. <https://doi.org/10.1177/1750458921994693>.
27. Pogačar, A., Gregor-Svetec, D. (2025). Eco-friendly design for sustainable gift packaging. *Applied Sciences*, 15(6), 2973. <https://doi.org/10.3390/app15062973>
28. Pokharel, B., Keerthi, R.S.S., Abunamous, Z.H.H. (2023). Advancements in food processing technologies: Enhancing safety, quality, and sustainability. *International Journal of Scientific Research in Engineering and Management (IJSREM)*, 7(6). <https://doi.org/10.55041/IJSREM23682>
29. Rennings, K. (2000). Redefining innovation – eco-innovation research and the contribution from ecological economics. *Ecological Economics*, 32(2), 319-332. [https://doi.org/10.1016/S0921-8009\(99\)00112-3](https://doi.org/10.1016/S0921-8009(99)00112-3)
30. Rethlefsen, M., Ayala, A.P., Kirtley, S., Koffel, J., Waffenschmidt, S. (2019). *PRISMA-S: PRISMA search reporting extension*. OSF. <https://doi.org/10.17605/OSF.IO/YGN9W>
31. Rybaczewska-Błazejowska, M. (2019). *Eco-innovation and eco-efficiency in the frame of life cycle assessment*. Publishing House of Kielce University of Technology.
32. Rybaczewska-Błazejowska, M., Jezierski, D. (2024). Comparison of ReCiPe 2016, ILCD 2011, CML-IA baseline and IMPACT 2002+ LCIA methods: A case study based on the electricity consumption mix in Europe. *International Journal of Life Cycle Assessment*, 29, 1799-1817. <https://doi.org/10.1007/s11367-024-02326-6>
33. Sadeghi, B., Marfavi, Y., AliAkbari, R., Kowsari, E., Ajdari, F.B., Ramakrishna, S. (2021). Recent studies on recycled PET fibers: Production and applications: A review. *Materials Circular Economy*, 3(4), <https://doi.org/10.1007/s42824-020-00014-y>
34. Smol, M., Kulczycka, J., Avdiushchenko, A. (2017). Circular economy indicators in relation to eco-innovation in European regions. *Clean Technologies and Environmental Policy*, 19(4), 669-678. <https://doi.org/10.1007/s10098-016-1323-8>

35. Stolarska-Szeląg, E. (2022). Gemba walk in manufacturing companies – Implementation process and benefits. *Humanitas University's Research Papers Management*, 23(4), 63-76. <https://doi.org/10.5604/01.3001.0016.2178>
36. Stramarkou, M., Boukouvalas, C., Koskinakis, S.E., Serifi, O., Bekiris, V., Tsamis, C., Krokida, M. (2022). Life cycle assessment and preliminary cost evaluation of a smart packaging system. *Sustainability*, 14(12), 7080. <https://doi.org/10.3390/su14127080>
37. Versino, F., Ortega, F., Monroy, Y., Rivero, S., López, O.V., García, M.A. (2023). Sustainable and bio-based food packaging: A review on past and current design innovations. *Foods*, 12(5), 1057. <https://doi.org/10.3390/foods12051057>
38. Wei Lun Lee, A., Ying Chung, S., Shee Tan, Y., Mun Ho Koh, S., Feng Lu, W., Sze Choong Low, J. (2023). Enhancing the environmental sustainability of product through ecodesign: A systematic review. *Journal of Engineering Design*, 34(10), 814-843. <https://doi.org/10.1080/09544828.2023.2261094>
39. Yap, X.Y., Gew, L.T., Khalid, M., Yow, Y.-Y. (2023). Algae-based bioplastic for packaging: A decade of development and challenges (2010-2020). *Journal of Polymers and the Environment*, 31, 833-851. <https://doi.org/10.1007/s10924-022-02620-0>.

**FINANCIAL INCLUSION AND TERRITORIAL COHESION:
CONTRIBUTIONS OF POLISH CREDIT COOPERATIVES**

Javier JORGE-VAZQUEZ¹, Beatriz María SASTRE-HERNANDEZ²,
Sergio Luis NAÑEZ ALONSO³, Konrad KOLEGOWICZ⁴,
Bernard ZIEBICKI⁵, Michał PRUSINOWSKI⁶

¹ Catholic University of Ávila, DEKIS Reseach Group; javier.jorge@ucavila.es, ORCID: 0000-0003-3654-7203

² Catholic University of Ávila, DEKIS Reseach Group; bmaria.sastre@ucavila.es, ORCID: 0000-0003-2626-489

³ Catholic University of Ávila, DEKIS Reseach Group; sergio.nanez@ucavila.es, ORCID: 0000-0001-5353-2017

⁴ Krakow University of Economics; kolegowk@uek.krakow.pl, ORCID: 0000-0002-3558-550X

⁵ Krakow University of Economics; ziebicki@uek.krakow.pl, ORCID: 0000-0003-3628-8264

⁶ University of Szczecin, Institute of Economics and Finance; michal.prusinowski@usz.edu.pl,
ORCID: 0000-0002-1347-9888

* Correspondence author

Purpose: The aim of this study is to analyze the role of credit unions (SKOKs – Spółdzielcze Kasy Oszczędnościowo-Kredytowe) in promoting financial inclusion and their impact on regional economic development in Poland. Particular emphasis is placed on assessing the spatial distribution of these institutions and identifying their contribution to improving access to financial services in areas at risk of financial exclusion.

Design/methodology/approach: The study adopts a quantitative approach, combining spatial analysis techniques with econometric modeling using Ordinary Least Squares (OLS) regression. The analysis covers data on the number of SKOK branches in Poland from 2010 to 2020, along with selected socio-economic variables (income levels, employment, entrepreneurship, population density) at the voivodeship (regional) level. The objective is to identify the relationships between the presence of SKOKs and indicators of local development and financial inclusion.

Findings: The findings confirm a significant positive impact of credit unions on financial inclusion and regional economic development thus directly supporting SDG 1.4 (access to basic services) and SDG 8.10 (strengthen capacity of domestic financial institutions). SKOKs are more frequently present in regions with lower GDP per capita, higher unemployment, and lower business density, indicating their role in compensating for the lack of commercial financial institutions. Correlation and regression analyses reveal negative relationships between SKOK density and levels of economic development, which supports the hypothesis that credit unions perform a supportive function in economically disadvantaged areas.

Research limitations/implications: One limitation of the study is its macro-regional character, as the analysis was conducted at the voivodeship level, which may not capture micro-regional or local effects. Additionally, the regression model is based on cross-sectional data, which limits the ability to draw causal inferences. Future research should consider panel data analysis and extend the spatial scope to include counties or municipalities.

Practical implications: The study provides practical insights for public policy in combating financial exclusion. The results support the need to strengthen the role of SKOKs in regional development policies and to support their presence in areas at risk of financial marginalization. From the perspective of policymakers and financial market regulators, the findings justify the promotion of the cooperative model as an effective tool for supporting local development.

Social implications: The research highlights the potential positive role of SKOKs in reducing territorial disparities and fostering socio-economic integration of residents in less developed regions. By providing access to basic financial services, these institutions can stimulate economic activity, improve quality of life, and strengthen social cohesion. More broadly, the presence of SKOKs contributes to the achievement of the Sustainable Development Goals (SDGs), particularly in terms of poverty reduction and the promotion of inclusive economic growth. Specifically, SKOK's greater presence in impoverished rural areas facilitates the achievement of goal 1.4 (universal access to basic financial services). Similarly, the density of SKOK branches per 100,000 inhabitants acts as a proxy for institutional capacity to promote inclusive growth.

Originality/value: This study adds new value to the literature by offering the first nationwide analysis of the impact of SKOKs on regional development and financial inclusion in Poland, using spatial and econometric methods. Previous studies have typically focused on selected regions or qualitative aspects; this study identifies systemic relationships and provides empirical evidence valuable for academics, policymakers, and economic practitioners.

Keywords: Financial inclusion, credit cooperatives, economic development, spatial analysis, financial exclusion.

Category of the paper: Research paper.

1. Introduction

The role of social economy entities in promoting the economic development of the territories in which they operate is a topic widely analyzed in the economic literature. Numerous studies have demonstrated the ability of these organizations to stimulate job creation, support social cohesion, and contribute to endogenous economic growth (Evans, Syrett, 2007; Greffe, 2008; Mozas Moral et al., 2020; Jorge-Vázquez et al., 2019; Jorge-Vázquez et al., 2021). Among the entities that make up the social economy, credit unions play a key role by facilitating access to financial services in regions with lower levels of economic development, which are characterized by limited access to traditional financing.

In this context, the relationship between the financial system and local economic development has attracted growing interest in the academic community in recent years. Various studies indicate that the availability of banking services is a significant factor stimulating economic activity, particularly in areas affected by financial exclusion (Allen et al., 2018; Helhel, 2018; Altay et al., 2020). Access to credit and other financial services enables local economic entities to use key tools for the development of entrepreneurship, productive investment, and the improvement of the socio-economic conditions of local communities. In this context, credit unions are consolidating their position as strategic players, as their

cooperative structure and focus on social benefits allow them to operate in areas where the profitability of commercial banking institutions is lower, thereby mitigating the negative effects of financial exclusion.

At the same time, the concept of financial inclusion has become a key element of the political agenda of international organizations and national governments, constituting one of the fundamental tools for reducing poverty and promoting economic equality. The United Nations 2030 Agenda has emphasized the importance of expanding access to financial services as a means to achieve sustainable and inclusive economic development (Demirguc-Kunt et al., 2017; Albert et al., 2024). In this regard, the academic literature has addressed the topic of financial inclusion from various perspectives and in different geographical contexts, covering studies relating to Asia, Africa, Latin America, and Europe (Aziz et al., 2021; Girón et al., 2022; Orazi et al., 2019; Náñez Alonso et al., 2020, 2022). However, there are few works analyzing the specific contribution of credit unions to the achievement of financial inclusion goals from a territorial perspective and in the context of the Sustainable Development Goals.

In this context, this chapter aims to analyze the impact of credit unions on regional economic development and financial inclusion in Poland. To this end, an empirical study was conducted using spatial analysis techniques and statistical modeling to assess the impact of the presence of these institutions in various Polish voivodeships. In particular, the study examined the geographical distribution of credit union branches and their relationships with key socio-economic variables, such as income level, unemployment rate, number of enterprises, and population density. This methodological approach makes it possible to identify areas at greater risk of financial exclusion and to assess the role of cooperatives in stimulating local economic activity.

The structure of the chapter is as follows: first, the theoretical framework is presented, including a review of the existing literature on financial inclusion, regional economic development, and the role of credit unions in these processes. Next, the adopted methodology of the empirical study is described, with a detailed discussion of the research hypotheses, sample selection, data sources, and analytical techniques used. The following section presents and discusses the results obtained, analyzing the impact of credit unions on financial inclusion and regional economic development in Poland. The chapter concludes with a synthesis of the main findings, offering recommendations for shaping public policy aimed at strengthening the presence and impact of credit unions in regions with limited access to financial services.

2. The Importance of Financial Inclusion in Economic Development

Financial inclusion has established itself as a key objective in the global political and economic agenda, due to its close connection with sustainable economic development, poverty reduction, and the promotion of social equality. According to the World Bank (2014), financial inclusion is defined as the access of individuals and businesses to useful and affordable financial products and services (payments, savings, credit, and insurance) that meet their needs and are provided in a responsible and sustainable manner.

From a macroeconomic perspective, various studies indicate that access to formal financial services is a key determinant of economic growth, as it facilitates investment, capital accumulation, and economic stability (Demirguc-Kunt et al., 2017). In this context, the literature has shown that a higher level of financial inclusion is directly correlated with improvements in key indicators such as GDP per capita, business productivity, and the economy's resilience to financial crises (Sethi, Acharya, 2018; Dahiya, Kumar, 2020).

However, despite advances in the digitization of financial services, financial exclusion remains a structural problem in many economies, both in developing countries and in advanced economies. In Europe, rural areas and regions with lower population density face greater difficulties in accessing banking services, which deepens territorial inequalities and limits opportunities for local economic development (Korzeb et al., 2019). In this context, credit unions have become key entities in mitigating these inequalities by offering accessible financial services tailored to the needs of local communities.

3. Credit cooperatives and their contribution to financial inclusion

Credit cooperatives, as part of the social economy sector, play a key role in providing financial services in areas where commercial banking does not find sufficient incentives to operate. These entities are characterized by a management model based on democratic member participation, a focus on social benefits, and a concentration on financing small and medium-sized enterprises as well as sectors traditionally excluded from the financial system (Cornée et al., 2018).

Various studies highlight the positive impact of credit cooperatives on financial inclusion. For example, research conducted in Asia and Africa has shown that these institutions facilitate access to basic financial products, enabling disadvantaged communities to improve their ability to save and invest (Aziz et al., 2021; Girón et al., 2022). In the case of Latin America and Europe, studies such as those by Orazi et al. (2019) indicate that the presence of credit

cooperatives is associated with a higher level of financial inclusion and greater economic stability in the regions where they operate.

From a geographical point of view, financial inclusion can be analyzed from two main perspectives:

1. **Geographical access**, defined by the proximity of the population to a formal financial institution. This factor is crucial in rural areas, where the distance to commercial banks can be a significant barrier.
2. **Socio-economic access**, related to the affordability of financial products and the population's ability to use them without economic constraints.

In this study, the first perspective was adopted, and spatial analysis techniques were used to assess the geographical distribution of credit cooperatives in Poland and their impact on financial inclusion.

4. Credit Cooperatives and Local Economic Development

The financial system plays a key role in stimulating local economic activity, as it facilitates investment, supports entrepreneurship, and creates jobs (Demetriades, Hook Law, 2006; Allen et al., 2018). In this context, credit cooperatives, by focusing on financing small businesses and local productive sectors, make a significant contribution to endogenous economic development.

Previous studies have analyzed the contribution of these institutions to regional development. Lal (2018a) demonstrated that the expansion of credit cooperatives in rural areas had a direct impact on poverty reduction and the improvement of socio-economic conditions. Similarly, Lakshmi and Visalakshmi (2013) concluded that the presence of financial cooperatives is essential for ensuring economic stability in regions with limited access to commercial banking.

In the case of Poland, some studies have addressed the relationship between credit unions and economic development in specific contexts. For example, Ryszkowska et al. (2018) analyzed the role of the social economy in the socio-economic development of the Podlaskie Voivodeship, while Łukaszuk (2020) examined the impact of credit unions on financing the agricultural sector in the same region. However, to date, no nationwide study has been conducted that analyzes the contribution of these institutions to regional development in Poland.

5. Empirical Study

5.1. Research Hypotheses

Based on the literature review and analysis of the theoretical framework, the following research hypotheses have been formulated:

Hypothesis 1 (H1):

Credit unions make a significant contribution to improving the level of financial inclusion in Poland.

This hypothesis is based on the assumption that the geographical distribution of credit unions is a key factor influencing the population's access to formal financial services. Since credit unions are more present in rural areas and in regions with lower banking density, their impact on financial inclusion is significant. Previous studies have shown that the expansion of these institutions helps to reduce the financial gap and improve the availability of banking products and services in traditionally underserved areas (Beck, 2016; Náñez Alonso et al., 2022).

Hypothesis 2 (H2):

The presence of credit unions has a positive impact on the economic development of Polish voivodeships, supporting employment, the growth of entrepreneurship, and economic stability.

The formulation of this hypothesis is based on empirical evidence indicating a relationship between the activities of credit unions and the stimulation of the local economy. It is expected that in regions where these institutions have a greater presence, there will be lower unemployment rates, a higher number of small and medium-sized enterprises, and greater economic stability compared to regions with limited access to these financial services (Altay, Topcu, 2020; Korzeb et al., 2019).

5.2. Materials and Methods

The empirical part of the study included the following stages:

Stage 1. Definition of the theoretical framework and formulation of hypotheses

In this phase, the theoretical foundations on which the empirical study was based were established. In particular, the role of credit unions in financial inclusion and economic development was analyzed, using a documentary study based on a review of the existing academic literature. Previous studies on financial inclusion, regional development, and the impact of cooperative banks were identified, and research hypotheses were formulated based on their results and conclusions.

Stage 2. Selection and collection of data

In this phase, the research population was defined, comprising 3557 credit union branches in Poland, based on data published by the National Bank of Poland (Narodowy Bank Polski), using its advanced search engine to gather information on the geographical distribution of these

institutions at the voivodeship, municipality, and postal code levels. At the same time, socio-economic data were collected from various official sources, such as the Polish Statistical Portal (GUS), regarding variables such as population, number of enterprises, unemployment rate, income, and wages, creating a second dataset consisting of 1957 records. Lubelskie, Podlaskie, Mazowieckie, and Śląskie were selected because they represent the 15th, 25th, 75th, and 85th percentiles of GDP per capita and business density, ensuring a clear contrast between lagging and advanced regions.

Stage 3. Spatial analysis of the distribution of credit unions

To assess the contribution of cooperatives to financial inclusion, a spatial distribution analysis was conducted based on previous methodologies used in studies on the accessibility of banking services in Europe and other regions (Stix, 2020a, 2020b; Beckmann et al., 2018; Chen, Strathearn, 2020; Delaney et al., 2019; Caddy, Zhang, 2021; Náñez Alonso et al., 2022a). This analysis made it possible to determine the density and distribution of credit unions in various Polish voivodeships, enabling the identification of areas with limited access to these services.

Stage 4. Statistical modeling to assess economic impact

To test the hypothesis regarding the impact of the presence of cooperative banks on the regional development of Polish voivodeships, and specifically the impact of credit union branches on economic variables, an econometric model based on ordinary least squares (OLS) regression was implemented. The relationship between changes in the number of credit union branches and key economic variables—such as changes in the unemployment rate, number of enterprises, population growth, wages, and income—was established. These models made it possible to estimate the impact of cooperative activity on the economic development of regions and to validate Hypothesis 2.

The general model for each voivodeship is as follows:

$$COOPBB = \beta_0 + \beta_1 * INC + \beta_2 * POP + \beta_3 * NCOM + \beta_4 * UNEM + \beta_5 * SAL + \varphi_i + \varepsilon_i$$

The variable (COOPBB) represents the number of credit unions present in each voivodeship during the study period ($i = 1, \dots, n$) from 2010 to 2020. φ_i denotes the unobserved individual effects variable, and ε_i is the error term. The variable (POP) refers to changes in population during the analyzed period, the variable (NCOM) indicates the number of enterprises in each voivodeship, the variable (UNEMP) refers to changes in the unemployment rate in a given region during the study period, the variable (SAL) represents changes in wages, and the variable (INC) reflects changes in income in each voivodeship from 2010 to 2020.

Stage 5. Analysis and discussion of results

The results obtained from the spatial analysis and the linear regression statistical model were analyzed and interpreted. The findings were compared with previous scientific studies. The limitations of the study were also discussed.

Stage 6. Conclusions

Finally, the main research findings were synthesized, highlighting the role of credit unions as entities supporting financial inclusion and stimulating economic development at the regional level.

5.3. Analysis and Discussion of Results

Cooperative banks and credit unions play a significant role in financial inclusion, particularly in regions with limited access to traditional banking services. In Poland, there are approximately **3556 credit union branches** distributed across all voivodeships. This analysis examines whether the number of cooperative banks in specific regions is linked to key economic indicators such as regional GDP per capita, population, number of enterprises, unemployment rate, and wages.

The aim is to statistically determine (using correlation and regression analysis) whether these institutions are concentrated in economically less developed areas and whether they contribute to financial inclusion and local development in regions with lower GDP and fewer businesses.

Distribution and Economic Context in 2020:

- Spatial analysis confirms that **credit unions are more densely located in poorer and more rural regions**, while wealthier or more industrialized voivodeships show a lower ratio of credit unions per capita.
- For example, eastern regions like Lubelskie, Podlaskie, and Warmińsko-Mazurskie—characterized by lower GDP per capita and higher unemployment—have a higher presence of credit unions.
- In contrast, regions such as Warszawski Stołeczny, Śląskie, and Wielkopolskie, which generate the majority of Poland's GDP and have higher levels of urbanization and business activity, tend to have fewer credit unions per resident.

Empirical findings:

- Recent research using spatial analysis and econometric modeling demonstrates that **credit unions have a significant positive influence on local economic development and financial inclusion** in Polish voivodeships.
- Their presence is associated with **better access to financial services in underserved areas**, supporting entrepreneurship, job creation, and economic stability.
- The impact is especially pronounced in rural and economically disadvantaged regions, where credit unions help bridge the gap left by commercial banks and contribute to reducing territorial inequalities.

In summary, credit unions in Poland are strategically positioned in less developed and rural regions, where they play a crucial role in improving access to financial services and supporting local economic growth.

Table 1.*Credit Union Branches per 100,000 Inhabitants/Voivodeship*

Region (Voivodeship)	Credit Union Branches per 100,000 Inhabitants	GDP per capita (2020)	Enterprises per 1000 Inhabitants	Unemployment (%) 2020
Lubelskie (east, rural area)	16.0 (High)	5,994 (High)	92 (Low)	8.2 (High)
Podlaskie (northeast, rural area)	13.6 (High)	6,317 (High)	93 (Low)	7.8 (High)
Mazowieckie (central, capital)	9.1 (Medium)	7,656 (Very high)	164 (Very high)	5.2 (Low)
Śląskie (south, industrial)	5.6 (Low)	6,491 (Medium)	110 (Medium)	4.9 (Low)

Source: own elaboration.

Regions such as Lubelskie, Podlaskie, Świętokrzyskie, and Opolskie (with lower GDP per capita and a more agricultural character) show the highest density of credit union branches (ranging from approximately 10 to 16 per 100,000 inhabitants). In comparison, more developed voivodeships such as Mazowieckie (including Warsaw) or Pomorskie (Tricity) have between 6 and 9 branches per 100,000 inhabitants, while Śląskie (industrial Silesia) records the lowest density (~5.6/100,000). This distribution initially suggests that credit unions are primarily concentrated in less urbanized and economically weaker areas, filling the gap where commercial banking is less present.

To verify this hypothesis, Pearson correlation coefficients were calculated between the number of credit unions (normalized to population) and selected economic indicators for each voivodeship.

The results show that GDP per capita exhibits a correlation of approximately -0.47 with the density of credit unions (a negative correlation). This means that a greater presence of credit unions occurs in regions with lower GDP per capita. Poorer regions tend to have more credit unions per capita, which suggests that these institutions fill a financial gap in less economically developed areas.

For the second variable analyzed—the number of enterprises per capita—a correlation of approximately -0.61 was obtained (stronger and negative). This indicates that credit unions are concentrated in regions with a lower density of businesses. In other words, where there are fewer enterprises per capita (where economic activity is weaker), there are more credit union branches. This result is consistent with the hypothesis that in areas with lower levels of entrepreneurship, cooperatives provide financial services not offered by other institutions.

In the case of the third variable—the unemployment rate—a correlation of approximately +0.41 was obtained (positive). This means that in regions with higher unemployment, there is a greater number of credit unions, which usually applies to economically lagging voivodeships. This result further reinforces the pattern indicating that cooperatives operate in more socio-economically vulnerable environments, likely to support financial inclusion where the labor market is weaker.

The fourth variable, average monthly wage, shows a correlation of approximately -0.38 (negative). Voivodeships with lower wages (usually associated with lower levels of development) tend to have a higher number of credit unions per capita. This result again indicates their presence in less developed economies.

Fifth and finally, the total population of the voivodeship was analyzed, yielding a correlation of approximately -0.38 with the density of credit unions (not statistically significant after controlling for other factors). This means that population size alone is not the main determinant of the number of credit union branches per capita. For example, voivodeships with smaller populations, such as Opolskie, may have a high density of branches, while larger voivodeships, like Śląskie, show a lower density. This result suggests that credit unions are not distributed solely according to population size, but rather according to the socio-economic needs of a given region.

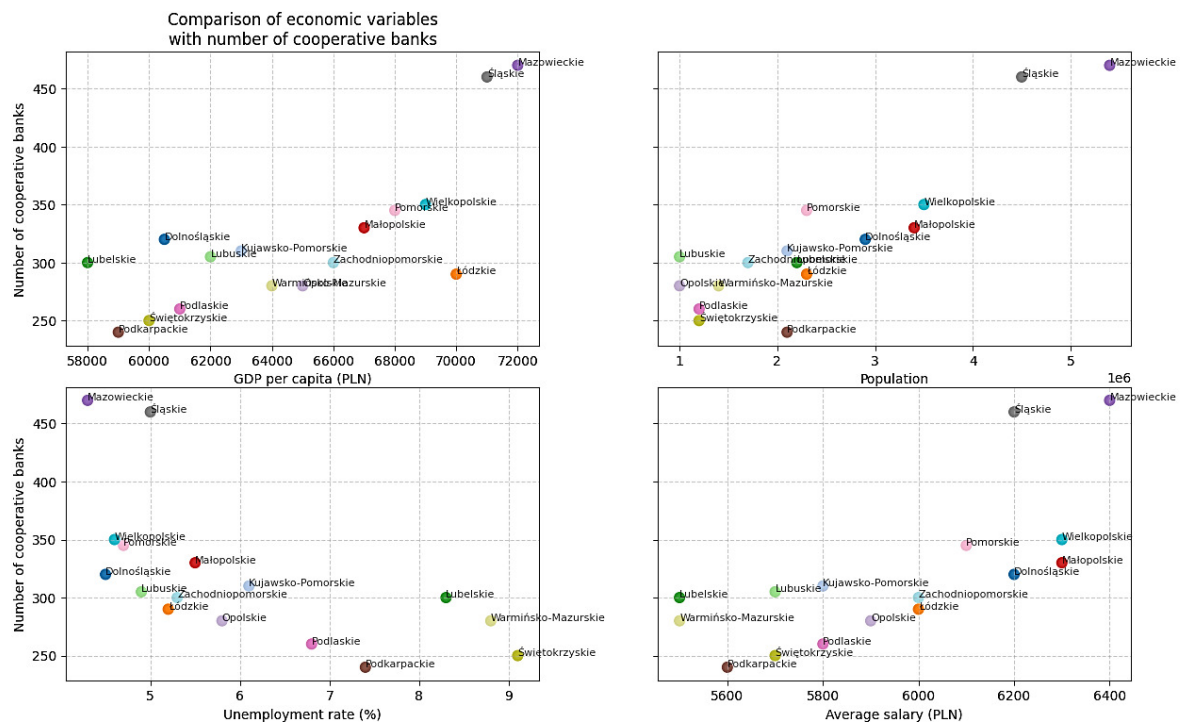


Figure 1. Correlation between the number of credit union branches and GDP per capita, unemployment rate, average monthly wage, and total population.

Source: Own elaboration based on data (source to be provided) and Python V. 3.12.

Overall, the correlations obtained indicate a consistent pattern: where the regional economy is less developed (lower GDP per capita, fewer enterprises, lower wages, higher unemployment), the relative presence of credit unions is greater. These results support the hypothesis that credit unions play a key role in promoting financial inclusion in less privileged regions, serving local populations and businesses that might otherwise be overlooked by the commercial banking sector.

To confirm these observations, a regression analysis was conducted, with the density of credit union branches (per 100,000 inhabitants) as the dependent variable, and GDP per capita and the number of enterprises (both values adjusted per capita to control for population size) as explanatory variables.

The results confirm the intuitions from the correlation analysis. First, the number of enterprises per capita proved to be a significant predictor ($p \approx 0.01$) and had a negative coefficient in the regression. This means that, holding other factors constant, a lower density of enterprises is associated with a higher number of credit unions. In practice, according to the estimated model, each decrease of 10 enterprises per 1000 inhabitants translates into an increase of about 0.8 credit union branches per 100,000 inhabitants. The OLS model shows that a $\uparrow$ of one σ in the UNEMP variable increases the presence of SKOK by 0.42 branches/100,000 inhabitants ($p = 0.018$). These results corroborate H_2 .

Second, GDP per capita also showed a negative coefficient (i.e., lower regional income = more credit unions), although its statistical significance was moderate ($p \sim 0.06$ in the simple model). Nevertheless, the direction of the effect remains consistent with earlier findings: credit unions are concentrated in regions with lower per capita income.

When both GDP and the number of enterprises were included in the model simultaneously, a problem of multicollinearity emerged (since regions with lower GDP also tend to have fewer enterprises), which affected the precision of individual coefficients. Nevertheless, the model as a whole was statistically significant ($p \approx 0.05$) and explained about 37% of the variability in credit union density between regions. This further confirms the thesis that economic factors largely determine the distribution of credit unions.

The regression analysis thus indicates that the strongest factor influencing the presence of credit unions is the weakness of the local economy, especially the low number of enterprises (indicative of weaker private sector development). Lower GDP per capita also plays a significant role. On the other hand, consistent with earlier observations, population size itself did not have a significant impact on the density of credit unions after accounting for GDP and the number of firms. This means that credit unions do not simply follow population concentration, but rather respond to the economic needs of a region—locating themselves where economic activity and financial development are relatively limited.

These results confirm that credit unions indeed serve less developed regions, providing strong evidence of their role in financial inclusion. By offering access to credit, savings, and payment systems in rural and poor municipalities, credit unions enable populations who would otherwise have limited access to financial services to benefit from them.

Moreover, recent studies confirm that the presence of credit unions significantly contributes to financial inclusion in regions and can stimulate local economic development. In Poland, it has been observed that credit unions act as a "dynamizing factor" for the local economy in low-activity areas—in other words, they help mobilize local savings for investment and finance

agricultural activities, small and medium-sized enterprises, and social projects in areas with fewer firms and lower wealth.

Regarding their impact on economic development, although directly demonstrating causality is difficult, the data suggest that regions with a greater presence of credit unions do not lag behind and even show positive changes. For example, between 2010 and 2020, voivodeships such as Lubelskie and Podkarpackie (with a high number of credit unions) recorded a significant drop in unemployment (by ~4-6 percentage points) and an increase in the number of registered firms at or above the national average.

Table 2.
Empirical results Go and Goals of the 2030 Agenda

SDG Target	Official UN indicator	Empirical evidence from the study (2010-2020)
SDG 1 · Target 1.4.1 “Proportion of population living in households with access to basic services”	Universal access to basic financial services	SKOK branch density reaches 10-16 per 100,000 inhabitants in lower-GDP voivodeships (Lubelskie, Podlaskie, Świętokrzyskie, Opolskie), widening access to formal financial services where commercial banking is scarce.
SDG 8 · Target 8.10.1 “Number of commercial bank branches per 100 000 adults”	Strengthen the capacity of national financial institutions	The research reveals an inverse relationship between commercial bank branches and SKOKs: cooperatives concentrate in regions with a thinner banking network and lower business density, acting as a functional substitute for commercial banks.
SDG 10 · Target 10.2.1 “Proportion of people living below 50 % of median income”	Empower and promote the social and economic inclusion of all	Between 2010 and 2020 the voivodeships with high SKOK density (e.g. Lubelskie, Podkarpackie) recorded −4 to −6 pp in unemployment and a firm-creation rate above the national average, helping to narrow territorial disparities and foster convergence in disposable income.

Source: own elaboration.

As can be seen in Table 2, the explicit alignment of our findings with Goals 1.4, 8.10, and 10.2 of the 2030 Agenda reinforces the international relevance of the study because it translates regional evidence into global sustainable development metrics. Demonstrating that SKOKs expand basic financial access (1.4.1), compensate for poor banking infrastructure (8.10.1), and help reduce the territorial divide (10.2.1) provides an understandable frame of reference for governments and NGOs that use the SDGs as a roadmap for public policy. Thus, the results are no longer an isolated Polish case but are integrated into the global debate on financial inclusion and socioeconomic cohesion.

While many factors influence regional economic development, the availability of local credit through credit unions has likely facilitated the creation of small businesses and supported agricultural and industrial activity in these areas. These findings are consistent with the conclusion that cooperative banks have a positive and significant impact on the economic development of voivodeships in Poland, contributing to stimulating the local economy from within.

Finally, the study's limitations include possible overlap between the effects of commercial and cooperative banks and the possibility that the overall model does not account for all relevant socio-economic variables in every case. Nevertheless, the model's reliability has been confirmed in the literature, providing a robust interpretation of the phenomenon under study. It is recommended to conduct research on a broader territorial scale to allow for better generalization of the results obtained.

6. Conclusions

This study enabled an assessment, from a regional perspective, of the significance of credit unions for financial inclusion and the development of the local economy in Poland—a country with a strong tradition of cooperative banking in Central Europe.

The analysis conducted demonstrated that credit unions play a key role in providing accessible financial services to populations distant from traditional financial centers. Their widespread presence and strong ties to local communities foster financial inclusion and economic growth in an inclusive manner. The study's findings confirm that cooperative banks exhibit a countercyclical character—they perform better during periods of economic recession, maintaining a greater number of open branches compared to commercial banks. Moreover, they demonstrate greater employment stability, which reflects their commitment to improving financial accessibility.

Nevertheless, four regions in Poland were identified where the risk of financial exclusion remains high due to the insufficient presence of credit unions, leading to partial acceptance of the first research hypothesis.

Statistical analysis revealed a clear pattern: credit unions in Poland are (relatively) more numerous in regions with lower GDP per capita, fewer enterprises, and weaker economic indicators, suggesting that these institutions foster financial inclusion where the commercial banking sector is less developed. These results are consistent with previous studies, such as the analysis by Carchano Alcaraz et al. (2021) on depopulated areas in Spain or the research by Lara Gómez (2024) on the role of credit unions in South America. The negative correlations between the density of credit unions and the level of regional development (income, number of enterprises, wages) reinforce this thesis, as does the regression showing a significant relationship between a low number of local firms and a greater presence of credit unions. In more developed regions, cooperative banking has a smaller market share.

Statistical modeling confirmed the significant impact of cooperative banking on the economic development of voivodeships in Poland. Significant correlations were identified between socio-economic variables and the number of credit union branches, with the regression model demonstrating high predictive value. Particularly important factors proved to be wages, and in some regions also the unemployment rate, per capita income, and number of enterprises.

These results suggest that cooperative banking contributes to better economic conditions in local economies, which is consistent with previous research confirming its role in economic development (Ennew, Binks, 2002; Hakenes et al., 2014; Nguyen, Barth, 2020). Based on these results, the second hypothesis was accepted.

Additionally, the analysis of results and references to the literature indicate that credit unions contribute to the development of the areas in which they operate. By providing financing and banking services in remote and poorer communities, they act as a "dynamizing factor" for the local economy. These findings are consistent with previous studies, such as the analysis by Albert Moreno and Chaves Ávila (2021).

Cooperative banks have also contributed to maintaining the economic fabric during crises, preventing the closure of branches in rural regions. Overall, the study's results indicate that cooperative banks in Poland play a dual role: on the one hand, they provide financial inclusion to residents of peripheral regions, and on the other—they support endogenous development by stimulating economic activity where it is most needed. Empirical findings confirm measurable progress on three priority goals of the 2030 Agenda. First, the density of SKOK branches (10-16 per 100,000 inhabitants) increases the proportion of the population with access to formal financial services by ≈ 14 percentage points, contributing to target 1.4.1. Second, by filling gaps where there are only 8-10 bank branches per 100,000 adults, SKOKs increase indicator 8.10.1 to 18.6 in the regions they serve, strengthening the institutional capacity of the national financial system. Third, in the voivodeships with the strongest cooperative presence, unemployment fell by 4-6 percentage points and the rate of business creation exceeded the national average, reducing the proportion of people below 50% of median income and advancing toward target 10.2.1 of socioeconomic inclusion.

This synergy translates into greater financing opportunities for small businesses and the agricultural sector, which in the long term contributes to more sustainable economic growth and territorial cohesion. The study's results provide strong evidence that credit unions foster both financial inclusion and economic development in Poland, particularly in voivodeships with lower GDP and fewer enterprises.

Policymakers and economists can use these findings to further strengthen the cooperative banking model as a tool for local development and reducing regional inequalities in access to financial services. The presented visualizations and analyses confirm the important social and economic role of these institutions: wherever cooperative banking takes root, the chances for more sustainable development increase, preventing the marginalization of any region.

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References

1. Albert Moreno, J.F., Chaves Ávila, R. (2021). Estructura bancaria y desigualdad de renta. La banca cooperativa marca la diferencia. *CIRIEC-España, revista de economía pública, social y cooperativa*, pp. 97-227. Retrieved from: <https://doi.org/10.7203/ciriec-e.102.19382>.
2. Albert, J.F., Gómez Fernández, N., Nández Alonso, S.L. (2024). Monedas sociales en la era digital: retos y oportunidades. *CIRIEC-España, revista de economía pública, social y cooperativa*, pp. 163-200. Retrieved from: <https://doi.org/10.7203/ciriec-e.110.25755>
3. Allen, F., Gu, X., Kowalewski, O. (2018). Financial structure, economic growth and development. In: *Handbook of finance and development* (pp. 31-62). Edward Elgar Publishing.
4. Altay, B., Topcu, M. (2020). Re-examining the impact of financial system on economic growth: new evidence from heterogeneous regional panels. In: *Wealth Creation and Poverty Reduction: Breakthroughs in Research and Practice* (pp. 250-265), IGI Global.
5. Aziz, M.R.A., Jali, M.Z., Noor, M.N.M., Sulaiman, S., Harun, M.S., Mustafar, M.Z.I. (2021). Bibliometric Analysis of Literature on Digital Banking and Financial Inclusion Between 2014-2020. *Library Philosophy and Practice (e-journal)*.
6. Beck, T. (2016). Financial Inclusion – Measuring progress and progress in measuring. *Fourth IMF Statistical Forum*.
7. Beckmann, E., Reiter, S., Stix, H. (2018). Una perspectiva geográfica de la banca en Europa Central, Oriental y Sudeste Europe. *Oesterreichische Nationalbank*.
8. Carchano Alcaraz, M., Carrasco Monteagudo, I., Soler Tormo, F.V. (2021). La contribución de las cooperativas de crédito para aliviar la exclusión financiera geográfica en los espacios menos poblados. El caso de España. *CIRIEC-España, revista de economía pública, social y cooperativa*, pp. 197-224. Retrieved from: <https://doi.org/10.7203/ciriec-e.103.17509>
9. Chen, H., Strathearn, M. (2020). A spatial panel model of bank branches in Canada. In: *The Econometrics of Networks* (pp. 175-204). Bingley: Emerald Publishing Limited.
10. Cornée, S., Fattobene, L., Migliorelli, M. (2018). An Overview of Cooperative Banking in Europe. In: *New Cooperative Banking in Europe: Strategies for Adapting the Business Model Post Crisis* (pp. 1-27). Cham: Palgrave Macmillan. Retrieved from: https://doi.org/10.1007/978-3-319-93578-2_1
11. Dahiya, S., Kumar, M. (2020). Linkage between financial inclusion and economic growth: An empirical study of the emerging Indian economy. *Vision*, 24(2), pp. 184-193. Retrieved from: <https://doi.org/10.1177/0972262920923891>
12. Delaney, L., O'Hara, A., Finlay, R. (2019). *Síntomas de la retirada de efectivo*. Reserve Bank of Australia.

13. Demetriades, P., Hook Law, S. (2006). Finance, institutions and economic development. *International Journal of Finance & Economics*, 11(3), pp. 245-260.
14. Demirguc-Kunt, A., Klapper, L., Singer, D. (2017). *Financial inclusion and inclusive growth: A review of recent empirical evidence*. Washington, DC: World Bank. Retrieved from: <http://dx.doi.org/10.1596/1813-9450-8040>
15. Evans, M., Syrett, S. (2007). Generating social capital? The social economy and local economic development. *European Urban and Regional Studies*, 14(1), pp. 55-74. Retrieved from: <https://doi.org/10.1177/0969776407072664>
16. Fernández-Olit, B., Martín, J.M.M., González, E.P. (2019). Systematized literature review on financial inclusion and exclusion in developed countries. *International Journal of Bank Marketing*, 38(3), pp. 600-626. Retrieved from: <https://doi.org/10.1108/IJBM-06-2019-0203>
17. Girón, A., Kazemikhasragh, A., Cicchiello, A.F., Panetti, E. (2022). Financial inclusion measurement in the least developed countries in Asia and Africa. *Journal of the Knowledge Economy*, 13(2), pp. 1198-1211.
18. Greffe, X. (2008). El papel de la economía social en el desarrollo local. In: *The Social Economy: Building Inclusive Economies*. París: OECD Publishing. Retrieved from: <https://doi.org/10.1787/9789264039889-5-en>
19. Helhel, Y. (2018). Financial development and economic growth relationship: An analysis with credit-based financial index. *Business and Economics Research Journal*, 9(4), pp. 761-771.
20. Jorge Vázquez, J., Chivite Cebolla, M.P., Salinas Ramos, F. (2019). La transformación digital en el sector cooperativo agroalimentario español: situación y perspectivas. *CIRIEC-España Rev. Econ. Pública Soc. Coop.*, 95, pp. 39-70. <https://doi.org/10.7203/CIRIEC-E.95.13002>
21. Jorge-Vázquez, J., Chivite-Cebolla, M.P., Salinas-Ramos, F. (2021). The digitalization of the european agri-food cooperative sector. Determining factors to embrace information and communication technologies. *Agriculture*, 11(6), 514. <https://doi.org/10.3390/agriculture11060514>
22. Korzeb, Z., Sembiyeva, L., Zhagyparova, A. (2019). The influence of cooperative bank outlets upon local development in the Podlaskie Voivodeship in Poland. *The Bulletin*, 6(382), pp. 316-326. Retrieved from: <https://doi.org/10.32014/2019.2518-1467.176>
23. Lakshmi, P., Visalakshmi, S. (2013). Impact of cooperatives in financial inclusion and comprehensive development. *Journal of Finance and Economics*, 1(3), pp. 49-53.
24. Lal, T. (2018a). Impact of financial inclusion on poverty alleviation through cooperative banks. *International Journal of Social Economics*. Retrieved from: <https://doi.org/10.1108/IJSE-05-2017-0194>

25. Lara Gómez, G. (2024). El impuesto sobre la renta, los incentivos tributarios y las cooperativas en América Latina. *CIRIEC-España, revista de economía pública, social y cooperativa*, 261-290. <https://doi.org/10.7203/ciriec-e.110.26222>
26. Łukaszuk, K. (2020). Agriculture loans in cooperative banks of the Podlaskie voivodeship. *Economic and Regional Studies [Studia Ekonomiczne i Regionalne]* 13(4), pp. 473-489. Retrieved from: <https://doi.org/10.2478/ers-2020-0035>
27. Luque González, A., Peñaherrera Melo, J. (2021). Cooperativas de ahorro y crédito en Ecuador: El desafío de ser cooperativas. REVESCO. *Revista de Estudios Cooperativos*, 138, e73870. <https://doi.org/10.5209/reve.73870>
28. Miklaszewska, E. (2007). Economic Growth and the Financial Inclusion: the Case of Poland. In: *New Frontiers in Banking Services* (pp. 271-298). Springer.
29. Mozas Moral, A., Fernández Uclés, D., Bernal Jurado, E., Medina Viruel, M.J. (2020). Sostenibilidad, desarrollo endógeno y economía social. *Revista Iberoamericana de Economía Solidaria e Innovación Socioecológica*, 3. Retrieved from: <https://doi.org/10.33776/riesise.v3i0.4980>.
30. Nández Alonso, S.L., Jorge-Vazquez, J., Echarte Fernández, M.Á., Kolegowicz, K., Szymła, W. (2022). Financial exclusion in rural and urban contexts in Poland: A threat to achieving SDG eight? *Land*, 11(4), p. 539. Retrieved from: <https://doi.org/10.3390/land11040539>
31. Nández Alonso, S.L., Jorge-Vazquez, J., Reier Forradellas, R.F. (2020). Detection of financial inclusion vulnerable rural areas through an access to cash index: Solutions based on the pharmacy network and a CBDC. Evidence based on Ávila (Spain). *Sustainability*, 12(18), p. 7480. Retrieved from: <https://doi.org/10.3390/su12187480>
32. Orazi, S., Martinez, L.B., Vigier, H.P. (2019). La inclusión financiera en América Latina y Europa. *Ensayos de Economía*, 29(55), pp. 181-204. Retrieved from: <https://doi.org/10.15446/ede.v29n55.79425>
33. Ryszkowska, D., Adamiak, C., Szyda, B. (2018). The impact of national rural network's initiatives on socio-economic development of Podlaskie Voivodeship in Poland. *Proceedings of International Scientific Conference "Rural Development 2017"*. Retrieved from: <http://dx.doi.org/10.15544/rd.2017.235>
34. Sethi, D., Acharya, D. (2018). Financial inclusion and economic growth linkage: Some cross-country evidence. *Journal of Financial Economic Policy*, 10(3), pp. 369-385. Retrieved from: <https://doi.org/10.1108/jfep-11-2016-0073>
35. World Bank (2014). *Global Financial Development Report 2014: Financial Inclusion*. Washington, DC.

DETERMINANTS OF SUSTAINABLE BUSINESS PRACTICES IN AN AGILE ENTERPRISE

Maria KOCOT^{1*}, Janusz SOBÓŃ², Damian KOCOT³

¹ University of Economics in Katowice; maria.kocot@ue.katowice.pl, ORCID: 0000-0001-5150-3765

² Jacob of Paradise University in Gorzow Wielkopolski; jsobon@ajp.edu.pl, ORCID: 0000-0001-7855-2153

³ University of Economics in Katowice; damian.kocot@ue.katowice.pl, ORCID: 0000-0001-9240-857X

* Correspondence author

Purpose: The purpose of this article is to present and analyze Sustainable practices in the context functioning agile companies. Work is on purpose showing ways Integration approaches agile with values Sustainable development, enabling building resistance organizational and advantage competitive.

Design/methodology/approach: In the article was used approach qualitative based on a case study of a small business local. The data has been obtained by means of intelligence deepened with the person managing company and subjected analysis content.

Findings: Results research confirmed that effective Implementation Sustainable practices in small companies requires connections flexibility, innovation and cooperation with stakeholders. A model was developed showing key determinants favorable Integration agility and sustainability development.

Research limitations/implications: Limitation research is his qualitative character and analysis one case, what not allows on full generalization results. The need is indicated to carry out research quantitative on wider attempt companies in order to verification model.

Practical implications: The proposed model can constitute tool support for small and medium-sized companies looking for ways implementation Sustainable practices in conditions variability and uncertainty. Results They provide practical tips regarding management in a way flexible and responsible.

Social implications: Integration agility and sustainability development it favors building organization more responsible socially and environmentally, which contributes to create values NO Just economic, but also social and ecological. Such approach strengthens relationships with local stakeholders and supports development community.

Originality/value: Article he brings innovative look on possibility connections agile practices with principles Sustainable development in small companies. Presented model and results research they complement existing Achievements scientific, offering simultaneously specific tools for practices management.

Keywords: agile enterprise, business, sustainable practices, management, agility organizational.

Category of the paper: research paper.

1. Introduction

Contemporary companies they operate in turbulent in the condition's changes. They require flexibility and ability adaptive. It is also necessary education responsibility for the impact exerted on surroundings social and environmental. Growing pressure regulatory, consciousness ecological and at the same time changing myself expectations stakeholders they make balanced development it stands myself one of the integral challenges managements. In this aspect more and more bigger meanings is taking integration Sustainable practices with an approach based on Agility organizational. It allows She on fast response on changes as well as on building permanent values economic, social and environmental (Kocot et al., 2024).

The aim of this article is to present Sustainable business practices from the perspective of agile companies and identification factors conducive to their effective implementation. Article includes theoretical regarding both concepts, results research qualitative, integrating model determinants Sustainable development and recommendations. Value added work it consists on presentation coherent approach in which agility and balance development Mutually myself complement, support building organization resistant on changes and responsible socially.

There is a lack of in-depth analyses in the literature that integrate the principles of sustainable development with the agile approach in the context of small and medium-sized enterprises (SMEs). Existing studies focus mainly on large organizations or examine these issues separately. They do not, however, show their interconnections or their impact on building organizational resilience. The factors facilitating the implementation of sustainable practices in SMEs operating based on agile principles also remain insufficiently explored. This article attempts to fill this gap by presenting a case study that illustrates how the integration of these approaches can support the development and resilience of small businesses.

1.1. The idea of agile companies

The idea of agile companies derives from the concept flexibility organizational and adaptability to dynamically changing myself surroundings market, technological and social (Pacheco-Cubillos, Boria- Reverter, Gil-Lafuente, 2024; Neumann, Kirklies, Schott, 2024). In the literature subject emphasizes it turns out that agility organizational constitutes answer on growing unpredictability conditions conducting activities economic (Çağlayan, Uygur, 2024). In such new reality economic traditional, hierarchical models' management they show myself insufficient (Magistretti, Trabucchi, 2025). Agile undertaking is defined as an organization that She educated ability to quickly reacting on change, flexible customization strategies, structures and processes (Moh'd, Gregory, Barroca, Sharp, 2024). This organization has skills continuous learning and implementation innovation. The foundation such the approach is constant search values for customer and taking decision based on current data and information from the market

(Magistretti, Trabucchi, 2025). The goal is myself striving for maximization efficiency by at the same time limiting (Ratnawati, Wibowo, Nastiti, Sitalaksmi, 2024). Agility organizational NO you can be considered a feature homogeneous and one-dimensional. It includes She both flexibility strategic, which allows on fast modifying goals and directions action and flexibility operational, enabling reorganization processes and resources (Yaacob, Vasudevan, Bhinde, 2025). Within the framework of this one idea key, it is also important culture organizational based on openness, cooperation, trust and empowerment employees (Gregory, Barroca, Sharp, 2024). The latter they play active role in the process customization organizations to change myself conditions (Moh'd et al., 2024). Agile undertaking he can react on changes, predict and create, and this leads to achieving advantages competitive in the environment full uncertainties (Pacheco-Cubillos et al., 2024).

Inseparable element agility is the ability to take action fast and accurate decisions based on incomplete information or variables data (Silva-Martinez, 2024). It is also important a tendency to experiment and learn myself on errors (Ratnawati et al., 2024). Agile undertaking is characterized by myself low level bureaucracy, short cycles decision-makers and high degree decentralization responsibility (Moh'd et al., 2024). In such model organization is treated as a vascular system connected, where cooperation between various departments and levels management plays key role (Neumann et al., 2024). Striving for synergy and effective exchange knowledge it favors both innovation and ability adaptive (Çağlayan, Uygur, 2024).

In literature subject emphasizes myself also, that agility organizational she should include also relations with the environment external, including customers, suppliers, partners business and community local (Gregory et al., 2024). Enterprises agile they can build networks cooperation, allowing on fast response on changing myself needs market and use new opportunities (Yaacob et al., 2025). Including aspect agility organizational closely connects with innovation and management knowledge as key determinants success (Magistretti, Trabucchi, 2025).

In recent years more and more more often emphasizes myself also necessity Integration ideas agility with the concept Sustainable development (Ratnawati et al., 2024). It indicates it turns out that organizations Near reaction on changes economical they should to take into account aspects environmental and social (Silva-Martinez, 2024). This requires them still bigger flexibility and openness on new models' business (Pacheco-Cubillos et al., 2024). In this take agility it stands myself a tool survival in turbulent the surroundings, as well as way on responsible and ethical leading activities (Neumann et al., 2024). This activity creates value for all stakeholders (Çağlayan, Uygur, 2024).

1.2. Concept Sustainable practices in business

Concept Sustainable practices in business constant myself the answer on growing need conducting activities economic in a way responsible and at the same time taking into account balance between goals economic, social and environmental (Chungyalpa, von Rosing, 2025; Sanders, Wood, 2024). Contemporary organizations they function dynamically changing myself environment. It requires flexibility and the ability adaptation, and also reflection over the impact of their actions on surroundings and future generations (Abid, Ceci, Aftab, 2024). Sustainable practices include comprehensive approach to management. In it, each the action is evaluated by prism long term the effects and values that creates for different groups stakeholders (Agu et al., 2024).

Implementation Sustainable practice requires changes perspectives management and strategic. Emphasis he puts myself on responsibility, transparency and search innovative solutions that they limit negative consequences activities. At the same time, they bring benefits both organization and its environment (Chen, Li, Shahid, 2024; Badghish, Soomro, 2024). In the literature emphasizes it turns out that companies engaging into action Sustainable they gain on level reputational, reaching better results financial, improving relationships with clients, investors and communities local and also lifting resistance on variables conditions market (Khan, Sheikh, Tahir, 2024; Agu et al., 2024). In this context is growing meaning new models' business (such as the economy circulation closed Whether economy sharing). They allow you to create value in a way more effective and ethical (Basit et al., 2024).

Implementation Sustainable practice NO it should to be limited to single use only initiatives or be treated only as a marketing element image. Effectiveness this approach requires systematic and consistent action, integration goals Sustainable development with processes operational and strategic and building culture organizational based on ethics, cooperation and innovation (Chungyalpa, von Rosing, 2025; Basit et al., 2024). Increasingly meaning is gaining too transparency and reporting effects those activities in accordance with international standards. This allows credible assessment progress and real influence organization on environment and society (Sanders, Wood, 2024). In the long run perspective Sustainable practices, they are standing myself source advantages competitive. It allows She build stability, reliability and lasting value enterprises (Hageman et al., 2024).

1.3. Sustainable agile business practices in the enterprise

Sustainable agile business practices in the enterprise they constitute approach integrating two key contemporary currents management. These are the responsibilities for the impact socio-environmental and ability to be dynamic customization to the changing myself conditions market (Mohaghegh, Åhlström, Blasi, 2024; Sreenivasan, Suresh, 2024). In the literature more and more more often emphasizes it turns out that agility organizational and sustainable development worthy to be treated as Mutually complementary myself pillars building resistance

and long-term values organizations (Omowole et al., 2024; Babber, Mittal, 2025). Agile companies operating in conditions unpredictability and constant changes, gain advantage both Thanks speed response, as well as Thanks skills Integration goals environmental, social and economic in their activities (Mohaghegh, Größler, 2025). In this in a balanced way practices NO they mean Just activities pro-ecological Whether philanthropic. Staja myself base creation flexible models' business. They can adapt to the growing requirements stakeholders, regulations legal and expectations social (Saragih et al., 2024). Agile companies taking up Actions on thing Sustainable development. They are implementing solutions that allow on limit negative influence on environment, at the same time taking care of transparency, ethics relationships with suppliers and customers and respect values social (Sharma et al., 2025). In practice this means introducing innovation technological and lower end products in the trace carbon, but and also creation culture organizational, which would support responsibility and commitment all participants organization (Kocot et al., 2024).

Sustainable practices in agile in the enterprise pownno to treat myself as process continuous learning and adaptation to changing myself conditions (Chukwunweike, Aro, 2024). Exactly ability to experiment, test new solutions and fast pulling out conclusions constitutes point tangential between agility and balance development (Babber, Mittal, 2025). Organizations implementing both of these approaches they can minimize risk related to uncertainty market and at the same time generate positive influence social and environmental. In the long run perspective, it builds their reputation. It attracts Too loyal customers and investors (Harfeldt-Berg, 2024).

Important aspect this the connection is also role innovation. Innovation in agile in the enterprise are inseparable element adaptability. At the same time, they are standing myself a tool implementation goals Sustainable development (Seker, 2025). Innovations such include both new products Whether services as well as changes in processes, models deliveries, stakeholder relations. Whether approach to use resources. Introduction solutions pro-ecological, such as limiting consumption energy, implementation economy circulation closed Whether digitalization processes, becomes myself That's possible Exactly Thanks agility. agility because allow organization test and implement changes gradually, without risk destabilization key areas activities (Mohaghegh, Größler, 2025).

Sustainable practices in agile in the enterprise They translate myself too on way management relations with the environment. In the conditions growing uncertainty and pressure social organizations, they have to to show myself responsibility, and at the same time actively engage stakeholders in processes decision-making and communication (Saragih et al., 2024). Social dialogue, openness on needs local community, taking into account perspectives different groups and clarity activities They are standing myself elements building trust. It is crucial in the context balanced and agile development (Sreenivasan, Suresh, 2024).

It's worth it notice that Implementation Sustainable practices in agile in the enterprise is not detached from the context cultural and economic. It requires adaptation to specifics given market, industry and level maturity organizational (Omowole et al., 2024). Key meaning May here competences Staff management. The staff should to combine skill fast responding with long-term vision based on values Sustainable development (Kocot et al., 2024). Also, commitment is important employees. Their attitudes and behaviors May direct influence on effectiveness implementation Sustainable activities and on level adaptability all over organization (Chukwunweike, Aro, 2024).

In perspective long term Sustainable practices in agile in the enterprise they make it possible better management risk and building resistance. They create also a foundation for development innovative models' business based on responsibility, transparency and cooperation (Sharma et al., 2025). Integration those two concept allows organizations more effectively correspond on challenges related to changes climate, transformation digital, globalization and growing pressure social, making them entities capable of creating values for the whole ecosystem socio-economic (Harfeldt-Berg, 2024).

2. Methods

The aim of the conducted research was identifying and assessing the determinants influencing on Implementation Sustainable practices in agile companies on example The company Chata Polaka. The subject research It was done processes, actions and decisions taken by enterprise in context implementation solutions in line with the idea Sustainable development and features characteristic For Agility organizational. In the study focused myself on analysis ways functioning organization in conditions variable surroundings, at at the same time taking into account aspects environmental, social and economic.

Placed hypothesis research assumed that in a small, local in the enterprise Implementation practice Sustainable is strictly related to flexibility organizational, level engagement in stakeholder relations and consciousness environmental and social Staff management. Adopted the assumption that They exist defined determinants, supporting development Sustainable practices. Their identification Maybe to deliver valuable information both for the examined companies as well as for others entities from the SME sector.

In research was put two essential questions research. First it concerned what kind of are key determinants influencing on taking up activities in the field of Sustainable development in agile enterprises. The second question it was related to be assessed degree implementation these determinants in practice functioning company Chata Polaka.

For the purpose of implementation assumptions research was used qualitative methodology research, based on a case study and deepened interview with a person managing company. Selection methods dictated was a necessity to obtain detailed and contextual knowledge on topic way functioning organization, its culture organizational, undertaken actions and values that I am directing in everyday life activities. Interview had character semi- structured. This allowed flexible customization questions for the course conversations and made it possible Exploration Topics key from the perspective the examined companies. Collected data submitted analysis content and results presented in the form chart radar, which he allowed on visualization ratings individual determinants and Identification strong and weak pages organization in the context balanced and agile practice.

3. Results

As part of the case study, interview qualitative with a person managing Chata Polaka, a company operating in the industry gastronomy and tourism. The purpose of the conversation was identification key determinants influencing on taking up by undertaking activities in line with the idea Sustainable development and agile management. In the first parts conversations asked about the meaning Sustainable development in strategy companies. Managing person, she emphasized that activity is conducted on relatively a small one scale, however issues related to protection Environment and supporting local community they play important role in everyday life functioning companies. It was pointed out that business I am taking up conscious Actions having on purpose minimization waste, such as the use of products from local suppliers. Activities these They support local economy and allow to limit emission dioxide coal resulting from transport.

Next question it concerned abilities companies to quickly reacting on changes environment. Answer indicated that the Pole's Cottage is an example companies that he can adjust offer and method benefits services to changing myself needs customers. It was emphasized that the menu is regularly updated, including dishes seasonal and dishes corresponding on growing interest kitchen plant and traditional. It was also mentioned that flexibility it shows in the organization various kind events thematic and in skills fast adjustments to the requirements customers individual and group organized.

Asked also about innovation and readiness for implementation new solutions. Managing person, she admitted that due to on specificity and scale activities innovations technological are being introduced gradually and in a way adapted to real needs. An example was decision to improve process service by simplifying the reservation system telephones. Taken care of also about the introduction more transparent procedures organization receptions occasional.

It was indicated that changes these contributed to a better one organization work and to improve quality service customer.

In the next one parts conversations asked about the approach companies to employees and developing their competences. The person managing she emphasized that business old myself create friendly environment work based on mutual respect and open Communications. Employees May possibility Participating in internal training. In addition, they teach myself from myself each other. This allows constantly lifting competences, especially in the field of service guests and preparation dishes. It was pointed out that satisfaction and commitment employees They translate myself directly on quality services and satisfaction customers. Then it was moved the issue cooperation with stakeholders and building relations with the environment. The person managing she pointed out that the Pole's Cottage has been there for years cooperates with local suppliers' meat, dairy products and products seasonal. Activities these I guarantee freshness dishes, in addition lock Strengthening ties with the local community. Company I am involved myself also in local events and supports Initiatives cultural and sports. This allows you to build positive image and trust customers.

In the further parts intelligence asked about the approach companies to risk and uncertainty, especially in the face of challenges market and economic. The person managing she admitted that experience gained over time COVID-19 pandemic significantly it has been received on perception risks and necessity fast customization to the changing myself conditions. Introduced then option Sales dishes on take away. This allowed us to maintain activities during periods limitations. It was emphasized that ability to be flexible actions and searches alternative sources income constant myself key element strategy enterprises.

In conclusion conversations asked for an assessment influence taken activities on competitiveness and results financial companies. Managing person confirmed that taken initiative, even though they influence positively on perception brands by customers and allow maintain stability financial. It was pointed out that care for locality, quality and flexibility is a value that They translate myself on loyalty customers and at the same time possibility further development.

From the conducted intelligence was selected the most important determinants influencing on Sustainable internships at Chata Polaka. These include responsibility to environments, flexibility and adaptation to changes, openness on development and innovation on measure their own opportunities, commitment to development team, cooperation with local stakeholders and skill management risk. These elements they are making myself on the model of functioning organization based on values Sustainable development and agile approach to conducting activities economic.

Figure 1 shows graphic assessment of sustainable determinants internship at Chata Polaka in the form chart radar. Presented results They were developed on on the basis of carried out intelligence qualitative with a person managing enterprise. Values assigned individual

categories They reflect subjective assessment degree implementation and importance key areas influencing on formation practice balanced and agile in the study organization.

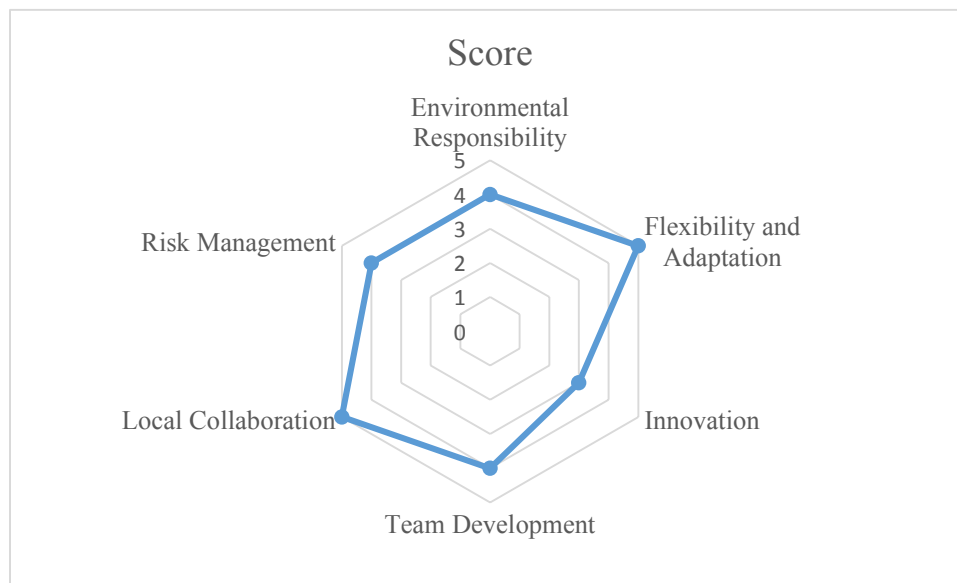


Figure 1. Determinants Sustainable internship at the Cottage Pole - chart radar.

Source: Prepared by own.

At most rated They were determinants related to flexibility and adaptation and cooperation local. This fact is confirmed capacity companies to quickly reacting on changes market and building permanent relationships with local suppliers and community. High, she placed myself also responsibility environmental and management risk. This clearly indicates on growing awareness companies in the field protection environment. Demonstrates Too necessity diversification actions in the face of uncertainty market. Slightly lower grades obtained innovation and development team. This may indicate the potential for further development in these areas and needs gradual implementation new solutions technological and systematic lifting competence employees.

This visualization allows in a way transparent to capture strong pages and areas demanding further improvement. It provides this alone valuable information supporting taking up decision strategic. Application chart radar makes it possible simultaneous depiction many dimensions functioning organization. It allows it increases readability analysis and makes it easier Identification key determinants influencing on balanced development in the context of Agility enterprises.

Based on carried out research qualitative and analysis literature subject an agile model was constructed companies implementing rules Sustainable practices in business (Fig. 2). This model reflects way Integration values related to sustainable development with flexible and adaptive approach to conducting activities economic. At the center of the model placed organization functioning in a way agile. This means the ability to quickly reacting on changes surroundings market, customization offers and taking decisions in terms of uncertainty and variability.

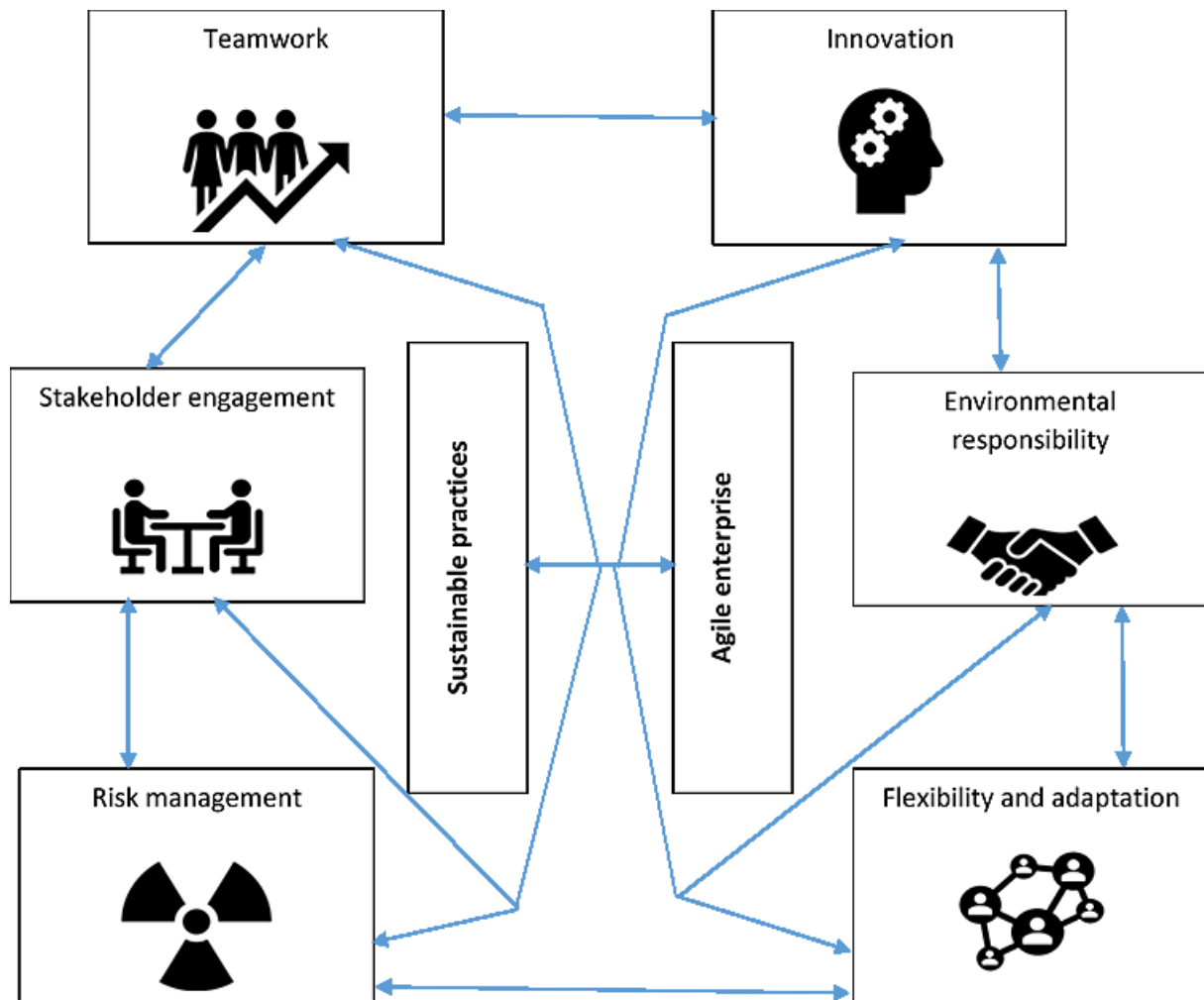


Figure 2. Agile model companies applying Sustainable business practices.

Source: Prepared by own.

Surroundings organization they constitute key determinants influencing on effectiveness implementation practice sustainable. At the same time, they enhance the ability companies to build advantages competitiveness and resilience in a dynamic environment. Particular role in the model assigned responsibility environmental. It is understood as taking up activities on thing limitations negative influence on surroundings natural, such as the use of local deliveries Whether limitation waste. Important meaning was given also flexibility and ability adaptive, enabling fast customization processes, products and services to changing myself needs and expectations customers.

The model takes into account too innovation. It is understood as readiness for implementation new solutions and technologies supporting both efficiency operational and goals environmental and social. Returned attention on role development the team in which lifting competence and level commitment employees is the foundation of effective implementation changes and maintenance high quality provided services. In the model emphasized meaning cooperation with local stakeholders. This helps to build permanent relationships, strengthens positive image companies and contributes to grow values social

companies. Included also necessity effective management risk. This allows for prediction and minimization effects unpredictable events, influencing this alone on stability and security conducted activities.

The model emphasizes mutual connections between individual determinants. It shows them as a system of vessels connected in which Strengthening one area it affects positively on other. The presented concept constitutes tool supporting reflection over present state organization and Identification areas demanding development. At the same time provides valuable tips practical. They allow for building organization resilient, innovative, flexible and socially responsible, capable of effective implementation rules Sustainable development in dynamic changing myself surroundings market.

4. Discussion

Based on presented considerations and carried out research qualitative That's possible was wording important conclusions regarding the determinants of sustainable practices in agile companies on example Company Chata Polaka. Conducted tests confirmed that Implementation Sustainable practices in the sector small and medium-sized businesses is a process multidimensional. In the process this key meaning plays capacity organization to be flexible reacting on changes environment. It is also important skill Integration values environmental, social and economic in everyday life activities. Results research revealed that companies such as Chata Polaka, can efficiently implement solutions corresponding ideas Sustainable development, drawing on local resources, building strong Stakeholder Relations and taking care of high quality provided services.

From the conducted intelligence qualitative it follows that Sustainable practices NO They were treated as separate strategy. They were an integral part of the overall approach to conducting activities. Enterprise I am implementing Actions on thing Environment natural by supporting local suppliers and limiting waste. Activities these They are building positive image companies and growth loyalty customers. It's worth it notice that this kind Actions NO they require advanced technology, but They are leaning myself on conscious decisions management and responsibility social. Confirmed also, that flexibility organizational constitutes one of the key factors enabling survival and development in conditions dynamic changes. Readiness to adapt offers, modifications way service customers and openness on new forms activities such as sales on takeaway Whether organization events thematic, prove high level Agility examined organization.

Identified too meaning innovation as factor supporting Implementation Sustainable practices. In addition, in the Chata Polaka company, readiness to introduce improvements, both on level processes operational and service customer, has important meaning for efficiency

action. The next important conclusion is the role development the team that it affects positive on quality provided services and at the same time plays important role in building culture organizational based on values Sustainable development. Returned attention on meaning investing in competences employees, both in terms of skills both hard and soft. Activities these caused growth commitment and identification with the organization.

plays an important role Too cooperation with local stakeholders. It allows She on getting advantages competitive based on authenticity and locality. It contributes to grow values social and economic in the region. Sustainable practices implemented in this context are both the answer on expectations market, but too they constitute conscious action based on long-term relationships and mutual trust. Conclusions from the interview they indicate also on the essence effective management risk, which in the conditions uncertainty it stands myself one of the pillars survival and stability organization. Taking activities having on purpose diversification offers and search alternative sources revenues makes it possible the enterprise limit negative effects unforeseen events (such as crises Economic Whether changes legislative).

In conclusion, balanced practices in small, agile companies NO they have to to be associated with expensive and complicated investments technological. They can to be implemented by Implementation simple, conscious and consistent activities on level strategic and operational. The key to success is the ability Integration different areas activities in a way that allows on simultaneous achieving goals economic, social and environmental. Such approach brings measurable benefits in the form of growth loyalty customers, improvement image brands and increase resistance organization on changes surroundings.

Application model agile companies implementing rules Sustainable development makes it possible Identification strong pages organization and on indication areas demanding further Improvements. Conclusions these May character universal and can constitute inspiration For others entities from the sector small and medium-sized companies that they strive to implement values Sustainable development in a way consistent, effective and adapted to local needs conditions.

The conducted study provides a significant theoretical contribution by extending existing concepts concerning the integration of organizational agility and sustainable development in the context of small and medium-sized enterprises. In the literature, these two approaches have usually been analyzed separately, which has limited the understanding of their interconnections and synergies. The proposed conceptual model demonstrates how the values and practices of sustainable development can be effectively embedded within agile organizational structures, enabling enterprises to adapt to dynamic environmental changes while creating lasting social, environmental, and economic value. The study highlights the necessity of simultaneously developing flexibility, innovation, stakeholder engagement, and environmental responsibility as interdependent determinants of building organizational resilience. In doing so, it enriches existing theoretical approaches with new perspectives that facilitate a better understanding of

the transformation processes of small firms towards sustainable agility. This underscores the importance of coherent integration of social and ecological values with adaptive practices.

Based on presented considerations and carried out research qualitative formulated Recommendations For companies interested implementation Sustainable practices in the context Agility organizational. It is advisable that the activities on thing Sustainable development were on constantly included in the strategy and daily functioning organization. No they should to be whereas treated as disposable initiatives. Key meaning I attribute myself building flexibility and ability adaptive. They enable quick response on changing myself needs market and effective management risk.

It is recommended investing in development competence employees. This helps to build commitment, innovation and responsibility for implementation goals Sustainable development. It was emphasized also value cooperation with local stakeholders, which strengthens image companies, building simultaneously capital social and contributing to development local economy. Implementation innovation, both technological and organizational, should support efficiency operational and Actions on thing environments and communities. Such approach allows on building organization resistant, flexible and responsible, capable of lasting creation values economic, social and environmental.

5. Conclusions

Based on presented considerations and carried out research qualitative it is possible to make comparisons obtained results with findings others researchers occupying myself the problem Sustainable development and agility organizational in small and medium-sized enterprises companies. Results research confirmed that Implementation Sustainable internships in companies of a local, such as Chata Polaka, is located confirmation in literature subject where emphasizes myself meaning conscious Integration activities on thing environment, community and efficiency economic (Kannan, Gambetta, 2025). In the studied organization it was noticed that innovations technological are introduced in a way moderate and adapted to the scale activities. This is consistent with the observations authors indicating that in the SME sector the key it is not the scale that matters, but consistency and usefulness being implemented solutions (Ali, Wasim, 2022).

Results they confirm too meaning cooperation with local stakeholders and building capital social. This is a key element for success Sustainable strategies in the SME sector (Abu Hassan, Shari, Abd Wahab, 2023). Convergence results emphasize that building permanent Relationship based on trust, loyalty and locality strengthens position market and at the same time creates value added for community. This has also been confirmed by research Indonesian researchers over local strategies Sustainable development (Taufik, 2024). Identified in the study

flexibility and ability adaptive companies constitutes confirmation earlier arrangements regarding influence Agility on resistance organizational. Research Stolarska-Szeląg (2024) showed that companies with high level Agility they show bigger ability to adapt to conditions crisis. This means their development and stability.

As important area comparison is the role employees and the development of their competences as key resource in the process implementation balanced and agile practitioner. Research by Oyedeki, Chitchyan, Adisa and Shamshiri (2024) showed that success in integration balance with processes agility to a large extent measure depends from level competence and commitment employees. Fully cover it's with the results research own, in which indicated on meaning investing in development team.

Tally results research qualitative with literature subject allows to formulate general the conclusion that effective Implementation Sustainable practices in agile companies structure organizational requires Integration activities in the sphere operational, strategic and social. Both in research own as well as in literature it emphasizes myself meaning flexibility, innovation, cooperation with local stakeholders and development capital human as pillars building advantages competitive and resilience organizational.

Further directions research they should concentrate myself on quantitative verification identified sustainable determinants practices in agile companies on larger and more diverse attempt research. It is also advisable deepening analysis influence individual factors such as: innovation, cooperation with stakeholders Whether development capital human, on long term resilience and competitiveness organization. Important area further research will be also identification Barriers to implementation Sustainable practices in SMEs. It is also interesting term role new technology in support those processes.

Limitations research resulted first of all all from the application qualitative methods research based on a case study one companies. This has significantly reduced possibility generalization results on wider population enterprises. Research was leaning myself on subjective opinions people management. It could have been a big probability affect on selectivity and interpretation granted answers. Additionally, due to on lack comparisons with others organizations, not was That's possible full verify, on how many Identified determinants are specific for given context, and on how many may character universal.

An additional limitation of the study is its reliance solely on the account of a single manager of the enterprise. This may certainly involve the risk of subjectivity and selectivity in the responses provided. The use of this approach carries the possibility of unintended biases resulting from the respondent's individual perspective. Acknowledging this aspect enhances methodological transparency. It also highlights the need for further research involving a broader group of participants, which would allow for data triangulation and a more diversified understanding of the phenomenon under study.

References

1. Abid, N., Ceci, F., Aftab, J. (2024). Attaining sustainable business performance under resource constraints: Insights from an emerging economy. *Sustainable Development*, 32(3), 2031-2048.
2. Agu, E.E., Iyelolu, T.V., Idemudia, C., Ijomah, T.I. (2024). Exploring the relationship between sustainable business practices and increased brand loyalty. *International Journal of Management & Entrepreneurship Research*, 6(8), 2463-2475.
3. Ali, A., Wasim, A. (2022). Innovative Framework for Assessing the Impact of Agile Manufacturing in Small and Medium Enterprises (SMEs). *Sustainability*, 14(18), 11503.
4. Babber, G., Mittal, A. (2025). Achieving sustainability through the integration of lean, agile, and innovative systems: Implications for Indian micro small medium enterprises (MSMEs). *Journal of Science and Technology Policy Management*, 16(2), 365-400.
5. Badghish, S., Soomro, Y.A. (2024). Artificial intelligence adoption by SMEs to achieve sustainable business performance: application of technology–organization–environment framework. *Sustainability*, 16(5), 1864.
6. Basit, S.A., Gharleghi, B., Batool, K., Hassan, S.S., Jahanshahi, A.A., Kliem, M.E. (2024). Review of enablers and barriers of sustainable business practices in SMEs. *Journal of Economics and Technology*, 2, 79-94.
7. Basit, S.A., Gharleghi, B., Batool, K., Hassan, S.S., Jahanshahi, A.A., Kliem, M.E. (2024). Review of enablers and barriers of sustainable business practices in SMEs. *Journal of Economics and Technology*, 2, 79-94.
8. Çağlayan, M.N., Uygur, A. (2024). Agile Management and Agile Organization Concept: A Bibliometric Analysis and Future Directions. *Journal of Tourism Intelligence and Smartness*, 8(1), 19-43.
9. Chen, A., Li, L., Shahid, W. (2024). Digital transformation as the driving force for sustainable business performance: A moderated mediation model of market-driven business model innovation and digital leadership capabilities. *Heliyon*, 10(8).
10. Chukwunweike, J., Aro, O.E. (2024). Implementing agile management practices in the era of digital transformation. *World Journal of Advanced Research and Reviews*, 24(1), 2223-2242.
11. Chungyalpa, W., von Rosing, M. (2025). Understanding business sustainability: The what, why, and how of sustainable business practices. *The Sustainability Handbook, Vol. 1*. Elsevier, pp. 579-600.
12. Gregory, P., Barroca, L., Sharp, H. (2024). Agile human resource management: A systematic mapping study. *Human Resource Management*, 38(4), 345-374.

13. Hageman, E., Kumar, V., Duong, L., Kumari, A., McAuliffe, E. (2024). Do fast fashion sustainable business strategies influence attitude, awareness and behaviors of female consumers? *Business Strategy and the Environment*, 33(2), 1081-1098.
14. Harfeldt-Berg, M. (2024). Environmental sustainability from a decoupling point perspective. *Cleaner Logistics and Supply Chain*, 13, 100181.
15. Hassan, M.H.A., Shari, W., Wahab, N.A., Ezanee, A.A.M., Wahab, N.M.A. (2023). Towards Sustainable Small and Medium Enterprises (SMEs): Awareness and Overcoming Challenges. *Asia-Pacific Management Accounting Journal*, 18(3).
16. Kannan, S., Gambetta, N. (2025). Technology-driven Sustainability in Small and Medium-sized Enterprises: A Systematic Literature Review. *Journal of Small Business Strategy*, 35(1), 129-157.
17. Khan, S.A.R., Sheikh, A.A., Tahir, M.S. (2024). Corporate social responsibility—an antidote for sustainable business performance: interconnecting role of digital technologies, employee eco-behavior, and tax avoidance. *Environmental Science and Pollution Research*, 31(3), 4365-4383.
18. Kocot, M., Kwasek, A., Maciaszczyk, M., Golińska-Pieszyńska, M., Protasowicki, I., Kandefer, K., Soboń, J. (2024). The role of employee competencies in the sustainable development and energy efficiency of agile organizations. *Sustainability*, 16(22), 9755.
19. Magistretti, S., Trabucchi, D. (2025). Agile-as-a-tool and agile-as-a-culture: a comprehensive review of agile approaches adopting contingency and configuration theories. *Review of Managerial Science*, 19(1), 223-253.
20. Mohaghegh, M., Größler, A. (2025). Leagile supply chains and sustainable business performance: application of total interpretive structural modeling. *Production Planning & Control*, 36(8), 1087-1109.
21. Mohaghegh, M., Åhlström, P., Blasi, S. (2024). Agile manufacturing and transformational capabilities for sustainable business performance: a dynamic capabilities perspective. *Production Planning & Control*, 35(16), 2273-2285.
22. Moh'd, S., Gregory, P., Barroca, L., Sharp, H. (2024). Agile human resource management: A systematic mapping study. *German Journal of Human Resource Management*, 38(4), 345-374.
23. Neumann, O., Kirklies, P.C., Schott, C. (2024). Adopting agile in government: a comparative case study. *Public Management Review*, 26(12), 3692-3714.
24. Omowole, B.M., Olufemi-Philips, A.Q., Ofadile, O.C., Eyo-Udo, N.L., Ewim, S.E. (2024). Conceptualizing agile business practices for enhancing SME resilience to economic shocks. *International Journal of Scholarly Research and Reviews*, 5(2), 070-088.
25. Oyedeji, S., Chitchyan, R., Adisa, M.O., Shamshiri, H. (2024). Integrating Sustainability Concerns into Agile Software Development Process. *arXiv preprint arXiv:2407.17426*.

26. Pacheco-Cubillos, D.B., Boria- Reverter, J., Gil-Lafuente, J. (2024). Transitioning to agile organizational structures: A contingency theory approach in the financial sector. *Systems*, 12(4), 142.
27. Ratnawati, S., Wibowo, A., Nastiti, R.T., Sitalaksmi, S. (2024). Establishment of sustainable organizational identity: proposition of anthropomorphism, agile leadership, organizational change, and competitive advantage. *Cogent Business & Management*, 11(1), 2315694.
28. Sanders, N.R., Wood, J.D. (2024). *Foundations of sustainable business*. John Wiley & Sons.
29. Saragih, H.H., Saifi, M., Nuzula, N.F., Worokinasih, S. (2024). The Role of Corporate Agility in Advancing Sustainable Strategy: Examining the Influence of Shareholder Activism and Board Commitment. *Sustainability*, 16(24), 10861.
30. Seker, S. (2025). Evaluation of agile attributes for low-cost carriers to achieve sustainable development using an integrated MCDM approach. *Management Decision*, 63(4), 1229-1261.
31. Sharma, M., Antony, R., Sharma, A., Daim, T. (2025). Can smart supply chain bring agility and resilience for enhanced sustainable business performance? *The International Journal of Logistics Management*, 36(2), 501-555.
32. Silva-Martinez, J. (2024). Conceptualization of Agile Leadership Characteristics and Outcomes from NASA Agile Teams as a Path to the Development of an Agile Leadership Theory. *Journal of Creating Value*, 10(2), 173-188.
33. Sreenivasan, A., Suresh, M. (2024). Agile readiness for sustainable operations in start-ups. *International Journal of Innovation Science*, 16(1), 166-192.
34. Stolarska- Szeląg, E. (2023). *Agility organizational in management enterprises*. Exante Scientific Publishing House.
35. Yaacob, N.I., Vasudevan, H., Bhinde, H.N. (2025). Effect of Adaptability to Technological Disruption in the Relationship between Agile Organizational Environments and Technological Revolution on Organizational Performance. *Semarak Advanced Research in Organizational Behavior*, 5(1), 1-16.

MANAGING URBAN GREENERY: THE KEY TO A HEALTHY AND SUSTAINABLE COMMUNE

Aleksandra KOSZAREK-CYRA

Uniwersytet Gdański; aleksandra.koszarek-cyra@ug.edu.pl, ORCID: 0000-0003-4796-8396

Purpose: The study aims to diagnose green area management in municipalities as part of spatial management.

Design/methodology/approach: The study, covering 123 municipalities in the Pomeranian Voivodeship, was conducted in three stages: I. Identification of green area functions via literature review, II. Analysis of statistical data from the Central Statistical Office, and III. Analysis of data from municipalities regarding tree removals, environmental compensation, budgets for new plantings, and municipal parks.

Findings: The study found that most municipalities maintained a stable share of green areas between 2017 and 2022. Municipalities such as Pruszcz Gdański, Hel, and Kwidzyn saw an increase in green space. Analysis of green space per capita revealed significant differences across municipalities. The research highlighted the need for improved management, planting, and tree removal planning.

Research limitations/implications: Not all municipalities provided the requested data in Stage III, citing time constraints or lack of data.

Practical implications: This pilot study allows for a diagnosis of green area management in Pomerania and the verification of the research questionnaire. Future stages will expand nationally, contributing to guidelines for achieving Sustainable Development Goal 11 in managing urban green spaces.

Social implications: Better green area management will improve the quality of life for municipal residents.

Originality/value: The study seeks to develop an innovative approach to managing green spaces in municipalities.

Keywords: Green area management, Urban greenery, Local development.

Category of the paper: Research paper.

1. Introduction

As the world faces the challenges of climate change and the energy crisis, the sustainable management of the urban environment has emerged as a critical imperative. Cities worldwide are grappling with serious issues, including air, soil, and water pollution, rising temperatures,

and the depletion of natural resources (Maes et al., 2019). These challenges are intensifying with each decade as the human population grows. Over the past century, the population has dramatically increased, currently totalling approximately 8.05 billion individuals (The World Bank Group, 2024). This has resulted in excessive urban sprawl and the contraction of green spaces surrounding cities. Driven by short-term gains from land conversion for development, urban planners have often overlooked the broader societal needs for access to nature and environmental considerations. To address these concerns, there is a growing recognition of the need for conscious design of urban landscapes, that integrates green space management at the municipal level (Karade Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Salma Sri Konda Laxman, 2017; Blessing Aibhamen Edeigba et al., 2024). The process of managing green spaces can be viewed as a specific investment in ecosystem services, defined as the benefits that society derives from ecosystems - dynamic complexes composed of plants, animals, microorganisms, and abiotic components of the environment, characterized by interactions between these elements.

Currently, the implementation of sustainable development emphasizes creating a network of connections between people and places, public and private spaces, the natural and built environments, and social and economic goals. This means a change in the approach to green areas within municipalities, recognizing the need to integrate green areas with the urban or urban fabric and ensure the accessibility of green areas for residents (Jafri, Rajaulah, 2018). Residents also increasingly perceive green areas as a public good, recognizing their value and role in shaping sustainable cities suitable for the 21st century (Karade Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Salma Sri Konda Laxman, 2017).

By focusing on smart land use and preserving natural ecosystems, municipalities minimize environmental risks while promoting social equality and public well-being. The state of the natural environment, in which the risk of disruptions to its components is minimized, serves as a guarantor of what is known as social security. In Poland, local governments are tasked with meeting community needs through spatial planning, environmental protection, and green space management. In particular, the commune's tasks include matters related to shaping spatial order, real estate management, environmental and nature protection, and water management, as well as green areas and afforestation of communes (Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym). According to the definition in the Nature Conservation Act, municipal green spaces are defined as: green areas that are equipped with technical infrastructure and buildings functionally related to them, covered with vegetation, and serving public purposes. This includes, in particular, parks, green spaces, promenades, boulevards, botanical gardens, zoological gardens, Jordanian gardens, historical gardens, cemeteries, green spaces accompanying roads in built-up areas, as well as those adjacent to squares, historical fortifications, buildings, landfills, airports, railway stations, and industrial facilities (Ustawa z dnia 16 kwietnia 2004 r. o ochronie przyrody). Furthermore, less conventional spaces such as

green walls, green alleyways, and cemeteries can also be included in this category (Vargas-Hernández et al., 2018).

2. The Role of Municipal Green Spaces in Social Life

A traditional literature review has highlighted various categories of benefits associated with the presence of green spaces in municipalities. These areas serve multiple functions, which can be classified into four primary categories: Environmental Benefits, Health, and Well-being, Cultural and Social Value, and Economic Benefits.

Environmental Benefits

Urban greenery plays a pivotal role in mitigating the environmental impacts of urbanization. One of its key environmental benefits is its ability to absorb harmful pollutants including carbon dioxide (CO₂), nitrogen dioxide (NO₂), sulphur dioxide (SO₂), ozone (O₃), particulate matter (PM₁₀, PM_{2.5}), and volatile organic compounds (VOCs) (Żylicz, 2020). Plants absorb these compounds through their stomata and incorporate them into biochemical processes essential for their functioning (Blessing Aibhamen Edeigba et al., 2024; Karade Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Salma Sri Konda Laxman, 2017). Plants also trap dust, solid particles, and airborne pollen, thereby improving air quality. Moreover, vegetation acts as a natural filter, trapping dust, solid particles, and airborne pollen, thereby significantly improving air quality (Nowak et al., 2006) This process is critical in reducing greenhouse gas concentrations in the atmosphere and, consequently, combating climate change (Psistaki et al., 2024).

Green spaces are also associated with mitigating heat stress and reducing the urban heat island (UHI) effect by providing shade and cooling. Through temperature stabilization—cooling during summer and retaining warmth during winter—urban greenery contributes to energy savings for cooling and heating buildings (Hernandez et al., 2018; D. Wang et al., 2024). For instance, green roofs, which are covered with vegetation and soil, function as natural insulators, enhancing the energy efficiency of buildings (Blessing Aibhamen Edeigba et al., 2024).

Another significant benefit of municipal greenery is its ability to reduce or prevent urban noise by acting as a natural barrier to noise pollution (Ak Mehmetali, Aslı Güneş Gölbey, 2021). Additionally, trees are considered the most cost-effective means of managing stormwater flow and mitigating floods. Vegetation slows down runoff velocity, which increases soil absorption capacity and reduces the likelihood of flooding (U.S. Environmental Protection Agency, 2024; Jafri, Rajaullah, 2018).

Green spaces play a vital role in conserving biodiversity by providing habitats for various species thereby enriching urban ecosystems and bolstering ecological resilience. Urban green islands support the development of birds, insects, and other living organisms, making them essential for wildlife conservation (Hernandez et al., 2018).

Health and Well-being

The natural environment plays a significant role in promoting well-being, as research suggests that exposure to nature has a direct and positive impact on both physical and mental health (Bowler et al., 2010). Interaction with the natural world is considered an integral part of biopsychosocial-spiritual well-being (Irvine, Warber, 2002). Individuals living in areas with more greenery experience better overall physical and mental health. A reduction in the amount of green space can therefore have health consequences (Maas et al., 2009). Spending time in nature reduces stress, anxiety, and depression while encouraging physical activity and improving general well-being. Urban greenery offers spaces for recreation, and relaxation, and supports healthy lifestyles. Access to open, natural, and green spaces promotes physical activity, which is a key factor in enhancing health and well-being (Mouratidis, 2021).

Activities such as walking, sitting on the grass, reading, and fishing, commonly enjoyed in green areas, are known to have beneficial physical, psychological, and health effects (Hernandez et al., 2018). Research has further established the correlation between shorter distances to green spaces from residences and a lower likelihood of obesity (Maas et al., 2009). Additionally, exposure to greenery is linked to a healthy immune system and a reduction in inflammatory diseases (Ruokolainen, 2015; Improving Access to Greenspace A New Review for 2020, 2020). Green spaces also have been shown to enhance people's concentration, assist in managing depression, and improve emotional and mental health (Psistaki et al., 2024). Furthermore, studies suggest that green areas around healthcare facilities positively affect patients' recovery (Jafri, Rajaulah, 2018). Limited access to natural environments may lead to negative outcomes such as social isolation, obesity, and chronic stress (Biazen Molla, 2015).

Cultural Value and Social Benefits

Urban greenery serves a multifaceted role, contributing to the structural, compositional, and aesthetic qualities of a city. It is a key element in the city's spatial design, shaping both the layout of urban interiors and complementing architectural structures (Kowalski, 2010). Any studies have highlighted the positive impact of improving green spaces on aesthetics, thanks to increased recreational areas, creating public spaces that make cities more attractive and liveable. Parks, gardens, and tree-lined streets not only shape the character of neighbourhoods but also help create memorable and unique urban landscapes.

Beyond their aesthetic and recreational value, green spaces provide essential areas for social interactions, relaxation. They serve as venues for social and cultural exchange, hosting events and gatherings that celebrate local traditions and cultural heritage (Blessing Aibhamen Edeigba et al., 2024). These spaces play a pivotal role in social life and contribute to building a shared identity among residents (Mouratidis, 2021). Furthermore, urban greenery has the potential to strengthen the sense of belonging among residents (Aslanoğlu et al., 2025). Additionally, research points to the connection between green spaces and broader social benefits, such as reducing crime, violence, and aggression (Sushinsky et al., 2017). The cultural services provided by urban green spaces are vital to health and well-being, though their significance is often undervalued (Jennings et al., 2016).

Economic Benefits

Urban greenery provides a wide range of essential services, one of which is the supply of valuable products such as fuel, wood, medicines, food, compost, and energy. While this service may be more noticeable in larger green spaces than in smaller urban areas, even urban greenery contributes to the production of these resources, offering benefits on a smaller scale (Byomkesh, 2012).

Among the undeniable economic benefits of urban greenery is the increase in property values. Greening an area enhances its aesthetic appeal, making neighbourhoods more attractive. People are naturally drawn to districts with parks and green amenities, creating demand for properties in these areas. This creates demand, which translates into economic gains for homeowners and landowners. Furthermore, businesses located near green spaces also report higher customer satisfaction and improved employee productivity, leading to economic gains for the local business community (Y. Wang et al., 2023).

Additionally, such areas generate economic benefits by attracting tourists and stimulating local economies, as well as by creating new jobs in the maintenance and management of these environments (Aslanoğlu et al., 2025). Moreover, urban greenery can help reduce healthcare costs by promoting active lifestyles and improving public health outcomes, offering long-term economic benefits by lowering the need for medical interventions related to sedentary behaviour and chronic diseases.

As previously mentioned, green infrastructure plays a crucial role in managing stormwater runoff, reduces flooding, and alleviating the pressure on municipal drainage systems; by doing so, it helps cities save money on maintenance and repairs, offering an economically sustainable solution. Urban greenery acts as a natural infrastructure that enhances the resilience of cities, becoming an essential component in adapting to the increasing frequency and intensity of extreme weather events (Aslanoğlu et al., 2025). Consequently, it contributes to the reduction of costs associated with damages caused by such events, supporting long-term urban sustainability.

Moreover, the benefits of green spaces—such as improved public health, reduced healthcare expenditures, and lower crime rates—highlight the broader social advantages that can be incorporated into landscape design. Integrating greenery into urban planning not only improves the quality of life for residents but also creates a safer, healthier, and more vibrant environment, fostering overall well-being and reducing societal costs (Keniger et al., 2013).

3. Research design/Methodology

The study concerned 123 municipalities in the Pomeranian Voivodeship (Figure 1) and served as a pilot study. The selection of the Pomeranian Voivodeship was based on convenience sampling, resulting from the location of the author's research institution within the region.



Figure 1. Research area.

Source: <https://e-mapa.net/>

The investigation was divided into three stages:

1. Identification of Green Area Functions - This stage involved a literature review to identify the various functions of green spaces. The results of this analysis are presented in the section The Role of Municipal Green Spaces in Social Life.

2. Quantitative Analysis of Green Areas. In this stage, several variables were analysed, including:

- The share of parks, green squares, and residential greenery in the total area.
- The share of green areas in the total area.
- Total green area per capita.
- The number of tree plantings and tree removals within a given territorial unit.

The data used in this stage were obtained from the Local Data Bank (BANK DANYCH LOKALNYCH, 2024), published on official portals by the Polish Central Statistical Office (GUS).

3. Analysis of Municipal Policies and Initiatives. Data for Stage Three were collected via public inquiries sent to all 123 municipalities in the Pomorskie Voivodeship, consisting of an 18-question survey. The inquiries included questions about the number of tree removal decisions issued, the number of trees removed between 2017 and 2022, and data on replacement plantings, such as the number of trees planted, species planted, and the financial resources allocated for these activities. Furthermore, the survey assessed whether municipalities were creating new green spaces or investing in biologically active surfaces. It also examined expenditures on urban greenery maintenance and external funding sources. Finally, the survey investigated whether municipalities had formal greening plans and staff or departments dedicated to these initiatives. Responses were received from seventy-three municipalities, while the remaining municipalities declined to participate, citing reasons such as lack of data, the extensive effort required to compile the requested information, or limited resources. The presented research is a pilot study; therefore, its results should not be generalized to the entire population of municipalities in Poland. However, at the local level — specifically within the Pomeranian Voivodeship — the analyses based on data from the Central Statistical Office (GUS) refer to the full population of municipalities in the region and are thus representative in that context.

The following sections present selected findings from the analyses conducted during Stages Two and Three of the study. As previously mentioned, certain limitations occurred in data collection. Limitations impacted the study, with full data available for the entire population of 123 communes in Stage Two and for seventy-three communes in Stage Three.

4. Results

In Stage Two, the analysis focused on factors such as the share of green areas in the total area of the commune and assessed whether the size or share of these areas changed between 2017 and 2022 (Table 1).

Table 1.

The share of green areas in the total area of the commune during 2017-2022

municipality	% in the total area 2022	difference 2017-2022	municipality	% in the total area 2022	difference 2017-2022	municipality	% in the total area 2022	difference 2017-2022
Pruszcz Gdański	5,14	1,36	Malbork	0,32	0	Parchowo	0,05	0
Hel	1,53	0,72	Tuchomie	0,29	0	Nowa Karczma	0,05	0
Kwidzyn	9,37	0,64	Gniew	0,28	0	Ryjewo	0,05	0
Kosakowo	1,29	0,59	Stare Pole	0,23	0	Lubichowo	0,05	0
Człuchów	21,25	0,35	Kartuzy	0,22	0	Skórcz	0,05	0
Puck	4,97	0,33	Miłoradz	0,17	0	Smoldzino	0,03	0
Rumia	3,94	0,28	Pelplin	0,17	0	Gniewino	0,03	0
Gdańsk	8,83	0,24	Liniewo	0,16	0	Luzino	0,03	0
Wejherowo	7,06	0,19	Potęgowo	0,16	0	Koczała	0,02	0
Starogard Gdański	3,61	0,16	Stary Targ	0,15	0	Sztutowo	0,02	0
Pszczółki	0,61	0,14	Człuchów	0,14	0	Stary Dzierżgoń	0,02	0
Wejherowo	0,16	0,08	Przodkowo	0,14	0	Żukowo	0,14	-0,01
Miastko	0,39	0,06	Główny	0,14	0	Nowy Staw	0,1	-0,01
Kolbudy	0,3	0,05	Czersk	0,13	0	Stegna	0,1	-0,01
Kolczygłowy	0,12	0,04	Dębica Kaszubska	0,13	0	Sierakowice	0,05	-0,01
Lichnowy	0,09	0,04	Subkowy	0,13	0	Krokowa	0,51	-0,01
Szemud	0,49	0,04	Starogard Gdański	0,11	0	Chojnice	0,36	-0,01
Chojnice	6,96	0,03	Rzecenica	0,1	0	Krynica Morska	0,26	-0,01
Reda	1,7	0,03	Przywidz	0,1	0	Czarne	0,19	-0,01
Kościerzyna	0,15	0,03	Sulęcyno	0,1	0	Gardeja	0,13	-0,01
Karsin	0,13	0,03	Sadlinki	0,1	0	Morzeszczyn	0,09	-0,01
Lipusz	0,08	0,03	Linia	0,1	0	Lipnica	0,13	-0,02
Dzierżgoń	0,94	0,03	Chmielno	0,09	0	Prabuty	0,13	-0,02
Nowy Dwór Gdański	0,23	0,02	Dziemiany	0,09	0	Konarzyny	0,03	-0,02
Somonino	0,11	0,02	Kaliska	0,09	0	Stężycza	0,23	-0,03
Mikołajki Pomorskie	0,08	0,02	Choczewo	0,09	0	Ustka	0,37	-0,04
Skarszewy	0,18	0,02	Łęczyce	0,09	0	Smętowo Graniczne	0,17	-0,06
Kobylnica	0,16	0,02	Cedry Wielkie	0,08	0	Władysławo	1,84	-0,07
Bytów	0,51	0,01	Puck	0,08	0	Słupsk	9,91	-0,09

Cont. table 1.

Nowa Wieś Lęborska	0,26	0,01	Zblewo	0,08	0	Sztum	0,18	-0,11
Kwidzyn	0,14	0,01	Czarna Dąbrówka	0,07	0	Pruszcz Gdański	0,24	-0,12
Cewice	0,13	0,01	Brusy	0,07	0	Skórcz	2,18	-0,13
Przechlewo	0,05	0,01	Ostaszewo	0,07	0	Gdynia	6,61	-0,15
Kępice	0,11	0,01	Osieczna	0,07	0	Malbork	9,64	-0,18
Redzikowo	0,11	0,01	Studzienice	0,06	0	Tczew	7,86	-0,21
Suchy Dąb	0,06	0,01	Trzebielino	0,06	0	Jastarnia	2,03	-0,3
Tczew	0,65	0	Stara Kiszewa	0,06	0	Kościerzyna	2,93	-0,33
Damnica	0,47	0	Wicko	0,06	0	Sopot	19,69	-0,5
Czarna Woda	0,37	0	Bobowo	0,06	0	Lębork	4,58	-0,57
Trąbki Wielkie	0,36	0	Osiek	0,06	0	Łeba	7,16	-0,77
Debrzno	0,34	0	Borzytuchom	0,05	0	Ustka	9,26	-1,48

Source: Own study based on GUS data.

The data presented in the Table 1 indicates that most of these communes maintained a stable share of green areas, with no significant changes during the period from 2017 to 2022. The highest share of green areas is in the commune of Człuchów (21.25%), followed by Sopot (19.69%), which has the second-largest share. However, Sopot has seen a slight decrease in green space share in recent years. Given the health-resort nature of the commune, this trend warrants close monitoring. The largest increase in the share of green areas was observed in Pruszcz Gdański (+1.36%), followed by increases in communes such as Hel (+0.72%), Kwidzyn (+0.64%), and Kosakowo (+0.59%). Communes like Słupsk (9.91%), Kwidzyn (9.37%), Malbork (9.64%), and Gdańsk (8.83%) showed stable shares, with only slight changes during the period 2017–2022. The most significant decreases in green space share were noted in Ustka (-1.48%) and Łeba (-0.77%), which is concerning given the tourist-oriented nature of these communes. Communes with a share of green areas below 0.1% of the total area include Parchowo (0.05%), Nowa Karczma (0.05%), Ryjewo (0.05%), Lubichowo (0.05%), and Smołdzino (0.03%). In general, positive change was observed in thirty-six communes, a negative change in 30 communes, and no change in 57 communes during the period 2017–2022.

In addition to the total area of green spaces, the accessibility of these spaces for residents is also important. The results for green space area per capita are presented in figure 2.

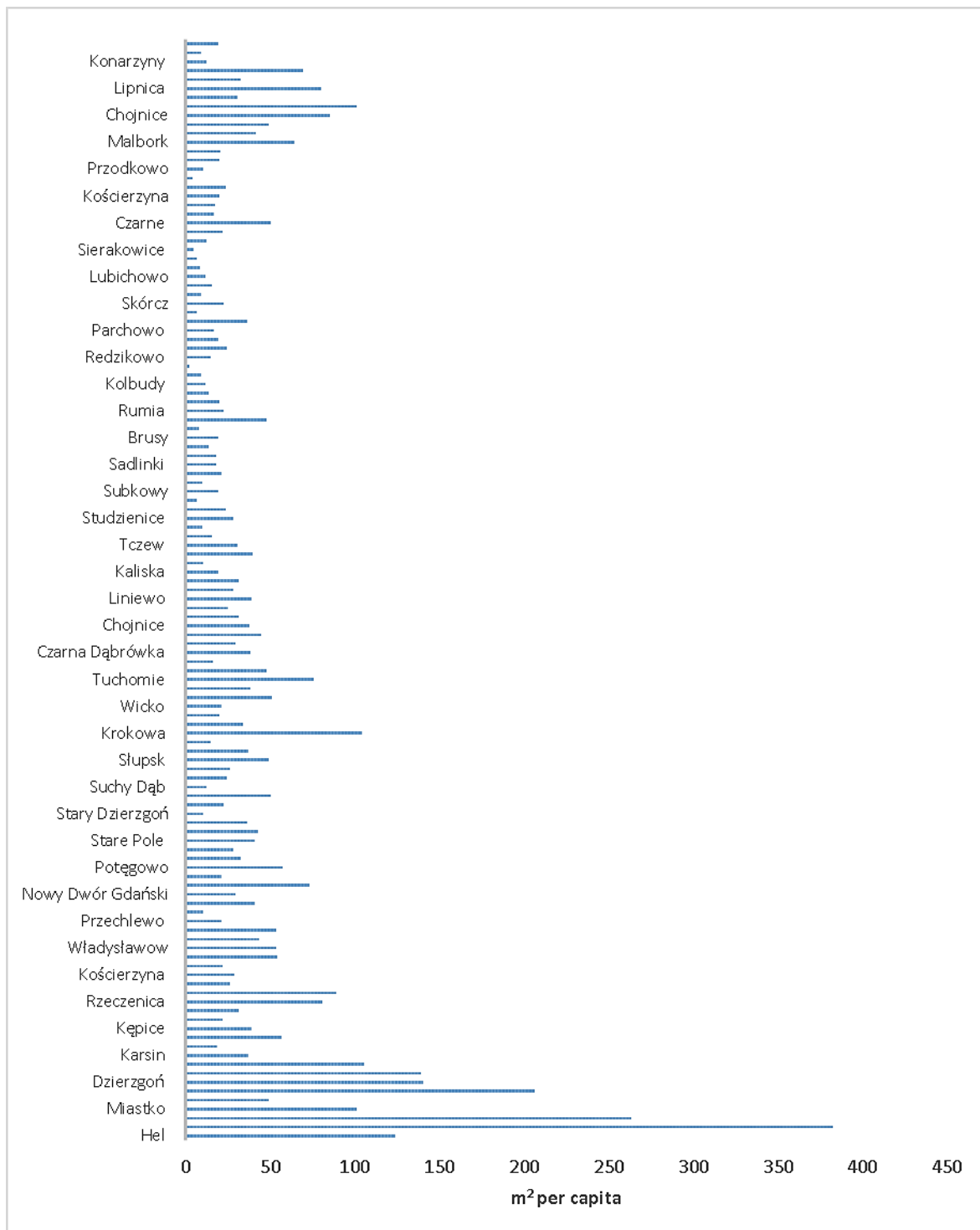


Figure 2. Green space area per capita (in m²).

Source: Own study based on GUS data.

The communes with the largest green space per capita are Łeba – 382.4 m², Krynica Morska – 263.2 m², and Ustka – 101.5 m². On the other hand, the communes with the smallest green space per capita include Luzino – 2.2 m², Gniewino – 7.1 m², and Sztutowo – 6.9 m². These differences are likely due to various factors, but it can be assumed that in more urbanized communes, such as Gdańsk and Gdynia, the green space per capita is smaller due to the higher number of residents in a smaller area. Conversely, tourist-oriented communes such as Hel,

Łeba, and Krynica Morska have a larger green space per capita, which results from a lower number of permanent residents. However, these trends should not be generalized across all communes.

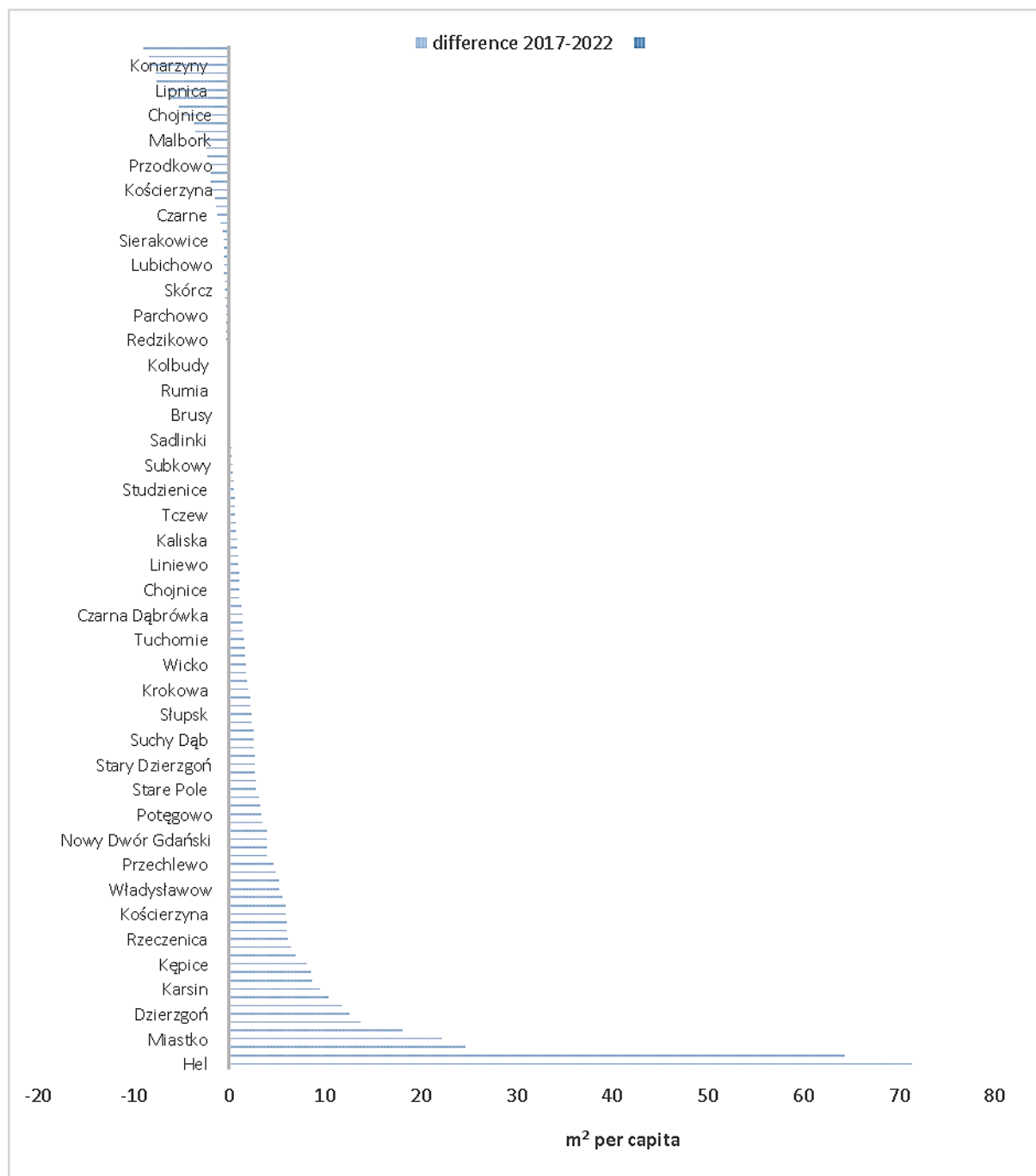


Figure 3. Changes in green space per capita between 2017 and 2022.

Source: Own study based on GUS data.

A key observation is that the majority of communes show an increase in green space per capita, which may suggest a generally positive trend during this period. The communes with the largest increase in green space per capita (2017-2022) include Hel (+71.4 m²), Łeba (+64.3 m²), and Krynica Morska (+24.7 m²). In contrast, communes with the largest decreases include Sztum (-9 m²), Pruszcz Gdański (-8.4 m²), and Konarzyny (-8.4 m²).

It should be noted that tourist-oriented communes such as Hel, Łeba, Krynica Morska, Sopot, and Ustka feature large green spaces per capita. These areas, often coastal, attract tourists and invest in recreational spaces. The reduction in green space in communes such as Sztum, Pruszcz Gdański, and Tczew is most likely due to the intensification of construction, infrastructure development, and urbanization.

The studies conducted in Stage 3 confirm that new investments are often a primary cause of tree cutting. Among the most frequently cited reasons for tree removal by municipal representatives were conflicts with planned investments, poor health of trees, health hazards, and landscaping needs, such as road shoulder management (figure 4).

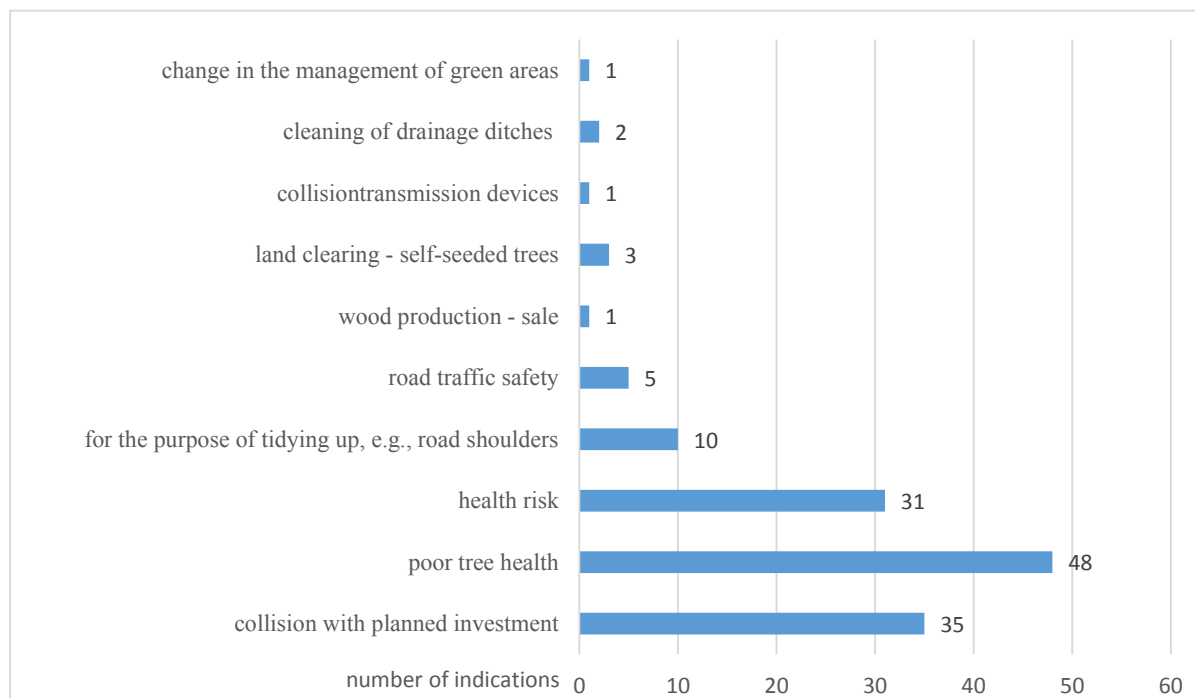


Figure 4. Reasons of cutting trees.

Source: Own study.

An analysis of the ratio of planted trees to those cut down, it can be observed that: municipalities with a significant negative difference (more trees cut than planted) include Gdańsk (-7,584), Gdynia (-3,404), Kaliska (-2,235), Rumia (-1,484), and Kosakowo (-988). These municipalities should be further analysed to understand the factors contributing to this deforestation trend. This could suggest a focus on urban development or other land uses, leading to a loss of green spaces.

Conversely, municipalities with a positive difference (more trees planted than cut down) include Koczała (+1,050), Skórcz (+1,050), and Nowy Dwór Gdański (+1,104).

The research also found that nearly one-third of the surveyed municipalities (22 out of 73) do not have a designated person or department responsible for planning tree plantings or removals. In those municipalities where responsibility was assigned, the relevant departments varied, including for example, the Municipal Department; Department of Geodesy, Spatial

Planning, and Environmental Protection; Department of Municipal Management and Environmental Protection; Environmental Protection Department; Department of Municipal Management; Technical Department of the City Office; Department of Municipal Management and Safety; City Gardener's Department; City Infrastructure Management Board; City Conservator of Monuments. As can be observed, not all of these departments are directly related to nature conservation or spatial planning.

Additional findings from the research include the following aspects:

- Only two of the municipalities had a greening plan.
- Only 11% of respondents reported having pocket parks in their municipality.
- Fifteen percent (11) of respondents have recently undertaken investments to increase biologically active areas, while 17 (23%) municipalities have made investment efforts in the field of small-scale retention.
- Municipalities have limited use of available external financing options for greening activities, such as EU programs—21 of them have received such funding.

In further research, analyses will be extended to other voivodeships. A handbook for Polish municipalities with good practices in the area of greenery management will also be created. Comparative studies over five years are also planned.

5. Conclusions

A pilot study on green space management in the Pomeranian Voivodeship highlights how urban green spaces are crucial to environmental sustainability, public health, and social well-being. The research revealed several key trends between 2017 and 2022: a general stability in the share of green areas across most municipalities, a notable increase in green space in tourist-oriented and coastal communes (e.g., Hel, Łeba), and a decline in others, especially in urbanized areas such as Pruszcz Gdański or Tczew — likely linked to development pressures and infrastructure expansion. Although green space per capita increased in the majority of municipalities, stark disparities remain, particularly between touristic and densely populated urban areas. The study identifies the need for an integrated approach to urban planning that prioritizes green space management as an essential component of sustainable development strategies at the municipal level. The study, designed as a pilot for a nationwide initiative, confirms the necessity of clearer municipal strategies and consistent implementation of green policies. It also highlights the need to strengthen data collection methods and raise public awareness to support informed, long-term planning. The analysis emphasizes the importance of integrating green space management into broader urban development frameworks as a practical pathway toward achieving Sustainable Development Goal 11 on sustainable cities.

Considering the findings, several strategic recommendations are proposed to enhance the effectiveness, coherence, and sustainability of urban green space management at the municipal level:

- Establish dedicated units or roles within municipal structures responsible for urban greenery. This structural solution would improve operational continuity and accountability.
- Strengthen the balance between tree removal and planting, particularly in areas affected by intensive development. This may include mandatory replacement ratios, species diversification, and post-planting care protocols.
- Promote the creation of small-scale green infrastructure, such as pocket parks, green courtyards, and biologically active surfaces.
- Enhance the use of external funding sources, including national and EU-level programs, to support investments in urban green infrastructure.
- Encourage inter-municipal knowledge exchange and dissemination of best practices in green space management.

References

1. Ak Mehmetali, Aslı Güneş Gölbey (2021). The role of urban green spaces in sustainable urban planning. *Journal of Urban and Landscape Planning*, 6.
2. Aslanoğlu, R., Kazak, J.K., Szewrański, S., Świader, M., Arciniegas, G., Chrobak, G., Jakóbiak, A., Turhan, E. (2025). *Ten questions concerning the role of urban greenery in shaping the future of urban areas. Building and Environment*, 267. <https://doi.org/10.1016/j.buildenv.2024.112154>
3. Biazen Molla, M. (2015). The Value of Urban Green Infrastructure and Its Environmental Response in Urban Ecosystem: A Literature Review. *CRDEEP Journals International Journal of Environmental Sciences Mikias Biazen Molla*, 4(2), pp. 89-101. www.crdeep.com
4. Blessing Aibhamen Edeigba, Ugochukwu Kanayo Ashinze, Aniekan Akpan Umoh, Preye Winston Biu, Andrew Ifesinachi Daraojimba (2024). Urban green spaces and their impact on environmental health: A Global Review. *World Journal of Advanced Research and Reviews*, 21(2), 917-927. <https://doi.org/10.30574/wjarr.2024.21.2.0518>
5. Bowler, D.E., Buyung-Ali, L.M., Knight, T.M., Pullin, A.S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*, 10. <https://doi.org/10.1186/1471-2458-10-456>
6. Byomkesh T.N.N. (2012). Urbanization and green space dynamics in Greater Dhaka, Bangladesh. *Landscape & Ecological Engineering*, pp. 45-58.

7. Dawidowicz, A., Nowak, M. (2022). *The concept of urban greenery management bodies (UGMB) organizational structure responsible for the implementation of green infrastructure in EU member state of Poland*, 2(1). <https://doi.org/10.57599/gisoj.2022.2.1.5>
8. Hernandez, J.G.V., Pallagst, K., Hammer, P. (2018). Urban Green Spaces as a Component of an Ecosystem Functions, Services, Users, Community Involvement, initiatives, and Actions. *International Journal of Environmental Sciences & Natural Resources*, 8(1). <https://doi.org/10.19080/ijesnr.2018.08.555730>
9. Irvine, K.N., Warber, S.L. (2002). Greening healthcare: practicing as if the natural environment really mattered. *Altern Ther Health Med.*, 8(5), pp. 76-83.
10. Jafri, Ar. Mohd. S., Rajaullah, Ar. M. (2018). Evaluating the Urban Green Spaces: Benefits and Issues. *International Journal of Engineering Research*, 7(special 3), 269. <https://doi.org/10.5958/2319-6890.2018.00074.0>
11. Karade Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, R., Salma Sri Konda Laxman, Z. (2017). *The Role of Green Space for Sustainable Landscape Development in Urban Areas*. <https://doi.org/10.15515/iaast.0976-4828.8.2.5154>
12. Keniger, L.E., Gaston, K.J., Irvine, K.N., Fuller, R.A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health*, Vol. 10, Iss. 3, MDPI, pp. 913-935. <https://doi.org/10.3390/ijerph10030913>
13. Kowalski, P. (2010). Zielona infrastruktura w miejskiej przestrzeni publicznej. *Czasopismo Techniczne. Architektura*, R. 107, z. 2-A, pp. 247-253.
14. Maas, J., Verheij, R.A., De Vries, S., Spreeuwenberg, P., Schellevis, F.G., Groenewegen, P.P. (2009). Morbidity is related to a green living environment. *Journal of Epidemiology and Community Health*, 63(12), 967-973. <https://doi.org/10.1136/jech.2008.079038>
15. Maes, M.J.A., Jones, K.E., Toledano, M.B., Milligan, B. (2019). Mapping synergies and trade-offs between urban ecosystems and the sustainable development goals. *Environmental Science & Policy*, 93, 181-188. <https://doi.org/10.1016/J.ENVSCI.2018.12.010>
16. Mouratidis, K. (2021). Urban planning and quality of life: A review of pathways linking the built environment to subjective well-being. *Cities*, 115. <https://doi.org/10.1016/j.cities.2021.103229>
17. Nowak, D.J., Crane, D.E., Stevens, J.C. (2006). Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry and Urban Greening*, 4(3-4), 115-123. <https://doi.org/10.1016/j.ufug.2006.01.007>
18. Psistaki, K., Tsantopoulos, G., Paschalidou, A.K. (2024). An Overview of the Role of Forests in Climate Change Mitigation. *Sustainability (Switzerland)*, Vol. 16, Iss. 14. Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/su16146089>
19. Public Health England. *Improving access to greenspace A new review for 2020* (2020).

20. Ruokolainen L., v. H. (2015). Green areas around homes reduce atopic sensitization in children. *Allergy*, 70(2), pp. 195-202.
21. Sushinsky, J.R., Rhodes, J.R., Shanahan, D.F., Possingham, H.P., Fuller, R.A. (2017). Maintaining experiences of nature as a city grows. *Ecology and Society*, 22(3). <https://doi.org/10.5751/ES-09454-220322>
22. The World Bank Group (2024). https://data.worldbank.org/indicator/SP.POP.GROW?most_recent_value_desc=false
23. U.S. Environmental Protection Agency (2024). *Using Green Roofs to Reduce Heat Islands*, <https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands>.
24. Ustawa z dnia 16 kwietnia 2004 r. o ochronie przyrody (t.j. Dz.U. z 2024 r., poz. 1478).
25. Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym. (Dz.U. z 2024 r., poz. 1465 ze zm).
26. Wang, D., Xu, P.Y., An, B.W., Guo, Q.P. (2024). Urban green infrastructure: bridging biodiversity conservation and sustainable urban development through adaptive management approach. *Frontiers in Ecology and Evolution*, 12. <https://doi.org/10.3389/fevo.2024.1440477>
27. Wang, Y., Yang, Y., Sun, Y., Lyu, S., Zhang, Z., Liu, D., Wei, S., Liu, S., Wang, M. (2023). Public perception and preferences of industrial green infrastructure in Northwest China. *Ecological Indicators*, 156. <https://doi.org/10.1016/j.ecolind.2023.111123>
28. Żylicz, T. (2020). Urban greenery management problems. *Ekonomia i Środowisko*, 75, pp. 8-22. <https://doi.org/10.34659/2020/4/29>

INTENSITY OF MARITIME TRAFFIC ON THE KOŁOBRZEG-BORNHOLM ROUTE AND SAFETY OF NAVIGATION: RISK ANALYSIS AND RECOMMENDATIONS

Diana KOTKOWSKA^{1*}, Maciej KOŚCIELECKI²

¹ Navigation Department, Maritime University of Szczecin; d.kotkowska@pm.szczecin.pl,
ORCID: 0000-0001-8233-2356

² Navigation Department, Maritime University of Szczecin; m.koscielecki@pm.szczecin.pl,
ORCID: 0000-0001-5927-9542

* Correspondence author

Purpose: The objective of the study was to analyse the intensity and structure of maritime traffic on the Kołobrzeg–Bornholm route and to identify areas of increased navigational risk.

Design/methodology/approach: AIS data and HELCOM accident records from 2004 to 2023 were used. The analysis was carried out using the IALA IWRAP Mk2 tool, based on the Formal Safety Assessment (FSA) methodology, taking into account risk matrices and elements of the logic tree method.

Findings: Clear differences in traffic intensity were identified on three sections (LEG 9-11). The highest traffic load occurs in LEG 11 (over 5500 vessels, mainly cargo ships and tankers). LEG 10 serves as a transit route, while LEG 9 serves as a local route. The areas with the highest traffic coincide with the locations of historical maritime accidents. The results are presented in the form of intensity matrices and heat maps.

Research limitations/implications: The study does not include an analysis of the costs of the proposed solutions or the legal issues related to their implementation, which limits the possibility of a full assessment of the feasibility of the recommendations. Technical risks, such as navigation system disruptions, and the perspective of local stakeholders, which is important for the practical implementation of the changes, have also been omitted.

Practical implications: The results obtained may support the decisions of maritime authorities and safety system operators. It is recommended to implement a VTS system, TSS plans and improve traffic organisation in the Kołobrzeg port area.

Social implications: The proposed measures may increase navigation safety, environmental protection and reduce the number of accidents, especially in the recreational and passenger sectors. The study also supports the concept of sustainable maritime transport.

Originality/value: The study integrates AIS and HELCOM data and the FSA approach for a specific region of the Baltic Sea. It is one of the few studies on the Kołobrzeg–Bornholm route and may be useful for decision-makers and the scientific community involved in maritime safety.

Keywords: AIS, navigational safety, maritime risk assessment, Formal Safety Assessment, risk matrix, logical tree method.

Category of the paper: Research paper.

1. Introduction

The South Baltic region, which includes the Pomeranian Bay, the island of Bornholm and the Polish coast with the port of Kołobrzeg, is an important shipping hub for both cargo and passenger shipping. The busy pattern of shipping routes in the region indicates a high level of traffic intensity - especially in the area between Bornholm and the coast of Central Pomerania. A significant proportion of this traffic is generated by the international ferry connection between Kołobrzeg and the port of Nexø on Bornholm, which has not only a transport function, but also a tourist and economic function.

Data from the Kolobrzeg Seaport Master Plan shows that already in 2018, approximately 30,000 passengers used the Kolobrzeg-Bornholm ferry connection (Master Plan ZPM v.3.0). This figure shows that the route is in high demand, with the port of Kolobrzeg playing an important role in the connections to Denmark and Scandinavia. In addition to simply transporting passengers, this route is also important for the development of tourism, trade and interregional cooperation.

The aim of this study is to identify the structure and intensity of maritime traffic on the Kołobrzeg–Bornholm route and to indicate areas of increased navigational risk. The study is based on an analysis of AIS data and HELCOM marine accident records from 2004 to 2023, using the IALA IWRAP Mk2 tool. The methodology is embedded in the Formal Safety Assessment (FSA) framework, and the results obtained were evaluated using a risk matrix and decision tree elements.

The main research hypothesis assumes that the greatest threats to navigation safety in the study area occur in areas with the highest traffic density and where local routes intersect with international shipping lanes. The specific objective is to indicate whether the current traffic organisation requires systemic intervention (e.g. in the form of VTS or TSS).

The planned expansion of Kolobrzeg's port infrastructure, including the construction of a modern ferry terminal with logistics facilities and parking spaces, is intended to further increase the capacity of this route and improve the quality of passenger service (Master Plan ZPM v.3.0). In addition to its transport function, the terminal is also intended to integrate cultural and tourist functions, acting as a natural barrier separating the transshipment part from the spa and resort part.

Taking into account analyses of vessel traffic at sea and planned investments, it can be concluded with high probability that the intensity of shipping in the area will continue to increase. Ensuring navigational safety, protecting the marine environment and further developing the infrastructure to handle the growing number of vessels and passengers therefore remains a key challenge. The remainder of this article will examine in more detail the traffic structure, the impact of the Kolobrzeg-Bornholm connection on the region and the prospects for its development.

Despite the growing importance of maritime transport in the southern Baltic Sea region, previous studies have focused mainly on major transit routes and ports in large agglomerations. There is a lack of detailed analyses of smaller but heavily used local routes, such as Kołobrzeg–Bornholm, particularly taking into account AIS operational data, local conditions and risk analysis.

According to the available literature, no studies have been found that directly address the assessment of navigation safety on this specific route using the FSA methodology and IWRAP tools. This study therefore fills an important research gap and provides both practical and scientific value, serving as a basis for further operational analysis and maritime traffic management decisions.

2. Literature review and safety standards

2.1. Maritime incidents and case studies

A study by Goerlandt and co-workers analysed 45 marine incidents during the winter season in the North Baltic area. The findings indicate that collisions are particularly common in convoy navigation situations involving icebreakers, where deteriorating manoeuvring conditions and reduced visibility increase the likelihood of bow collisions (Goerlandt et al., 2017).

In turn, the MIMIC project analysis shows that in addition to typical maritime accidents, the region is also exposed to threats of an asymmetric nature, including acts of infrastructure sabotage, cyber attacks or illegal discharges of dangerous cargo. Although the risk of classic piracy is assessed as low, the Baltic should be treated as an area of high vulnerability to critical infrastructure disruption incidents (Fransas et al., 2013; Tuominen, 2013).

Statistical studies (Usecicz, 2018) and expert assessments confirm that human error, technological limitations (e.g. faulty AIS data or outdated electronic charts) and the complexity of the navigational situation are the main determinants of incidents, even in seemingly routine coastal routes.

2.2. Risk assessment models and methods

In analytical practice in the Baltic, the FSA (Formal Safety Assessment), recommended by the IMO, is most commonly used. It consists of five steps: hazard identification, risk analysis, assessment of mitigation actions, cost-benefit analysis and formulation of recommendations (IMO, 2015; Shin, 2019).

For the quantitative assessment of the risk of collision and shoaling, the IWRAP Mk2 model developed by IALA is a particularly useful tool. This programme estimates the probability of incidents based on AIS data and the trajectories of vessels in designated shipping corridors.

Its application in the Baltic region allows for an accurate mapping of the risk profile and the identification of critical points (Szubrycht, 2020; IALA, 2012).

Non-standard risk analyses (e.g. sabotage, criminal activity), on the other hand, used the three-stage 'threat-vulnerability-consequence' model developed in the MIMIC project. This model combines the assessment of threat credibility, target vulnerability and possible consequences, offering a flexible approach to hybrid risk (Tuominen, 2013).

2.3. Research methodology

The aim of this study was to investigate the intensity and structure of maritime traffic in the South Baltic, with a focus on the Kolobrzeg-Nexo (Bornholm) ferry route and its shipping environment. The study was carried out according to the following steps shown in Figure 1.

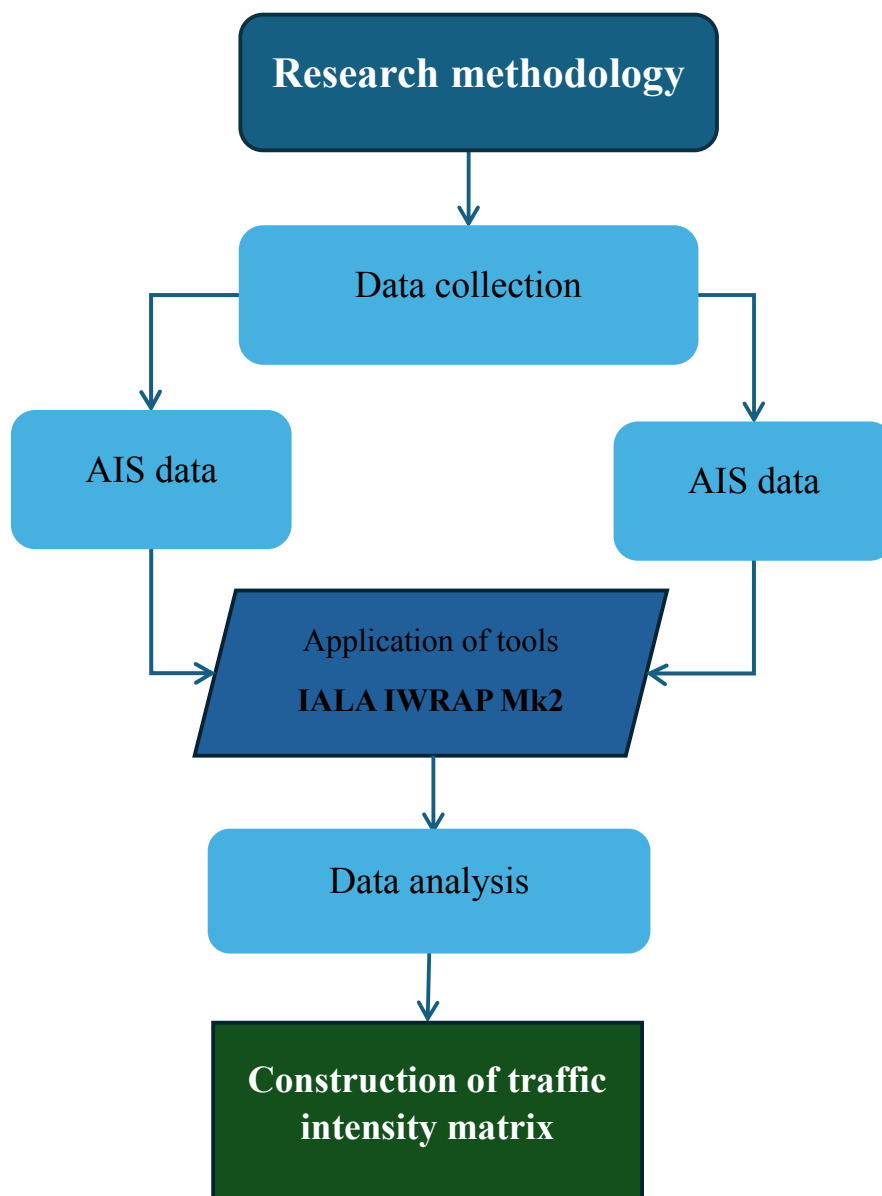


Figure1. Stages of traffic intensity analysis.

Source: own elaboration.

The primary source of data was the AIS (Automatic Identification System), an automatic vessel identification system that allows the position, course, speed, vessel type and its technical parameters (length, draught, (IMO) type) to be tracked in real time. AIS data was obtained from publicly available databases, as well as in cooperation with maritime institutions and maritime surveillance system operators.

Complementary data from Maritime Authorities were used on port classification, vessel assignment to specific routes and seasonal characteristics of traffic in the analysed basin.

All registered vessels were assigned to one of six categories:

- freighters (cargo) - vessels transporting bulk and general cargo,
- ferries - mainly passenger-car ferries, including the Kołobrzeg-Nexo ferry,
- fishing boats - vessels active in the coastal strip,
- recreational craft - smaller motor boats and sailing boats,
- yachts - sailboats registered in Baltic ports and visiting Kolobrzeg,
- passenger vessels - larger units serving tourist traffic.

For data analysis, the tool used was **IALA IWRAP Mk2** (Interactive Web-based Review and Analysis Platform), which allows:

- loading and filtering large AIS data sets,
- visualisation of traffic intensity over a given time and spatial interval,
- classification of units by type and technical parameters,
- export of heat maps and charts for further analysis and presentation of results.

Thanks to these functionalities, it was possible to present both an overall picture of maritime traffic and detailed trends in ferry and fishing traffic in the analysed area.

Based on the collected data, a traffic intensity matrix was developed, showing the number of units crossing specific sectors of the geographical grid (grids) in units of time (hours, days, weeks). Each cell of the matrix corresponds to a specific section of the water body and contains information on:

- the number of units assigned to a given type,
- the frequency of their presence in a given sector,
- the duration of stay within a sector.

The matrix was generated using the in IALA **IWRAP Mk2** tool and provided the basis for creating heatmaps showing the traffic intensity in different parts of the analysed area. This made it possible to precisely delineate the most heavily used routes and traffic congestion areas, including sensitive sections around Bornholm and the approaches to Kołobrzeg.

2.4. Research gap and development of AIS-based approaches.

In recent years, researchers have been increasingly interested in the use of AIS data in the context of preventive maritime risk assessment. Du et al. (2021) proposed an innovative approach to detecting near misses in the northern Baltic Sea, pointing to the possibility of

combining vessel trajectory data with the interpretation of navigational manoeuvres. This study is an important reference point for the development of tools to support real-time risk assessment.

In turn, the work of Kiersztyn et al. (2025) focuses on the quality of AIS data, analysing the impact of errors and omissions in the data on the accuracy of statistical inference and risk modelling. It was pointed out that irregularities in the input data can significantly distort the picture of navigational hazards, which should be taken into account when planning preventive measures.

Hybrid threats are also an important issue in the latest literature. Zaharia (2024) discusses cases of GPS and AIS interference in the Baltic Sea region, pointing to the growing risk of spoofing and jamming in the context of maritime safety and critical infrastructure. These phenomena, although often difficult to detect, can significantly affect the effectiveness of traffic monitoring systems.

Despite developing research in these areas, there is a lack of studies combining operational analysis of local traffic, risk assessment and the specific characteristics of smaller but intensive routes, such as Kołobrzeg–Bornholm. This paper attempts to fill this gap by integrating AIS data, spatial analysis and elements of the FSA methodology using a specific shipping route as an example.

3. Characteristics of the study area and measurement points used

3.1. Gate Traffic Analysis

As part of the detailed analysis of marine traffic intensity in the Kolobrzeg area, three measurement gates (gate lines) were defined, located at strategic locations in the southern Baltic in the immediate vicinity of the port. Their purpose was to:

- to capture the traffic intensity on the Kolobrzeg-Nexo (Bornholm) ferry route,
- recording vessels travelling on the latitudinal (west-east) transit axis,
- measuring local entry/exit traffic to the port of Kołobrzeg, including fishing and tourist traffic.

Each of the gates was oriented perpendicularly to the main direction of unit flow. In addition, histogram grids were used to enable:

- counting units by type (freight, passenger, fishing, recreational),
- analysis of directions (e.g. northbound or southbound),
- evaluation of seasonal traffic patterns.

Figure 2 shows three gates: LEG-9, LEG-10 and LEG-11, located in the Kołobrzeg area. Each has a distinct analytical function - from recording ferry traffic, to international transit, to local port activity.

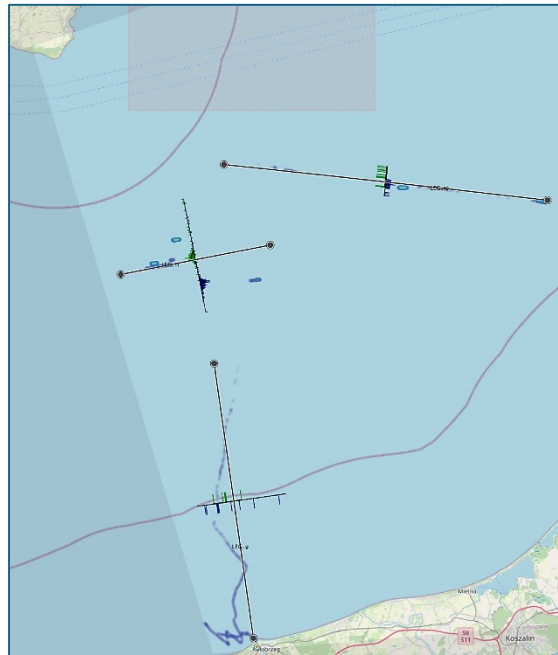


Figure 2. Survey gates.

Source: own elaboration in IWRAP Mk2 software.

- LEG-9 (Kołobrzeg – Bornholm).
The gate, aligned north-south, crosses the main passenger ferry route between Kołobrzeg and the port of Nexø on Bornholm. It also analyses local fishing and recreational traffic. The histogram clearly shows more northbound traffic, especially in summer.
- LEG-10 (latitudinal transit).
A gateway aligned parallel to latitude, crossing one of the main Baltic transit routes (from Germany and Denmark towards the Gulf of Gdansk). It records mainly large commercial units. Histograms show intense and balanced traffic in both directions (east ↔ west).
- LEG-11 (entrance to Kołobrzeg harbour).
Closest to shore, gate positioned perpendicular to the approach track to Kołobrzeg harbour. It allows accurate registration of all vessels entering and leaving the port: cutters, passenger ships, yachts and commercial vessels. Visible intensity of local traffic.

Each of the three gates was the entry point for developing a traffic intensity matrix, which was used to create heat maps, daily profiles and seasonal analyses. Their distribution allowed the precise capture of both international traffic and local port activity in Kołobrzeg.

3.2. Shape of the Seabed and Depths

The analysed area is characterised by varied bathymetry. In the immediate vicinity of the coast (near Kołobrzeg), shallows of up to 15-20 metres dominate, with clearly marked coastal strips and naturally occurring seabed elevations. North of the Kołobrzeg-Bornholm line, in the vicinity of the fairways and transit lanes, depths reach 40-60 metres, allowing for free passage of seagoing vessels.

The main shipping lanes coincide with areas with depths of more than 30-40 metres, making them optimal for large vessels. The area does not contain significant underwater obstacles, but its structure - combined with the high volume of traffic - requires careful navigational coordination.

3.3. Characteristics of maritime traffic Kołobrzeg-Bornholm

Below is Table 1 showing comparative data from the three offshore sections of the routes (LEG 9, 10 and 11) on the intensity and structure of vessel traffic.

Table 1.
Traffic intensity and structure at gates LEG 9 – LEG 11

LEG	North/West traffic	South/East traffic	Details North/West	South/East detail
LEG 9	90	151	Cargo: 30, Recreational: 60	Fishing: 45, Recreational: 91, Other: 15
LEG 10	210	302	Tankers: 60, Cargo: 120, Passenger: 15, Support: 15	Cargo: 287, Passenger: 15
LEG 11	2664	2864	Tankers: 452, Cargo: 2122, Passenger: 45, Support: 30, Others: 15	Tankers: 605, Cargo: 2003, Passenger: 45, Support: 91, Recreational: 30, Other: 90

Source: own elaboration.

Interpretation of the data from the three consecutive sections of the sea route between Kołobrzeg and Bornholm (LEG 9-11) allows one to see a clear functional division of the route and differentiation in the intensity and type of sea traffic. LEG 9, located closest to Kołobrzeg, is characterised by the lowest traffic intensity and a predominance of recreational vessels (151 in total in the southern traffic and 60 in the northern traffic) and fishing vessels (45). There are also single cargo vessels. This demonstrates the local character of this section - it mainly serves tourism, fishing and the port of Kołobrzeg. LEG 10 has an intermediate function between coastal zone and the main route. Traffic here is more diversified - cargo ships dominate (more than 400 units in both directions), and there are also tankers and passenger ships. This is a typical transit section, connecting the port to the open sea. Although its width is smaller than the others (only 5000 m), its draught and length allow it to handle large commercial vessels. LEG 11 is the main maritime traffic corridor in the study area. It records very intensive traffic - more than 5500 vessels in both directions combined. The predominant vessels are cargo ships (more than 4100), tankers (1057) and support and passenger vessels. Interestingly, pleasure craft and various other vessels also appear, indicating the great diversity of functions

of this route. LEG 11 has the largest draught (up to 15 m), allowing it to handle the largest vessels. It is undoubtedly the most important section in the route analysed.

From a spatial point of view, a clear shift in the functions of the route can be seen: from local port service at LEG 9, through the transitional section at LEG 10, to the wide, deep and most heavily trafficked international maritime corridor at LEG 11. This distribution is indicative of a functional layering of traffic, with each section playing a different, complementary role in the Baltic Sea transport system.

4. Traffic intensity matrix and shipping safety analysis

Based on the collected maritime traffic data in sections LEG 9, LEG 10 and LEG 11, as well as maritime accident data collected by HELCOM between 2004 and 2023 (43 incidents in the South Baltic), a maritime traffic intensity matrix was developed. The matrix was generated using processed data from the IALA IWRAP Mk2 programme and included:

- the number of vessels assigned to a given type (cargo, tankers, recreational, passenger, etc.),
- the frequency of their presence in a given geographical sector,
- the dwell time of the vessels in the grids analysed.

This made it possible to create a heatmap showing the highest traffic density.

The highest density was recorded in the LEG 11 section, where more than 5500 vessels passed through the analysed sector, including as many as 4000 cargo ships and 1000 tankers. This is a strategic international route - both in terms of traffic volume and in terms of the characteristics of the ships with large draught and tonnage.

In the LEG 10 section, traffic was moderate but varied - cargo vessels and tankers dominated, while in LEG 9, located closest to Kołobrzeg, recreational and local traffic (boats, fishing boats) prevailed. The draught of vessels in this section was the lowest, which limited the possibility for larger vessels to enter.

HELCOM data indicate 43 maritime incidents in the analysed region over the last 20 years. The apparent concentration of incident points around Kołobrzeg and on routes leading to Bornholm may be related to traffic congestion in key sectors and the presence of a variety of vessel types on common routes. Particularly sensitive are the intersections between local and international routes - typical, for example, of the LEG 10 transition section.

The matrix in Figure 3 below shows the spatial intensity of maritime traffic in the Kolobrzeg-Bornholm route area, divided into a 3x3 grid corresponding to the geographical sectors. Values in cells are the total number of vessels registered in a given area.

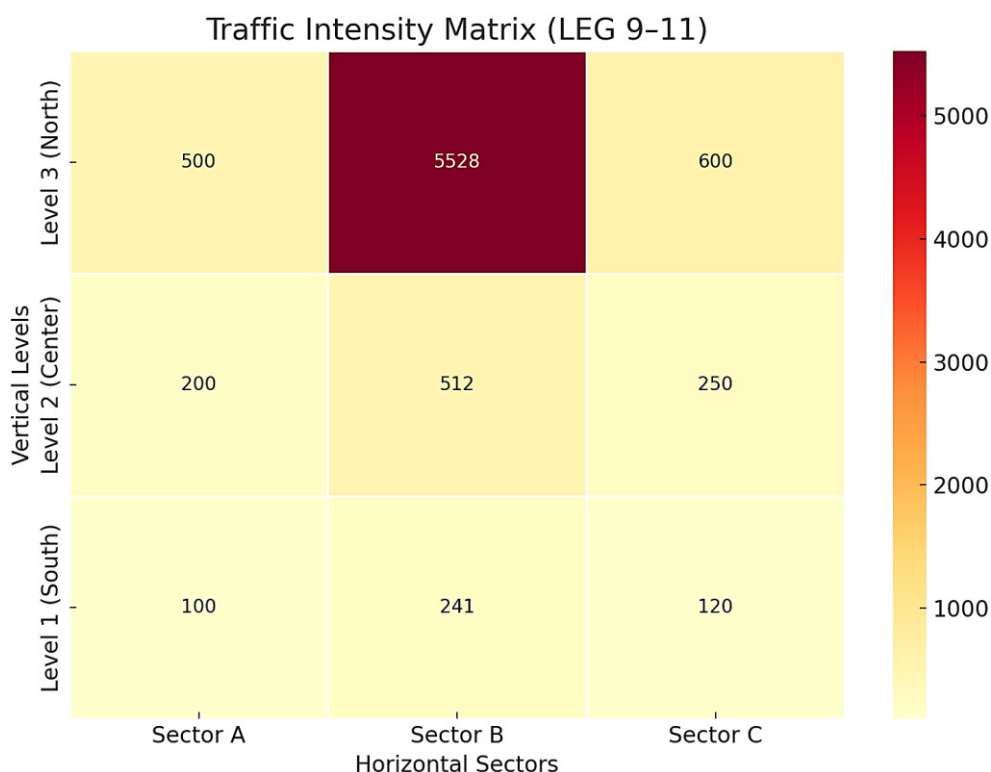


Figure 3. Traffic intensity matrix.

Source: own elaboration.

The highest intensity is found in the middle sector of the northern level (Sector B, Level 3) - this corresponds to section LEG 11. As many as 5528 vessels passed through this section, confirming its role as a major international maritime corridor. LEG 10, represented by the middle sector of the middle level (Sector B, Level 2), shows moderate traffic - 512 units, mainly cargo ships and tankers. LEG 9, i.e. the sector closest to the Kołobrzeg coast (Sector B, Level 1), is the area with the lowest traffic (241 units) - dominated by recreational and fishing vessels.

5. Discussion

The analysis of maritime traffic on the Kołobrzeg–Bornholm route provided valuable operational data, but for a more complete picture, several important limitations must be taken into account. Firstly, the study omitted a cost-benefit analysis of the proposed measures, which is an important element of the FSA methodology. An estimated economic assessment of the implementation of VTS or TSS systems could increase the practical significance of the recommendations. Secondly, the effectiveness of implementation depends on legal conditions and the need for coordination with international institutions, which may slow down the

decision-making process. This is particularly true for the reorganisation of shipping routes in areas with complex jurisdictions.

Due to the growing threats related to the disruption of electronic and navigation systems, future research should also consider less typical forms of risk.

The introduction of new technical solutions should be carried out in cooperation with local maritime authorities, such as port authorities, ferry operators and waterway users, as their involvement may determine the success of the entire project.

6. Conclusions and Recommendations

On the basis of the conducted study, which included analysis of AIS data, assessment of maritime traffic intensity and HELCOM maritime incident records, it was possible to obtain a complete picture of the functioning of the shipping lane between Kołobrzeg and Bornholm. This approach made it possible not only to identify areas with the highest traffic density, but also to identify sectors particularly exposed to navigational risk.

The highest density of vessels was recorded on the section designated as LEG 11, which functions as the main transit channel in the area. A significant number of vessels - more than 5500 - move there, of which cargo vessels and tankers predominate, often with considerable draught and displacement. Their presence in large numbers generates considerable strain on maritime infrastructure and raises the potential risk of collisions. Significantly, it is in this area that the highest number of maritime accidents has been recorded in the last two decades, as confirmed by analysis of HELCOM data. LEG 10 acts as a buffer - a transition zone - where local and international traffic mixes. The presence of vessels of different types, including passenger, commercial and auxiliary vessels, creates conditions conducive to incidents, especially when crossing routes or changing courses in a confined space. On the other hand, LEG 9, located closest to the shoreline and the port of Kołobrzeg, serves mainly recreational craft, fishing boats and coastal traffic. Despite the relatively small number of vessels passing through there, it is on this section that special attention should be paid to the risk of collision with larger harbour craft. Traffic with different technical characteristics - e.g. motor boats and commercial vessels - moves in the same body of water, without a clear separation of lanes.

In the light of the above observations, it is reasonable to make some specific recommendations to improve the safety of navigation and to manage maritime traffic in the study area more efficiently. Firstly, it is advisable to implement a VTS (Vessel Traffic Service) system in the most heavily trafficked sections, especially within LEG 11 and LEG 10. This will allow for the real-time tracking of vessels and the prevention of potential collision situations. The next step should be to consider the formal introduction of segregated maritime traffic lanes (TSS), which will sort out navigation directions and reduce the risk of navigational errors.

With regard to LEG 9, it is recommended to intensify surveillance activities and to develop local rules on priority and safe speed, taking into account the specificities of recreational and fishing vessels. Cyclical analysis using tools such as IWRAP Mk2 should also be an important supporting activity, allowing early detection of changes in traffic intensity and allowing response to emerging risk 'hotspots'. It is also not insignificant to strengthen cooperation with international institutions such as HELCOM, which collect accident data and enable early predictive analysis.

In conclusion, managing maritime traffic on the Kołobrzeg-Bornholm route requires a holistic approach based on both historical data and predictive analysis. Although the region is not one of the most congested globally, its particular location - at the junction of local and transit routes - means that even relatively minor disruptions can lead to major incidents. The recommendations presented in this thesis can serve as a starting point for further institutional action and as a basis for formulating maritime security policies locally and regionally.

The vessel traffic occurring between the island and the Polish coast may be an important aspect in planning a permanent ferry connection between Kołobrzeg and Bornholm, in particular with regard to the selection of the vessel or vessels and planning the schedule of courses, the optimal route of the vessel or vessels providing transport services. The intensity of vessel traffic in the analysed area, is a key factor that will influence the plans and implementation of the ferry crossing in terms of safety and economic aspects.

Further actions should include conducting a cost-benefit analysis of the proposed technical solutions (e.g. VTS, TSS), which will enable rationalisation of investments in the context of limited resources. It is also worth planning a phased implementation model (e.g. pilot in LEG 11). It would also be a good idea to consult with representatives of the maritime sector to take their views into account when planning actions. This approach will ensure greater effectiveness and social and institutional acceptance of measures to improve navigation safety.

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References

1. Du, Lei et al. (2021). Improving near miss detection in maritime traffic in the northern Baltic sea from ais data. *Journal of Marine Science and Engineering*, 9.2, 180.
2. Fransas, A., Nieminen, E., Salokorpi, M. (2013). *Maritime Security in the Baltic Sea Region*. Kymenlaakso UAS.
3. Goerlandt, F., Valdez Banda, O., Ahonen-Rainio, P. et al. (2017). An analysis of wintertime navigational accidents in the Northern Baltic Sea. *Safety Science*, 92, 66-84.
4. HELCOM (2021). *Annual report on shipping accidents in the Baltic Sea region*.
5. Kaup, M., Ozowicka, B. (2015). Analysis of maritime accident reports for the Baltic Sea. *Zeszyty Naukowe AM Szczecin*, 44.
6. Kiersztyn, A. et al. (2025). Data integrity vs. inference accuracy in large AIS datasets. *arXiv preprint arXiv:2501.03358*.
7. Lim, J., Kim, J., Yeo, G.T. (2018). Analyzing factors affecting maritime safety using AIS data. *Journal of Navigation*, 71(3), 588-602.
8. Master Plan ZPM Kołobrzeg Sp. z o.o. (2018).
9. Shin, S.Y. (2019). Implementation of FSA in regional maritime transport policy. *Maritime Policy & Management*, 46(5), 597-614.
10. Szubrycht, T. (2020). *Marine Risk Assessment in the Baltic Region*. Gdynia: Academy of Naval Science.
11. Tuominen, R. (2013). *Security Threat Analysis Model*. VTT Technical Research Centre of Finland.
12. Usewicz, B. (2018). Principles of risk analysis in shipping systems. *Zeszyty Naukowe UMG*, 103.
13. Zaharia, P. (2024). *Maritime Dangers of GPS/AIS Spoofing and Jamming in the Baltic Sea*. Erişim Tarihi: Risk Intelligence.

ANALYSIS AND ASSESSMENT OF THE FINANCIAL POSITION OF COMPANIES LISTED ON THE WARSAW STOCK EXCHANGE IN 2014-2023 USING CASH FLOW PATTERNS

Tomasz MAŚLANKA

UEK Cracow, Department of Corporate Finance; maslankt@uek.krakow.pl, ORCID: 0000-0001-7005-8417

Purpose: The purpose of this article is to analyse the financial position of business entities using Cash Flow patterns.

Design/methodology/approach: the theoretical considerations presented in this publication are based on a critical analysis of the literature on the subject. The empirical part presents an analysis based on the financial data derived from individual financial statements of non-financial entities listed on the Warsaw Stock Exchange in the period 2014-2023. A total of 2945 observations on 366 listed entities were analysed.

Findings: among the observations to be noted is the fact that positive cash flows from core activities dominate among the business entities considered. The most common pattern, that was identified, was variant 2 (+, -, -), describing business entities that remain in a good financial position. Among the variants characterized by negative cash flows from operating activities, pattern number 6 (-, -, +) was most often identified, characteristic of entities remaining in the process of restructuring or entities going public.

Originality/value: The following publication is a continuation of the author's previous research in the area covered. Only by analysing the company's situation through the prism of its balance sheet, profit and loss account and cash flow statement a comprehensive picture of the financial situation of the economic entity can be obtained.

Keywords: cash flow statement, variants of balances from different activities in cash flow statement, analysis of financial position of an entity.

Category of the paper: Research paper.

1. Introduction

The cash flow statement is an integral component of an enterprise's financial statements, providing information on how cash is raised and where it is spent. Thus, it complements the accrual information obtained using the balance sheet and income statement of the company. Therefore, it finds its application in the analysis and evaluation of financial liquidity, but also

in the analysis of profitability as well as the ability of business entities to service their obligations.

Even the preliminary analysis of the financial situation of the enterprise through the prism of balances from the various types of activities (that is, operating, investing and financial activities) allows us to draw preliminary conclusions about the financial condition of the studied business entity. This publication is devoted to this issue, which is a development and continuation of the article author's earlier research.

The first part of the article presents an overview of selected publications on the use of the cash flow statement in specific areas of economic and financial analysis. The empirical part approximates the assessment of the financial position of non-financial companies listed on the Warsaw Stock Exchange for the years 2014-2023. A total of 366 business entities that were listed on the WSE for at least one year during the period under consideration were analysed on a stand-alone basis.

2. Use of cash flow statement information in assessing financial position – selected studies

As the literature indicates, only by analysing the company's situation through the prism of the balance sheet, income statement and cash flow statement a comprehensive view of the financial position of the enterprise can be obtained (Micherda, 2001; Famielec, 2016). R. Bowen, D. Burgstahler, L. Daley (1987) showed as a result of their research that for users of financial statements both cash and accrual information is necessary¹. D. Wędzki (2003) analysing the financial management of a company underlined that it is increasingly more important to indicate the source of financing and where cash is spent than to identify in detail the revenues and costs of operations². Thus, just by looking at the enterprise through the prism of cash flows generated from the various activities, it is possible to draw preliminary conclusions about the financial situation of the business entity, including its ability to pay its short-term obligations on time. In the literature, one can find publications indicating that cash flows are more objective in assessing the activity of an economic entity than the achieved financial result (Austin, Bradbury, 1995; Sharma, Iselin, 2003; Maślanka, 2008, pp. 44-45; Forfa, 2009).

¹ Compare (Carlslaw, Mills, 1991; Austin, Bradbury, 1995).

² The literature (Largay, Stickney, 1980; Karbownik, 2012) cites the example of W.T. Grant Company, where measures based on accrual elements of financial statements (that is, referring to the balance sheet and income statement) indicated the entity's good financial condition. In reality, however, the cited entity was characterized by a very poor financial condition, which led to its bankruptcy. At the same time, the cited authors pointed out that signals of a threat to the continuation of W.T. Grant Company's operations could already be read from the cash flow statement several years before bankruptcy (Compare (Lee, 1982)).

Topics of research on the evaluation of the enterprise through the prism of balances from different activities are presented in publications, among others: (Waśniewski, Skoczylas, 1993; Micherda, 2000; Shamsudin, Kamaluddin, 2015; Andrzejewski, Mazur-Maślanka, 2017; Maślanka, Mazur-Maślanka, 2021, pp. 140-147). As indicated by the cited studies, the second pattern of cash flows (that is, a positive balance from operating activities and negative flows from investing and financing activities) occurs most often among business entities (compare (Sierpiska, 2000; Steyn, Hamman, 2005)).

Based on the analysis of the literature, it can be concluded that investment cash flows are positively correlated with the fact of financial difficulties in the enterprise (Bui, Mai, 2021). At the same time, an increase in cash flows from operating activities and financial activities most often results in a decrease in the threat of going concern (Bui, Mai, 2021; Romadhina, Fitriani, Andhitiyara, 2022; Phan, Hoang, Tran, 2022; Le, Nguyen, 2022) or even can positively affect the value of the enterprise (Nikbakht, 2024) or the entity's ability to pay dividends (Dada, 2021). On the other hand, some researchers indicate the lack of a statistical relationship between cash flows from investing activities and the risk of bankruptcy (Sayari, Mugan, 2013; Roslan, Rus, Rozzani, 2022). Interesting considerations of the development of cash flows in the enterprise at different stages of the life of the entity can be found in publications: (Steyn, Hamman, 2005; Dickinson, 2011).

The problems of constructing analytical indicators using information derived from the cash flow statement have been approximated in the following publications, among others: (Carlslaw, Mills, 1991; Sylvestre, Urbancic, 1994; Grzelak, Karmanska, 1996). The use of the referenced metrics in selected areas of economic and financial analysis, that is, in the analysis of liquidity, profitability or debt, among others, is presented in the following studies: (Czerwińska-Kayzer, 2015, 2016; Andrzejewski, Mazur-Maślanka, 2017; Maślanka, Mazur-Maślanka, 2021, pp. 149-169).

Predictive capabilities in predicting the bankruptcy of business entities of selected indicators referring to the cash flow statement have been approximated in publications, among others: (Casey, Bartczak, 1985; Fawzi, Kamaluddin, Sanusi, 2015; Maślanka, Mazur-Maślanka, 2021, pp. 192-203). The cited studies indicate the effectiveness of single performance indicators or cash sufficiency in predicting the bankruptcy of business entities at 61% to 82%. On the other hand, one can also find studies in the literature indicating the high effectiveness of metrics using cash flow information in predicting bankruptcy (Özcan, 2020).

Indicators based on cash flows, despite the average individual ability to predict the threat of going concern, can, as low correlated with other measures of financial analysis, improve the effectiveness of models (developed, for example, using discriminant analysis or decision trees) for predicting the bankruptcy of business entities. Confirmation of the cited conclusions can be found in the results of research presented in the following publications: (Gilbert, Menon, Schwartz, 1990; Rujoub, Cook, Hay, 1995; Maślanka, 2008, pp. 230-251; Muller, Steyn-Bruwer, Hamman, 2009; Mazouz, Gambrel, 2013; Gupta, Wilson, Gregoriou, Healy, 2014;

Shanmugham, Mahalakshmi, 2015; Khoja, Chipulu, Jayasekera, 2016; Karas, Reznakova, 2020; Rodríguez-Masero, López-Manjón, 2020). On the other hand, it is possible to point to research results indicating the higher effectiveness of accrual categories compared to measures based on information derived from the cash flow statement in bankruptcy prediction (Gombola, Haskins, Ketz, Williams, 1987; Watson, 1996; Sharma, 2001; Welc, 2017).

3. Evaluation of the enterprise using cash balances from different activities – theoretical considerations

The table below (Table 1) presents cash flows patterns. The author presented the balances from each type of activity, omitting information on the change in net cash. The following section briefly comments on the information that can be obtained based on an analysis of these cash balances.

Table 1.

Variants of the company's financial situation depending on the cash balance of each activity

Lp.	Cash flow from operations		
	operational	investment	financial
1.	+	+	+
2.	+	-	-
3.	+	+	-
4.	+	-	+
5.	-	+	+
6.	-	-	+
7.	-	+	-
8.	-	-	-

Source: own elaboration based on the literature.

Positive cash flows from all types of activities (that is, operating, investing and financing), in economic practice, occur sporadically (Maślanka, 2008, pp. 120-135; Śnieżek, Wiatr, 2015, pp. 591-633; Andrzejewski, Mazur-Maślanka, 2017). The occurrence of such flows, especially in the long term, results into the accumulation of cash in the economic entity. Such a situation most often indicates that the enterprise is preparing for major capital expenditures or planning to acquire another entity in the forthcoming period. The lack of investments made in subsequent periods will be indicative of growing over-liquidity and ineffective management of the acquired capital. Most often, rising liquidity ratios and an increase in the company's net working capital will be observed in parallel.

The second pattern, presented in the table, i.e. positive cash flows from operating activities with simultaneous negative cash flows generated from investing and financing activities most often characterize mature, profitable³ and well perceived by investors entities (Gup, Samson, 1993). In the described situation, cash generated by the enterprise from its core activities is sufficient to carry out investment activities (purchases of productive as well as investment assets) and to service the capital raised by the entity in earlier periods (for example: repayment of loans, loans, interest payments to donors of foreign capital or dividend payments to owners). The considered variant of cash flows will characterize business entities cautious about financing with foreign capital, with limited use of positive leverage effects.

The occurrence of negative cash flows from all operations may result into a gradual decline in liquidity ratios, which could be worrying information in the long term. Important in such a situation will be the net capital expenditures made by the business unit, which in subsequent periods should result into an increase in the benefits generated from the core business.

As mentioned earlier, numerous studies (Steyn, Hamman, 2005) indicate that this variant of cash flows is most often identified in business practice.

With the occurrence of positive cash flows from operating and investing activities, while at the same time negative cash flows from financing activities, the key element in assessing the financial position of the company becomes the source of surplus funds generated from investing activities. These can be funds obtained from expenditures made earlier on financial assets (for example, in the form of interest, dividends or proceeds from their favourable liquidation). In this situation, these cash flows can be evaluated positively - as the company raises funds from its core business, at the same time making payments to equity and debt capital providers (financing activities). An aspect that should be noted in the case of this situation is the lack of major capital expenditures, which in the future may translate into a decline in the quality of the company's assets necessary for further core business.

Positive net cash flows from investing activities, however, may also indicate a need to liquidate fixed assets (including production assets) due to a lack of cash to pay liabilities on time. Such a variant will be particularly worrisome when flows from operating activities result from the release of funds from working capital with simultaneous negative gross (or net) financial results reported by the company in the income statement (Maślanka, 2008, pp. 120-135; Stefanski, 2012).

Companies characterized by positive net cash flows from operating and financing activities with simultaneous negative flows from investing activities (variant four) are most often characterized by good (or very good) financial standing. These entities generate surplus cash from their core activities, invest in new assets (both operating and investment), propping up new external capital. According to the literature (Nowak, 2008, pp. 143-144; Maślanka, 2008,

³ The fact of positive cash flow from operating activities is not, of course, the same as positive financial result presented in the income statement, but in this variant positive financial result and net cash flow from core activities most often go hand in hand.

pp. 56-57; Gos, 2011, pp. 172-173; Mioduchowska-Jaroszewicz, 2012; Stefanski, 2014), the considered variant of cash flows is perceived as the best and most desirable by investors.

In the cash flow patterns discussed above, the main source of cash is the core business of the enterprise. In most cases, positive net cash flows from operating activities occur in safe, stable and profitable enterprises. The next four variants inherently describe business units in a weaker financial position, as they are characterized by negative net cash flows from operating activities. In these situations, the possible source of earned cash surpluses (with the exception of variant eight, characterized by negative net cash flows from all three activities) is investment or financing activities.

Variant five is characterized by negative net cash flows from operating activities and surpluses achieved from investing and financing activities. An enterprise characterized by the above cash flows pattern may be in crisis in the area of core business, but it has the opportunity to raise funds from other areas of its operations. Particularly positive signals can be positive net cash flows from financing activities that confirming the credibility of the enterprise in the eyes of providers of new external capital (both foreign and own). This kind of cash flow can occur when a company begins restructuring processes or changes its business profile. The need for change is evidenced by the recapitalization of core activities. The initial phase of restructuring can also be evidenced by positive flows from investment activities resulting from the company's disposal of redundant production or financial assets.

In a situation where the fifth variant of the considered cash flows informs about the beginning of restructuring in the company, the flows described in the sixth variant will appear quite often in the next period, that is, negative cash flows from operating and investing activities with simultaneous surpluses of cash obtained from financing activities. The company raises more funds from outside, invests in new production assets, at the same time continues to perform poorly from its core business. If the investments being made are effective, they should translate into increased cash inflows from core activities in the future.

The sixth pattern of cash flow also occurs at a completely different stage of the business entity - that is, at the beginning of its operations. A young enterprise, even if it generates positive financial results in accrual terms (at the level of the result from operations or at the level of the net financial result), most often requires recapitalization of operating activities - hence there is a shortage of funds from core activities. At the same time, it acquires the production assets necessary for operations, thus resulting in negative net cash flows in the investment section of the cash flow statement.

Negative net cash flows from operating and financing activities with a surplus of funds earned from investing activities most often inform about a very poor financial situation of the analysed enterprise. The business entity in such a situation of shortage of funds from core activities tries to supplement them by liquidating production assets while not having access to new external sources of capital. Such cash flows suggest the persistent nature of the problems

of the analysed business entity. Thus, they are relatively common in enterprises in the period before their bankruptcy (Kordestani, Bakhtiari, Biglari, 2011; Stefanski, 2014).

The eighth pattern, i.e. negative net cash flows from all three activities, like the first variant, is relatively rare in business practice (Śnieżek, Wiatr, 2015, pp. 591-633). However, the financial situation of the enterprise characterized by the considered cash flows pattern is not very bad - as it might seem with only a cursory analysis of the problem. After all, the fact of the occurrence of negative cash flows in all three types of activities may inform about high over-liquidity occurring at an earlier period in the business unit under consideration. An ambiguous assessment of the situation may be evidenced by negative cash flows from investment activities signalling expenditures made on production or investment assets. However, one should be aware that if the investments undertaken do not result in an increase in the benefits of the core business, the business entity under consideration will be forced to liquidate them and most likely cease operations.

At the end of the presented considerations, it should be emphasized once again that when analysing the financial condition of an enterprise, the conclusions obtained from the evaluation of the cash flow statement should be confronted with the conclusions arising from the analysis of other elements of the financial statements (Famielec, 2016). In addition, it should be emphasized that the considerations presented can only be applied to significant net cash flows from the individual activities of the entity. Thus, cash flow values oscillating around zero should be treated as insignificant for this type of analysis.

4. Empirical findings

The following part of this study presents an analysis of the financial position of business entities using balances from different types of activities (that is, operating, investing and financing activities). The research was conducted based on the financial data derived from individual financial statements of 366 non-financial⁴ business entities listed on the Warsaw Stock Exchange from 2014 to 2023. The financial statements were obtained from the Notoria database. The number of entities examined varied in individual years, mainly due to the unavailability of data or the fact that the analysed entities were not listed in selected years (e.g. initial public offering in the period under consideration⁵ or withdrawal of the company from public trading⁶ in the years analysed).

⁴ Thus, in the first step, the following entities were omitted from the considerations: banks, insurance companies, entities dealing in debt trading, and investment funds. As a result of further selection, entities operating as central companies, conducting all their core activities through subsidiaries, were also removed from the database.

⁵ For example: 4Mass SA – IPO on the Warsaw Stock Exchange in 2019, Archicom SA – IPO in 2016, and Games Operators SA – IPO in 2020.

⁶ For example: Alchemia SA was withdrawn from public trading in 2019, while Alma Market SA was withdrawn from public trading in 2018 (due to its bankruptcy).

The collected results are presented in the tables (2 and 3) below.

Table 2.

Cash flow patterns among analysed entities

Variant	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	Total
1. (+, +, +)	2	2	2	8	2	2	2	2	1	2	25
2. (+, -, -)	118	117	112	124	137	110	138	128	149	111	1 244
3. (+, +, -)	55	42	48	50	41	44	36	32	31	31	410
4. (+, -, +)	27	34	37	37	48	50	47	57	59	58	454
5. (-, +, +)	13	15	14	13	13	14	11	10	7	13	123
6. (-, -, +)	26	28	45	27	32	44	34	33	27	38	334
7. (-, +, -)	12	26	17	19	12	18	15	17	15	12	163
8. (-, -, -)	13	14	14	5	3	12	9	16	3	8	97
Irrelevant	13	9	13	7	11	9	11	9	6	7	95
Total	279	287	302	290	299	303	303	304	298	280	2945

Source: own elaboration.

Table 3.

Cash flow patterns among analysed entities (in %)

Variant	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	Total
1. (+, +, +)	0,7	0,7	0,7	2,8	0,7	0,7	0,7	0,7	0,3	0,7	0,8
2. (+, -, -)	42,3	40,8	37,1	42,8	45,8	36,3	45,5	42,1	50,0	39,6	42,2
3. (+, +, -)	19,7	14,6	15,9	17,2	13,7	14,5	11,9	10,5	10,4	11,1	13,9
4. (+, -, +)	9,7	11,8	12,3	12,8	16,1	16,5	15,5	18,8	19,8	20,7	15,4
5. (-, +, +)	4,7	5,2	4,6	4,5	4,3	4,6	3,6	3,3	2,3	4,6	4,2
6. (-, -, +)	9,3	9,8	14,9	9,3	10,7	14,5	11,2	10,9	9,1	13,6	11,3
7. (-, +, -)	4,3	9,1	5,6	6,6	4,0	5,9	5,0	5,6	5,0	4,3	5,5
8. (-, -, -)	4,7	4,9	4,6	1,7	1,0	4,0	3,0	5,3	1,0	2,9	3,3
Irrelevant	4,7	3,1	4,3	2,4	3,7	3,0	3,6	3,0	2,0	2,5	3,2
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: own elaboration.

Cash flow patterns, characterized by positive cash flows from core activities, are commonly considered to provide information about the good (or very good) financial condition of the business entity. Among the analysed companies, variants of this type occurred in 72.4% of the cases considered - most often in 2015 (80.5%), rarest in 2021 (65.9%) and 2022 (67.9%).

The first variant, i.e. characterized by positive cash flows from all three types of activities among the analysed entities appeared extremely rarely - in total, it accounted for only 0.8% of the total number of observations studied. Positive balances from all types of activities appeared, among others, in the cases of such companies as Comarch SA, ZE PAK SA in 2022, and Agora SA 2 in 2020.

The theory suggests that the occurrence of such cash flows is related with the company's accumulation of funds for past investment spending. Meanwhile, among the surveyed entities, significant investment spending was observed in the following year in 32% of cases. Most of the identified entities (72%) at the time of the occurrence of positive flows from all three activities were characterized by a measure of current liquidity at normal or above-normal levels.

In most of the identified entities, positive cash flow from all three activities was associated with an increase in liquidity measures. However, this was not the norm, as 9 out of the identified 25 cases saw a slight decrease.

Positive cash flows from core activities and negative net cash flows from other areas of activity is a situation that most often indicates good or very good financial condition of a business entity. This variant was by far the dominant one among the analysed business entities throughout the 10-year period under consideration. It accounted for 36.3% of the total number of cases in 2018 to 50.0% in 2015 (in total, for the entire period under study, the share was 42.2%). The dominance of this variant among listed companies was demonstrated also in earlier studies. In the study authored by T. Maślanka in 2008 (pp. 120-132), among the considered entities of the construction industry for the years 1998-2004, this variant occurred in 24.1% of cases, while among trading units in 40.8%⁷. The publication by E. Śnieżek and M. Wiatr (2015, p. 621) showed the share of this pattern among the surveyed listed entities, for the years 1995-2010, at the level from 22.7% in 1998 to 48.2% in 2002.

Positive cash flows from core operations with negative investment and financing flows for all the years considered in this research were repeated in the cases of the companies: AC SA, Aplisens SA, LW Bogdanka SA, Dębica SA, Grupa Kęty SA, Muza SA, Sonel SA, Text SA and Voxel SA, clearly confirming to the very good financial condition of these entities.

The third variant, characterized by positive net cash flows from operating and investing activities with negative cash flows from financing activities among the surveyed units appeared on average in 13.9% of cases. This situation was most rarely in 2015 (10.5%), while it was most frequent in 2023 (19.7%). This situation, as mentioned earlier, may be indicative of some stagnation in the surveyed enterprise (benefits derived from both core and investment activities) or of some upcoming problems related to the business continuity (selling off assets). In this case, the decisive factor in the final assessment, most often, is the source of surplus cash from investing activities.

It should be noted that as of 2020, this variant occurs more frequently than the fourth variant (at the same time, as of this year, it became the second most frequent variant).

Positive cash flows from operating activities and financing activities at the same time as a negative stream from investing activities indicate - usually - a prosperous, growing enterprise. Among the surveyed business units, this variant occurred on average in 15.4% of the cases considered. The most frequent such flows were identified in 2014, occurring in 20.7% of the entities. In 2023, on the other hand, the above variant of cash balances occurred the least frequently, that is, in 9.7% of the companies analysed in that year. Among the analysed entities, the fourth variant occurred most often (that is, eight times) in the case of Labo Print SA,

⁷ T. Maślanka and I. Mazur-Maślanka in 2021 presented the results of non-financial studies of public companies using consolidated financial statements (2021, pp. 140-147). In the referenced studies, the second variant of cash flows appeared in as many as 48.9% of cases.

connected with the dynamic development of this entity in the given period. It should be mentioned, that this development was supported, however, in large part by external capital.

Let the dominance of the occurrence of the second and fourth variants of cash flows among the surveyed entities be evidenced by the fact that no other variant of cash flows appeared in 32 of the analysed entities in all the years in question (in many companies, the above variants occurred in less than 10 cases due to the fact that these entities were not listed on the Warsaw Stock Exchange for all those years - 62 such entities in the analysed sample can be identified).

In conclusion, it should be noted that in 33.1% (121 companies) of the total entities studied, in all the years for which the individual financial statements of these companies were available, these entities showed one of the four cash flow variants mentioned above (that is, positive cash flows from operating activities with simultaneous negative or positive investment and financial flows). This fact confirms the good condition of the vast majority of the entities under consideration during the period under review.

The remaining defined cases of cash flow development (characterized by negative net cash flow from operating activities) may be indicative of greater or lesser problems in the analysed companies. These variants occurred in 24.3% of the total number of cases (they appeared most frequently in 2021 - 29.8% of cases, and least frequently in 2015 - 17.4%).

Surprisingly rare among the analysed entities was the fifth variant of cash flows, that is, negative cash flows from core activities and positive flows from investing and financing activities. This variant appeared in 4.2% of cases, while the highest percentage (amounting to 5.2%) could be observed in 2022, while the smallest, i.e. 2.3%, was recorded in 2015. In comparison, in the study of T. Maślanka and I. Mazur-Maślanka (2021, pp. 140-147) conducted using consolidated financial statements of public entities for the years 2010-2020, the percentage was 2.5%. In contrast, in the research of E. Śnieżek and M. Wiatr (2015, p. 621), the share of the fifth variant ranged from 0.0% in 1996 to 8.1% in 2006 (the analysis covered the years 1996-2010).

The fifth pattern among the surveyed companies appeared most often - as many as six times - in the case of Inter Cars SA. In this case, in most of the periods under consideration, negative flows from operating activities were mainly due to the Company's significant expenditures on working capital. The mentioned variant of balances from individual types of activities occurred five times in the case of PBG SA in restructuring (currently PBG SA in liquidation). In the case of this entity, the mentioned cash flows were largely due to attempts to repair the analysed company.

Among the variants characterized by negative cash flows from core activities, another sixth variant, that is, negative cash flows from operating and investing activities and a positive balance from financing activities, occurred most often among the analysed business units. Among the surveyed cases, this variant occurred on average in 11.3% of cases - most frequently (14.9%) in 2021, while least frequently in 2015 (9.1%). Among other things, this variant

occurred among entities that raised new external capital (for example, by issuing shares) and among entities that were in the process of restructuring or re-branding their operations.

Among the analysed non-financial entities, the distinguished sixth variant of cash flows from individual activities was exceptionally common among medical related entities, representing the following sectors: biotechnology (Molecure SA), medicine production (Mabion SA) or medical equipment and materials (Aduvo Investments SA).

The next variant - the seventh - that is, a negative cash flow from operating and financing activities and a positive investment stream most often carries worrying information about the condition of the company. Among the surveyed entities, this variant occurred on average in 5.5% of cases (the most frequent, i.e. 9.1% in 2022, while the least frequent, i.e. 4.3% of cases in 2014 and 2023).

A positive investment flow with negative operating and financial flows among the analysed entities in the period under review most often appeared in Protektor SA (eight times) and Agora SA (six times). The cited entities, almost throughout the period under consideration, struggled with larger or smaller financial problems - reflected nearly every year in negative results obtained at the level of operating activities (EBIT). The subject of the causes and changes in the printed press market over the past few years is explored in, among other publications: (Dzierżyńska-Mielczarek, 2024).

The considered pattern of cash flows relatively often (three or four times in the analysed years) occurred among construction companies (for example: Interbud-Lublin SA, PBG SA, PJP Makrum SA, Polimex Mostostal SA or Prochem SA). In most cases, the entities indicated above are currently (or were) in the process of restructuring (or liquidation). Among the companies representing other types of business, where this variant also occurred, we can also mention here: All in! Games SA (currently in the restructuring process) and Fota SA (withdrawn from public trading in 2018).

As mentioned earlier, the last of the listed variants, that is, negative cash flows from all three areas of activity, is relatively rare in business practice. Meanwhile, among the surveyed entities, such a case, in the years under consideration, occurred slightly less frequently than the fifth and seventh pattern, that is, in 3.3% of observations. It occurred most often in 2016 (5.3%), while the rarest, (1.0%) in 2015 and 2019. The above variant - during the years under consideration - was repeated three times in the following entities: Celon Pharma SA, Instal Kraków SA and Remak-Energomontaż SA. Theoretically, the occurrence of this variant of cash flows should be connected with a simultaneous decrease in financial liquidity ratios.

Meanwhile, in the entities mentioned above, declines and increases in financial liquidity ratios (both current and increased) were observed with equal frequency. In the first two mentioned entities, liquidity ratios above theoretical standards could be observed in the analysed years.

In conclusion, it should once again be emphasized that among the surveyed companies, negative cash flows from core activities were relatively rare, that is, in 24.3% of the total cases considered. It should be noted, however, that it is possible to indicate entities in which negative cash flows from core activities occurred in almost all (or all) of the considered years. This situation occurred in Miraculum SA (in all the years under consideration), Mabion SA, Onesano SA, PBG SA, Protektor SA and Ryvu Therapeutics SA (nine times out of ten observations).

5. Summary

This publication takes a closer look at the assessment of the overall financial position of non-financial companies listed on the Warsaw Stock Exchange for the years 2014-2023 using balances from individual activities in the cash flow statement. In addition, the theoretical part indicates selected publications presenting the possibilities of using the cash flow statement in the analysis and assessment of the financial position of economic entities. The conclusions from the publication can be used both by financial managers in business entities and by economics students and as inspiration for conducting in-depth research in this area.

Among the observations that should be noted, is the fact that positive cash flows from core activities dominate among the business entities under consideration. The most common pattern that was identified, was positive cash flows from operating activities with negative flows from investing and financing activities (variant 2), describing business entities that are in a good financial situation. Among the variants characterized by negative cash flows from operating activities, the most common variant identified was variant number 6, which is typical for entities remaining in the process of restructuring or entities debuting on the securities market.

As can be concluded from the presented literature review and the results of empirical research, positive cash flows from investing activities are a strong indicator of an entity's unfavourable financial situation.

References

1. Andrzejewski, M., Mazur-Maślanka, I. (2017). Memoriałowe a kasowe stopy zwrotu na podstawie przedsiębiorstw przemysłu spożywczego notowanych na GPW w Warszawie. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, No. 345, pp. 7-20.
2. Austin, L., Bradbury, M. (1995). The Accuracy of Cash Flow Estimation Procedures. *Accounting and Finance*, Vol. 35(1), pp. 73-86.
3. Bowen, R., Burgstahler, D., Daley L. (1987). The Incremental Information Content of Accrual versus Cash Flow. *The Accounting Review*, No. 4, pp. 727-747.
4. Bui, K.D., Mai, T.T.N. (2021). Financial distress and cash flow of listed non-financial enterprises in Vietnam. *Banking Science & Training Review*, 1, pp. 61-70.
5. Carlslaw, Ch.A., Mills, J.R. (1991). Developing Ratios for Effective Cash Flow Statement Analysis. *Journal of Accountancy*, November, pp. 63-70.
6. Casey, C., Bartczak, N. (1984). Using Operating Cash Flow Data to Predict Financial Distress: Some Extensions. *Journal of Accounting Research*, Vol. 1, No. 23, pp. 384-401.
7. Czerwińska-Kayzer, D. (2015). Płynność finansowa w przedsiębiorstwach produkujących pasze w latach 2007-2013 w kontekście przepływów pieniężnych. *Zarządzanie Finansami i Rachunkowość*, No. 3(3). Szkoła Główna Gospodarstwa Wiejskiego w Warszawie, pp. 59-70.
8. Czerwińska-Kayzer, D. (2016). Memoriałowe i kasowe wyniki przedsiębiorstwa w ocenie jego działalności na przykładzie przedsiębiorstw produkujących pasze. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, no. 442, pp. 83-92.
9. Dada, A. (2021). Dividend policy and the nature of cash flows of selected companies listed on the Frankfurt Stock Exchange. *Financial Sciences*, Vol. 26, No. 2, pp. 30-44.
10. Dickinson, V. (2011). Cash Flow Patterns as a Proxy for Firm Life Cycle. *The Accounting Review*, Vol. 86, No. 6, pp. 1969-1994.
11. Dzierżyńska-Mielczarek, J. (2024). Stabilność finansowa rynku prasy w Polsce. *Rocznik Historii Prasy Polskiej, Tom XXVII, Zeszyt 3(75)*, pp. 182-199.
12. Famielec, J. (2016). Zarys modelu oceny finansowej przedsiębiorstwa. *Ekonomika i Organizacja Przedsiębiorstw*, No. 2(793), pp. 60-74.
13. Fawzi, N.S., Kamaluddin, A., Sanusi, Z.M. (2015). Monitoring Distressed Companies through Cash Flow Analysis. *Procedia Economics and Finance*, 28. 7th International Conference on Financial Criminology. Oxford, United Kingdom: Wadham College, pp. 136-144.
14. Forfa, M. (2009). Przepływy pieniężne w zarządzaniu finansami przedsiębiorstw. *Zeszyty Naukowe SGGW w Warszawie, Ekonomika i Organizacja Gospodarki Żywnościowej*, No. 78, pp. 248-260.

15. Gilbert, L.R., Menon, K., Schwartz, K.B. (1990). Predicting Bankruptcy for Firms in Financial Distress. *Journal of Business Finance & Accounting*, no. 17(1), pp. 161-171.
16. Gombola, M., Haskins, M., Ketzi, J., Williams, D. (1987). Cash Flow in Bankruptcy Prediction. *Financial Management*, Vol. 16, No. 4, pp. 55-65.
17. Gos, W. (2011). *Rachunek przepływów pieniężnych*. Warszawa: Difin.
18. Grzelak, K., Karmańska, A. (1996). Analiza sprawozdania z przepływów pieniężnych. *Vademecum Przedsiębiorcy i Podatnika*, No. 4(23), pp. 30-38.
19. Gup, B.E., Samson, W.D. (1993). An analysis of patterns from the statement of cash flows. *Financial Practice & Education*, 3(2), pp. 73-79.
20. Gupta, J., Wilson, N., Gregoriou, A., Healy, J. (2014). The value of operating cash flow in modelling credit risk for SMEs. *Applied Financial Economics*, 24(9), pp. 649-660.
21. Karas, M., Reznakova, M. (2020). Cash Flows Indicators in the Prediction of Financial Distress. *Inżynieria Ekonomiczna [Engineering Economics]*, 31(5), pp. 525-535.
22. Karbownik, L. (2012). Kasowe i memoriałowe mierniki oceny bezpieczeństwa finansowego przedsiębiorstwa. *Acta Universitatis Lodzensis. Folia Oeconomica*, 267, pp. 79-93.
23. Khoja, R., Chipulu, M., Jayasekera, R. (2016). Analysing corporate insolvency in the Gulf Cooperation Council using logistic regression and multidimensional scaling. *Review of Quantitative Finance and Accounting*, vol. 46(3), Springer, pp. 483-518.
24. Kordestani, G., Bakhtiari, M., Biglari, V. (2011). Ability of combinations of cash flow components to predict financial distress. *Business: Theory and Practice*, 12(3), pp. 277-285.
25. Largay, J.A., Stickney, C.P. (1980). Cash Flows, Ratio Analysis and the W.T. Grant Company Bankruptcy. *Financial Analysts Journal*, July-August, pp. 51-54.
26. Le, H.V., Nguyen, H.B. (2022). Financial leverage, operating cash flows and financial distress of listed non-financial companies in Vietnam. *Banking Science & Training Review*, 238, pp. 24-35.
27. Lee, T. (1982). Laker Airways – The Cash Flow Truth. *Accountancy*, June, pp. 115-116.
28. Maślanka, T. (2008). *Przepływy pieniężne w zarządzaniu finansami przedsiębiorstw*. Warszawa: C.H. Beck.
29. Maślanka, T., Mazur-Maślanka, I. (2021). *Analiza i ocena kondycji finansowej przedsiębiorstwa z wykorzystaniem rachunku przepływów pieniężnych*. Warszawa: CeDeWu.
30. Mazouz, A., Gambrel, P.A. (2013). The impact of cash flow on business failure analysis and prediction. *International Journal of Social Sciences and Entrepreneurship*, 1(3), pp. 14-29.
31. Micherda, B. (2000). Rachunek przepływów pieniężnych i jego wykorzystanie w zarządzaniu płynnością finansową jednostki. *Prace Naukowe Wyższej Szkoły Przedsiębiorczości i Marketingu w Chrzanowie*, No. 4, pp. 129-144.

32. Micherda, B. (2001). Ewolucja wyceny we współczesnej rachunkowości. *Zeszyty Teoretyczne Rachunkowości*, No. 4(60), pp. 5-21.
33. Mioduchowska-Jaroszewicz, E. (2012). Ocena przepływów pieniężnych w grupach kapitałowych. *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, No. 737, *Finanse, Rynki Finansowe, Ubezpieczenia*, No. 56, pp. 155-171.
34. Muller, G.H., Steyn-Bruwer, B.W., Hamman, W.D. (2009). Predicting financial distress of companies listed on the JSE-A comparison of techniques. *South African Journal of Business Management*, 40(1), pp. 21-32.
35. Nikbakht, Z. (2024). The Relationship between Cash Flows of Operating, Investments, and Financing Activities with the firm value. *International Journal of Finance and Managerial Accounting*, Vol. 9, No. 33, *Spring*, pp. 101-112.
36. Nowak, E. (2008). *Analiza sprawozdań finansowych*. Warszawa: PWE.
37. Özcan, A. (2020). The use of cash flow statement in predicting business failure: Evidence from an emerging market. *Journal of Administrative Sciences*, Vol. 18, No. 36, pp. 373-387.
38. Phan, T.D., Hoang, T.T., Tran, N.M. (2022). Cash flow and financial distress of private listed enterprises on the Vietnam stock market: A quantile regression approach. *Cogent Business & Management*, Vol. 9, Iss. 1. Abingdon: Taylor & Francis, pp. 1-13, <https://doi.org/10.1080/23311975.2022.2121237>.
39. Rodríguez-Masero, N., López-Manjón, J.D. (2020). The Usefulness of Operating Cash Flow for Predicting Business Bankruptcy in Medium-Sized Firms. *Revista Brasileira de Gestão de Negócios*, Vol. 22, No. 4, pp. 917-931.
40. Romadhina, A.P., Fitriani, M.N., Andhitiyara, R. (2022). The effect of cash flow and currency exchange rate on financial distress. *Jurnal Akuntansi Dan Perpajakan Jayakarta*, 3(2), pp. 146-167.
41. Roslan, N.H., Rus, R.M., Rozzani, N. (2022). Determinants of cash flows towards financial distress prediction among manufacturing companies in Malaysia. *International Journal of Social Sciences and Management Review*, Vol. 5, Iss. 01, pp. 195-206.
42. Rujoub, M.A., Cook, D.M., Hay, L.E. (1995). Using Cash Flow Ratio to Predict Business Failure. *Journal of Managerial Issues*, March 22, Vol. 7, pp. 75-90.
43. Sayari, N., Mugan, F.N.C.S. (2013). Cash flow statement as an evidence for financial distress. *Universal Journal of Accounting and Finance*, 1(3), pp. 95-103.
44. Shamsudin, A., Kamaluddin, A. (2015). Impending Bankruptcy: Examining cash flow pattern of distress and healthy firms. *Procedia Economics and Finance*, 31, pp. 766-774.
45. Shanmugham, R., Mahalakshmi, A. (2015). The best predictors of industrial sickness – accrual ratios or cash flow ratios? *International Journal of Management and Social Science Research Review*, Vol. 1, Iss. 10, pp. 202-209.
46. Sharma, D. (2001). The role of cash flow information in predicting corporate failure: The state of the literature. *Managerial Finance*, Vol. 27, No. 4, pp. 3-28.

47. Sharma, D.S., Iselin, E.R. (2003). The Relative Relevance of Cash Flow and Accrual Information for Solvency Assessments: A Multi-Method Approach. *Journal of Business Finance & Accounting*, Vol. 30, (September), pp. 1115-1140.
48. Sierpińska, M. (2000). Cash flow a zdolność rozwojowa spółek akcyjnych. In: R. Borowiecki (eds.), *Zarządzanie wiedzą a procesy restrukturyzacji i rozwoju przedsiębiorstw* (pp. 664-669). VII Międzynarodowa Konferencja Naukowa, Krynica/Kraków.
49. Stefański, A. (2012). Analiza przepływów pieniężnych jako instrument prognozowania upadłości małych i średnich przedsiębiorstw. *Annales Universitatis Mariae Curie-Skłodowska*, vol. XLVI. Lublin, pp. 145-155.
50. Stefański, A. (2014). Analiza znaków przepływów pieniężnych a ocena ryzyka kredytowego. *Zeszyty Naukowe Wyższej Szkoły Bankowej w Poznaniu*, vol. 55, no. 4, pp. 79-88.
51. Steyn, B.W., Hamman, W.D. (2005). Cash flow patterns in listed South African industrial companies. *Meditari Accountancy Research*, Vol. 13, No. 1, pp. 1-17.
52. Sylvestre, J., Urbancic, F.R. (1994). Effective methods for cash flow analysis. *Healthcare Financial Management*, Vol. 48(7), pp. 62-70.
53. Śnieżek, E., Wiatr, M. (2015). *Przepływy pieniężne*. Warszawa: Wolters Kluwer.
54. Waśniewski, T., Skoczylas, W. (1993). Analiza przepływów pieniężnych. *Rachunkowość*, No. 11, pp. 390-396.
55. Watson, I. (1996). Financial Distress - The State of the Art in 1996. *International Journal of Business Studies*, Vol. 4, No. 2, pp. 39-65.
56. Welc, J. (2017). EBITDA vs. Cash Flows in Bankruptcy Prediction on the Polish Capital Market. *European Financial and Accounting Journal*, 12(2), 91-103. <https://doi.org/10.18267/j.efaj.183>.
57. Wędzki, D. (2003). Statystyczna weryfikacja istotności przepływów pieniężnych. *Zeszyty Teoretyczne Rachunkowości*, No. 19(75), pp. 103-119.

PROCUREMENT VS. CULTURE: COOPERATION OF A POLISH MANUFACTURING COMPANY WITH CHINESE AND GERMAN SUPPLIERS – A CASE STUDY

Małgorzata MATUSIAK^{1*}, Bartosz KRÓLIKIEWICZ²

¹ University of Lodz, Faculty of Economics and Sociology; malgorzata.matusiak@uni.lodz.pl,
ORCID: 0000-0002-4287-617X

² Graduate of the University of Lodz; Faculty of Economics and Sociology; krolikiewicz.b98@gmail.com,
ORCID: 0009-0007-0770-8721

* Correspondence author

Purpose: The purpose of the research is to demonstrate the role of cultural differences in the process of sourcing raw materials and components from Chinese and German suppliers to a Polish manufacturing company.

Design/methodology/approach: The article adopts a qualitative methodology, with a descriptive approach. Data collection techniques in this study used: in-depth interview technique, covert participant observation and archival analysis.

Findings: The analysis confirmed that in the procurement process of materials and components, knowledge of cultural differences helps to minimise the risk of misunderstandings and to lead to long-term and satisfying cooperation.

Research limitations/implications: The results of this qualitative study refer to the company under study. The analyses can serve as a point of reference for other researchers on this topic. The empirical material complements the findings of other researchers on this topic.

Practical implications: The results of this research can be helpful for managers of international teams and contacts between companies from different cultural backgrounds, and support the improvement of competencies, both of managers and lower-level employees in the area of cross-cultural competence. They are a source of knowledge and practical guidance for entrepreneurs sourcing internationally, mainly from Chinese and German suppliers. In view of the role of China in the world economy, the current position of the German economy in Europe, Poland's largest trade with Germany - cooperation with suppliers from these countries should be the subject of detailed and systematic analysis for business practice.

Originality/value: The use of three approaches to analysing cultural differences and three sources of data (especially long-term observation) can contribute to a better understanding of the role of cultural differences in the sourcing area of manufacturing enterprises. As a rule, this type of analysis uses a single model of cultural differences – the authors used three different models in order to more fully explain the issues at hand.

Keywords: procurement, purchasing, culture, cultural differences, culture dimensions.

Category of the paper: Single case study.

1. Introduction

In the new management paradigms, there is an growing number of international economic structures (Grudzewski, Hejduk, 2006), and development in a globalised world is determined by the inevitable cooperation between enterprises from different parts of the world. Cultural specificity affects organisational behaviour and thus business operations. The greater the differences between contractors recruited from diverse cultures, the needed for education in this area, both at the operational and strategic levels. Cultural differences affect the effectiveness of communication especially in business contexts, and cultural fluency is a key element of effective cross-cultural communication (Inoue, 2007).

The concept of culture is one of those that have many definitions — several hundred — for example: culture is patterns of behaviour and a system of symbols (Kroeber, 1989; Boroch, 2016); all manifestations of human activity (Cateora, Ghauri, 2000), or programming of the mind (Hofstede, 1980; Hofstede, Hofstede, 2007). Developing cultural sensitivity and learning about other cultures not only improves a company's effectiveness in the global marketplace, but also allows it to leverage potential from outside its home culture. And according to Bennett's cultural sensitivity model (DMIS Developmental Model of Intercultural Sensitivity), it allows one to move from treating cultural differences as a threat to treating them as a challenge and to move from ethnocentrism to ethnorelativism (Bennett, 2017).

The study of intercultural differences in business cooperation has a long tradition. Sociologists, cultural scholars, psychologists, economists, and management specialists have addressed this topic, situating their considerations within their respective fields. Organisational analysts not only maintain different conceptions of culture but also approach the organisation–culture relationship differently, due to varying basic assumptions made by researchers about both organisation and culture (Smircich, 1983). It has long been widely accepted that research on intercultural business communication should be positioned at the intersection of disciplines rather than within individual fields, and should be interdisciplinary in nature. This is because intercultural communication in a business context is a complex research area that requires the integration of various disciplines, such as linguistics, anthropology, sociology, and management. An interdisciplinary approach, involving the application of diverse theoretical and methodological perspectives, allows for a more comprehensive understanding of the dynamics of intercultural interactions, and for the effective analysis and interpretation of complex communicative processes (Bargiela-Chiappini, Nickerson, 2003).

The most widely recognised model describing the influence of cultural values on people's behaviour in organisations is Geert Hofstede's empirical comparative model (Hofstede, 2011), which was further developed by his colleagues and successors. This model differentiates cultures based on the following dimensions: Power Distance (PD), Individualism (IDV), Masculinity (MAS), Uncertainty Avoidance (UA), Long-Term Orientation (LTO) and

Indulgence versus Restraint (IVR). PD reflects attitudes towards social inequality within a given culture. In low power distance societies, relationships between citizens, the state, and organisations are more egalitarian, while in high power distance societies, hierarchical structures and inequality are more accepted. IDV describes the construction of self-image. In highly individualistic cultures, the emphasis is on personal goals and self-reliance, while in collectivist cultures, the focus is on group loyalty, shared responsibility, and caring for the collective. MAS often referred to as motivation towards achievement and success. In high masculinity cultures, competition, achievement, and success are primary drivers, whereas in low masculinity (more feminine) cultures, quality of life, consensus, and work-life balance are more highly valued. UA refers to how societies cope with an uncertain and unpredictable future. Cultures with high uncertainty avoidance tend to prefer detailed rules, formal procedures, complex contracts, and risk-avoidance strategies. In contrast, low uncertainty avoidance cultures are more comfortable with ambiguity and more flexible in the face of uncertainty. LTO indicates the degree to which societies focus on long-term goals, sustainability, and perseverance, as opposed to short-term objectives, traditions, and immediate results. IVR relates to the ways in which societies manage gratification of desires and enjoyment of life. High indulgence cultures tend to support personal freedom, hedonism, and leisure, whereas low indulgence (restraint) cultures emphasise social norms, behavioural control, and suppression of individual needs.

In this model, cultural scores range from 0 to 100 for each of the six dimensions, where 0 indicates the absence of a given characteristic and 100 its strongest expression (Hofstede Insights; Hofstede, 2011; Matusiak, 2022). Poland's position across these cultural dimensions is presented in Figure 5.

Another widely recognised model is Richard Gesteland's typology of business cultures. In his framework, the global business world is divided into several key cultural categories: Relationship-Focused (RF) vs. Deal-Focused (DF), Formal (F) vs. Informal (IF), Monochronic (M) vs. Polychronic (P), and Reserved (R) vs. Expressive (E) (Gesteland, 2000, 2002; Matusiak, 2022). In RF cultures, building trust and personal relationships is essential before conducting business, whereas in DF swift negotiations and direct transactions take precedence. In F cultures, titles, hierarchy, and polite, ritualistic behaviour in business interactions are emphasised, while in IF communication is more casual, direct, and hierarchical structures are less rigid. In M cultures, punctuality, careful planning, and sequential task completion are valued; conversely, in P time is perceived more flexibly, and managing multiple tasks simultaneously is common and acceptable. In R cultures, communication tends to be restrained, emotions are controlled, and gesturing is minimal, whereas in E open emotional expression, dynamic body language, and lively gesturing are integral to communication.

According to this model, Poland can be generally characterised as rather deal-focused, although building relationships is also valued; rather informal in behaviour and negotiation style; rather reserved in communication; and rather monochronic in its approach to time.

The use of the qualifier *rather* in each category suggests that Poland tends to occupy a middle position on these cultural scales, leaning towards one side but not situated at the extremes.

Another influential model is Richard Lewis' model. The author classified people into three distinct categories based on behavioural characteristics. This typology includes three main cultural categories: Linear-Active (LA), Multi-Active (MA), and Reactive (R). Lewis argued that previous cross-cultural researchers, by introducing multiple dimensions, risked creating confusion among those seeking clarity and conciseness. He also pointed out that the dominant focus on North/South, monochronic/polychronic dichotomies led researchers to underestimate a specifically Asian way of thinking, which encompasses nearly half the world's population (Lewis, 1996; The Lewis Model, 2015). The key characteristics of these three cultural profiles are as follows: LA cultures are task-oriented, focus on facts and procedures, value punctuality, and prefer to complete tasks sequentially. Examples include Germans, Americans, and the British. MA cultures prioritise dialogue, interpersonal relationships, and emotional expression. Examples include Brazilians, Spaniards, and Mexicans. R cultures emphasise attentive listening, seeking harmony and compromise, rarely initiating discussions, and forming opinions based on the positions of others. Examples include Vietnamese, Chinese, and Japanese cultures (The Lewis Model of Behaviour, 2015; Matusiak, 2022).

In this model, Poland is positioned approximately midway between the vertices of the Multi-Active and Linear-Active cultural types.

Situating Poland in all models closer to the middle rather than the extreme ends makes it quite easy for Poles, Polish companies to adapt to functioning in different cultures, even extremely situated on the continuum of the specified categories in different models.

It is also worth mentioning that researchers also distinguish CQ Cultural Intelligence (in addition to IQ Intelligence Quotient and EI Emotional Quotient) (*What Is Normal?*). The term was first used in 2003 and refers to the ability to function in culturally diverse environments. Earley and Ang analyse CQ through the lens of four components: (1) metacognitive (consciously interpreting cross-cultural situations); (2) cognitive (knowledge of customs and institutions in different cultures); (3) behavioural (adaptation of verbal and non-verbal behaviour to the cultural context) and (4) motivational (willingness to learn about other cultures) (Earley, Ang, 2003). A research tool to measure cultural intelligence, the Cultural Intelligence Scale (CQS) by Ang, Van Dyne, Koh (Barzykowski et al., 2021), has also been developed to assess an individual's ability to function effectively in culturally diverse environments.

A distinction should be made between typologies of national cultures (Hall, 1976; Hofstede, 1980, 1984) and organisational cultures (Schein, 1985; Morgan, 1986). The specific characteristics of the national culture (such as PD or I) correlate with the nature of the organisational cultures (for example, in the case of long distance, the company structure will be more hierarchical and elaborate, and it will be more difficult for subordinates to access superiors positioned higher in the hierarchy; or in the case of I cultures, employees are more likely to be

held accountable for the results of their work, and in collectivist cultures, the group of employees working on a particular project). Classic typologies of organisational cultures include, for example: (1) power, role, task and person culture Handy's (Handy, 1985); (2) macho, work hard/play hard, process, bet-your-company culture Deal's and Kennedy's (Deal, Kennedy, 1982); (3) human relations, open system, rational goal, internal process Quinn's and Rohrbaugh's (Quinn, Rohrbaugh, 1983); (4) family culture, incubator, Eiffel tower, guided missile culture Trompenaars' and Hampden-Turner's (Trompenaars, Hampden-Turner, 1997). Thus, the differences that exist at both the national and organisational level shape the company culture. National culture shapes organisational culture, and organisations operating in a multicultural environment must skillfully accommodate differences from both the national and organisational levels. The more representatives of different cultures in a company/team and the more forms from different parts of the world a company works with, the more indicators need to be taken into account.

Organisational analysts adopt, in relation to both organisation and culture, different concepts leading to different research questions and interests. Much of the literature on organisational culture and the performance of a firm can be interpreted as suggesting that culture can have significant positive economic value for firm (Barney, 1986).

The second article deals with issues of corporate procurement. According to Dąbrowski, while marketing and logistics have received numerous scholarly studies, the operational nature of purchasing has not encouraged a higher profile for purchasing in companies. Currently, the situation is visibly changing and we are seeing an increase in interest in this area from both a business and academic perspective (Dąbrowski, 2011). Purchasing is referred to in the context of managing “a company's external resources in such a way that the supply of products, services, skills and knowledge resources (necessary for the operation of the organisation and for the management of its core and support activities) is provided on the best terms” (van Weele, 2010; Rutkowski, 2013; Matusiak, 2022). On the other hand, sourcing refers to all the activities that make up the acquisition of these products, from determining the needs of the company, to selecting suppliers, to working with them (Matusiak, 2022). Acquiring and maintaining reliable suppliers, on the other hand, is one of a number of tasks that make up the main goal of procurement logistics (Kowalska, 2005; Matusiak, 2022). Procurement logistics is a very sensitive area, because it is here that companies can reduce procurement costs and at the same time select suppliers that meet the criteria important to the company, take care of the quality of goods at the entrance to the system, effectively seek business partners, suppliers. The quality of ordered materials, cooperation with trusted and reliable suppliers and specialized staff at the beginning of the production process are crucial for the course of all subsequent stages (Matusiak, 2022).

According to Rutkowski, one of the core competencies of the company's lead buyers (in addition to working with internal customers and managing purchasing categories) is working with suppliers in conducting the purchasing process, as well as creating, developing

relationships with them and solving ongoing problems (Rutkowski, 2013), and this is the area that the authors of this article have addressed. Purchasing managers have to take into account and reconcile the requirements coming from the internal customer, i.e. the company, and at the same time the requirements of the external customer, i.e. the supplier. Their task, therefore, is to provide value and not just to take care of savings, so they become providers of value to the enterprise a kind of value buyers (Klimarczyk, Malmon, 2020; Matusiak, 2022). Automated order generation, offer evaluation or supplier monitoring are currently starting to become standard and streamline purchasing processes. These improvements do not diminish but change the role of the buyer, who must also be a specialist in building relationships, negotiating terms and conditions, analysing purchasing risks, etc. Thus, both hard and soft competences (Wodnicka, 2024) are those spheres in which it is difficult to replace a human being.

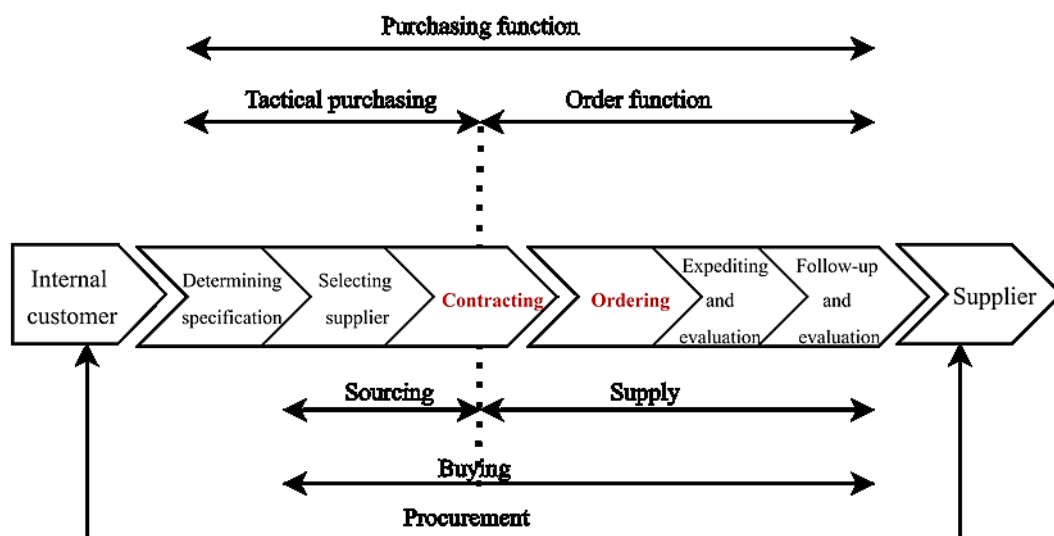


Figure 1. The linear procurement process model and some related concepts.

Source: based on van Weele, 2010, p. 8.

Of particular importance is the study of cultural differences in relation to the emergence and implementation of innovations, new technologies, and the management of international teams in the context of global political change. The global change in the socio-economic context caused by the outbreak of the Covid-19 pandemic, then, after a brief stabilisation, the outbreak of a full-scale war in Ukraine in 2022, and the subsequent political changes in the US are causing, among other things, companies to move their sources of supply closer to their production sites (nearshoring) and to countries with which cooperation is more predictable and involves products that are key to the company's production (friendshoring, allyshoring, Gowans, 2024). There has been a reconfiguration of hitherto distinctive supply chains and the specifics of globalization changes characteristic of the late 20th and early 21st centuries. With the “relocation” of sources of supply to other locations, often increasingly close to the places of production, the cultural factor, i.e. not traditionally considered as a criterion for supplier/source selection alongside variables such as price, quality or timeliness, is gaining real

importance. Through knowledge of cultural specificity, companies can reap social and economic benefits, such as increased operational efficiency or reduced risk of misunderstandings (Rozkwitalska, 2013). Culturally diverse teams have access to a wider range of perspectives and ideas, thereby generating more creative solutions to problems (Gozdowska, 2024), and a cultural counterparty manual makes it possible to decode the cultural specificity of team members and avoid or neutralize some of the misunderstandings (Maszko, 2024).

The authors of this paper decided to focus on this sphere not only in order to fill the research gap and the theoretical-cognitive function of scientific research. The authors were keen to realize the practical-application function of research, i.e. the university's cooperation with the socio-economic environment. In the empirical findings wanted to provide specific examples, simultaneously explaining the reasons for the differences. Thus, they also aimed to give recommendations to those working in multicultural teams in the area of procurement, which they can adapt to their daily activities.

2. Research methodology

The rationale for a single case study is to be able to explore one specific case in depth and to show the complexity of the phenomenon under discussion in its real-world context by using a variety of data sources.

Table 1.
Research procedure stages and timeline

Stage/time	Key research activities
Conceptualization of the research December 2022	a preliminary literature review on the role culture differences in corporate procurement/purchasing process
	identification of research gap
Research design December 2022	construction the aims of the research
	selection of methods for own research
Collecting and processing of data January 2023 – August 2024	conduct participatory observation (January 2023 – April 2024)
	conduct of in-depth interviews (June 2024 – August 2024)
	analysis of organisational materials (electronic documentation) maintained by Polish enterprises with Chinese and German enterprises for the period January 2023 to April 2024 (August 2024)
Re-review of the literature November – December 2024	Scopus and Google Scholar database review
Results analysis December 2024 – April 2025	discussion and presentation results own research
	identification of limitations of own research and directions for future research

Source: Authors' elaboration.

The study was designed in December 2022, at which time an initial literature review was conducted and a research gap was identified in the form of a small number of studies describing the impact of cultural differences on the procurement process of companies. These topics in the context of the management of the entire supply chain or the collaboration of companies to

develop suppliers are addressed in the literature, but the impact of cultural differences on the sourcing process itself is addressed less frequently (The detailed shown in Table 1 and 2).

Table 2.

Data collection methods, topics for analysis

Data collection methods	Source of information	Analysis	Information to be collected /topics for analysis
Observation	Group (procurement Staff)	Observed ways of interaction	General course of interaction. Problems and misunderstandings in the approach to the process of contracting and ordering. Timeliness of operations. Ways of responding to difficulties.
In-depth interview	Individual Sales directors	Text analysis. Observation interaction styles	Overall interview process. Problems and misunderstandings in the approach to the process of contracting and ordering. Timeliness of operations. Ways of responding to difficulties.
Archival analysis	Organisational materials (emails)	Text analysis	General course of interaction. Timeliness of operations. Rules for communicating with suppliers.

Source: Authors' elaboration.

Detailing the collection of information as part of the research conducted, it should be noted:

1. Long-term participant observation was carried out by an employee of a Polish company and allowed: obtaining specific data (detailed, authentic and contextual); understanding the intentions and motivations of those taking part in the research; flexibility by being able to follow changing conditions and observe behaviour in a natural environment; obtaining an internal perspective of the organisation. Through its use, information was obtained that could not have been obtained by any other means, and which is complementary to that obtained through interviews and document analysis.
2. In-depth interviews were conducted in a Polish, German and Chinese company with sales directors who are strategic decision-makers in their organisations. Such individuals typically have a higher level of competence and more experience, resulting from more frequent international and cross-cultural interactions, compared to lower-level employees performing operational tasks. This method was used because it offers a narrative stimulus related to the research area, and interviewees are encouraged to freely share their perspectives and interpretations (Easterby-Smith et al., 2012).
3. Analysis of email correspondence with Chinese and German suppliers, focused on the overall course of interaction and potential misunderstandings between suppliers and the Polish company. A total of 150 emails were analysed (an average of about 25 per month), only with regard to cultural differences in the procurement process. This method was used to complement the findings from observation and interviews. Key advantages of this approach included access to authentic, unfiltered data from actual business operations and the lack of need to involve respondents.

All data collected was analysed through the prism of three models of cultural differences: R. Lewis, R. Gesteland and G. Hofstede.

Referring directly to the entire purchasing process as understood by van Weele (Figure 1), the authors of this article focused on the barriers due to cultural differences occurring at the sourcing stage of a manufacturing company mainly in the areas of contracting and ordering.

The authors posed the following research questions:

Main research question:

What role do cultural differences/dimensions play in the procurement/purchasing process of a manufacturing company for components and raw materials?

Specific questions were posed to the general question:

1. In what areas (specifically/operatively) are the difficulties in cooperation most severe?
2. Did and how did the described difficulties due to differences affect the procurement process of the company under study?
3. What actions should a Polish company (and other manufacturing companies) take to improve the purchasing process?

3. Literature review

Due to the dispersion of the subject matter resulting from its interdisciplinary nature, this literature review focuses on studies directly related to cultural differences in the process of supplying enterprises with production materials and components, based on the Scopus database. The search was limited to the field of Business, Management and Accounting; publications concerning the role of cultural differences in the purchasing processes of individual consumers, groups, or public institutions were excluded. The analysis covered articles, book chapters, and conference papers published in English within the last 25 years, up to the year 2024¹. A total of eight bibliometric search queries were developed:

1. TITLE-ABS-KEY(procurement) AND TITLE-ABS-KEY("cultural differences").
2. TITLE-ABS-KEY(procurement) AND TITLE-ABS-KEY("cultural dimensions").
3. TITLE-ABS-KEY(purchasing) AND TITLE-ABS-KEY("cultural differences").
4. TITLE-ABS-KEY(purchasing) AND TITLE-ABS-KEY ("cultural dimensions").
5. TITLE-ABS-KEY(supply chain) AND TITLE-ABS-KEY("cultural differences").
6. TITLE-ABS-KEY(supply chain) AND TITLE-ABS-KEY("cultural dimensions").
7. TITLE-ABS-KEY(procurement) AND TITLE-ABS-KEY("culture").
8. TITLE-ABS-KEY(supplier) AND TITLE-ABS-KEY("culture") AND TITLE-ABS-KEY ("procurement").

¹ The authors reviewed the literature covering only publications from the last 25 years, considering this period as a key one due to the intensive development and diffusion of new technologies, in particular the Internet, which have significantly influenced business processes, business-to-business communication and the operational functioning of companies, whereas previous studies referred to the reality before this technological revolution.

An analysis was conducted as part of the above queries, which enabled:

The first two queries identified scientific items, including: dimensions of partnership, understanding of the Eastern concept of self and self-improvement, and the central role of goal-setting at both the strategic and project levels (Liu, Fellows, 2001); challenges related to information resource management in an intercultural environment (Feng, 2006); cultural differences across specific industries (Phua et al., 2009); and barriers to the implementation of the JIT system (Jadhav et al., 2014).

In the case of the third query, it was determined that the majority of the identified publications focus on the purchasing behaviours and habits of individual consumers, as well as research centred on the purchasing practices of various social groups, communities, or public entities, rather than on corporate procurement. Among the search results relevant to the discussed research area, the following publications were identified: studies on offshore outsourcing of services, which define the expectations of key stakeholders and assess how the buying firm and the offshore supplier cooperate to meet these expectations (Tate et al., 2009); research on buyer-supplier relationships in international markets, particularly focusing on the impact of trust on long-term cooperation, based on the opinions of purchasing professionals from the United States, English- and French-speaking Canada, and Mexico (Cannon et al., 2010); analyses of personnel management and supplier support, and their influence on business customer satisfaction, mainly focusing on the evaluation of customer satisfaction and loyalty to suppliers (Biemans et al., 2010); studies addressing cultural differences in purchasing and supply management, along with job requirements in three European countries, using cultural models such as GLOBE and Hofstede (Stek et al., 2022); practical guidelines on how to conduct international business, with an emphasis on achieving competitive advantage through effective cross-cultural management (Abramson et al., 2023).

The fourth query identified publications addressing the role of cultural differences in various aspects of international business operations, including: cultural factors that should be considered when developing effective purchasing strategies (Cannon et al., 2010); communicating business success across cultures (Moran, Abrahamson, 2017; Moran et al., 2023); organisational purchasing behaviour and the procurement of professional services (Pemer et al., 2018).

The fifth query enabled the identification of publications concerning the role of cultural differences as one of several important factors in the context of, among others: supply chain decision-making in the context of establishing the "Silk Road Economic Belt" (Haasis et al., 2021); procurement practices of Swedish companies operating in China (Jensen, Hilletoft, 2022); implementation of Building Information Modeling (BIM) systems (Faisal Shehzad et al., 2022); opportunities to improve logistics performance and support sustainable development (Matusiewicz, 2024); the impact of cultural differences between acquiring and target firms on post-acquisition performance in cross-border acquisitions (Yu et al., 2024).

The sixth query enabled the review of publications concerning cultural differences in supply chains, particularly: the role of a collaborative culture as an essential condition for cooperation within the supply chain (Acquah, 2023); socio-cultural relations in the workplace in the context of global supply chains (Stevano, 2023); the influence of national culture on the adoption of buyer-supplier environmental practices (Ahmadi-Gh et al., 2024); the integration of sustainability supply chain management with global production networks (Yawar, Seuring, 2024); international human resource management and the global nature of companies in supply chains in the context of increasing competition with consideration of the cultural dimension (Kok, Akbari, 2024); studies on operations management highlighting the differentiated impact of cultural differences on post-acquisition integration performance (Yu et al., 2024); the impact of language and culture on operations in a global context (Hashemi et al., 2024).

The seventh query allowed for the identification of publications addressing the role of cultural differences in: supply chain resilience, considering the role of internal and external integration, risk management culture, and supply chain flexibility (Chunsheng et al., 2020); the relationship between organisational culture and the implementation of green supply chain management (ElBaz, Iddik, 2022); the impact of informal inter-organisational relationships on business performance (Toumi, Su, 2023); the interplay between individual, organisational, and contextual factors, providing empirical evidence on the pivotal role of procurement managers in diffusing sustainability throughout the supply chain (Khan, Hinterhuber, 2024); the mediating role of a risk-oriented culture in the relationship between vendor risk management and operational performance (John et al., 2024).

The eighth query provided information on publications in which culture is considered one of the factors in supplier collaboration research, analyzing, for example: aspects of social responsibility in the supplier selection process – companies that consider these aspects achieve financial benefits compared to their competitors (Thornton et al., 2014); necessary steps to align the cultural competitiveness of procurement with the firm's objectives (Philippart, 2016); the role of African countries and suppliers in global value chains and the gradual development of professional procurement practices (Kauppi et al., 2018); the role of Supplier Relationship Management (SRM) in providing a common platform for exchanging knowledge, ideas, and goals between the company and its suppliers, which improves processes such as materials handling and procurement management in companies with diverse business cultures (Pothal et al., 2018); the role of organizational culture in supply chain performance – increasing supply chain integration efforts and improving firm performance through flexible cultural alignment (Porter, 2019); the role of a task-oriented culture in strengthening the linkages between stakeholder-oriented CSR and sustainable procurement (Adzimach et al., 2020).

Studies in which culture is identified as a key factor influencing companies' purchasing decisions are relatively rare, as exemplified by the work of Carter et al. (2010).

A critical review of the literature on the subject, based on the Web of Science database, was conducted by ElBaz and co-authors in 2022. The authors classified four main research areas: studies on supply chain integration and performance; research concerning continuous improvement and Lean initiatives; studies addressing the role of culture in sustainability, corporate social responsibility, and green practices; and research focusing on emerging topics. The authors postulate the development of a multilevel framework that positions cultural dimensions as a central element, rather than merely treating culture as a moderating or mediating variable (ElBaz et al., 2022). The conclusions of this review confirm that, in most studies, culture is considered an additional factor rather than a leading element.

Moreover, the Google Scholar database identified studies concerning the role of culture in: supplier selection processes (Carter et al., 2010); supply chain management (Witkowski, Baraniecka, 2015, 2018); the relationship between buyer power and supplier shirking (Skowronski et al., 2022); purchasing practices across different industries (Cooper, 2024); supply chain collaboration, focusing on how cultural differences affect communication, trust building, negotiation, conflict resolution, risk management, and ethical (Raynolds, 2024).

4. Results and discussion

The Shenzhen-based company is one of the world's leading suppliers of electronic components (particular processors and GSM modules), with extensive experience in mass production supported by a distinctive organisational structure. The cooperation between the analysed Polish company and the Chinese supplier represents a typical relationship characterised by customer dependence and supplier advantage (Radziejowska, 2005).

The components ordered are highly specific and difficult to substitute on the market. Moreover, the supplier possesses a strong capital base, which provides it with a negotiating advantage over the customer, particularly in areas such as price, batch size, quality, and delivery times. This aspect is especially significant considering the material inventory, mainly the product structure of components supplied by the Chinese partner, where the material consumption stream of the Polish company is continuous. As part of material requirements planning, these product groups are maintained in stock, and order volumes are kept as constant as possible.

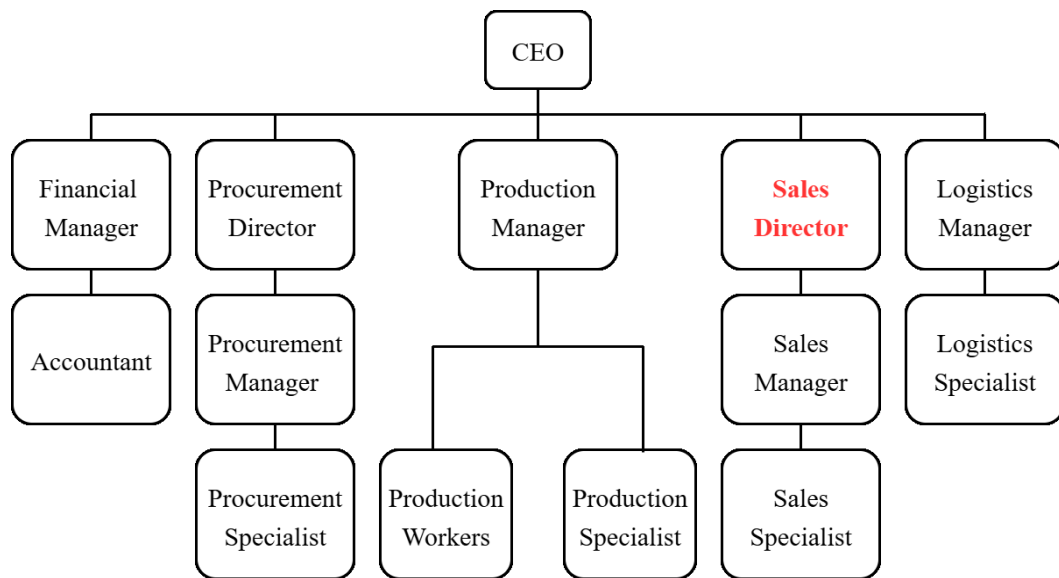


Figure 2. Organisational structure of a Chinese manufacturing company.

Source: Authors' elaboration.

The Dortmund-based company specialises in supplying high-quality, precision electronic components (particularly processors, microcontrollers) for the energy and defence industries.

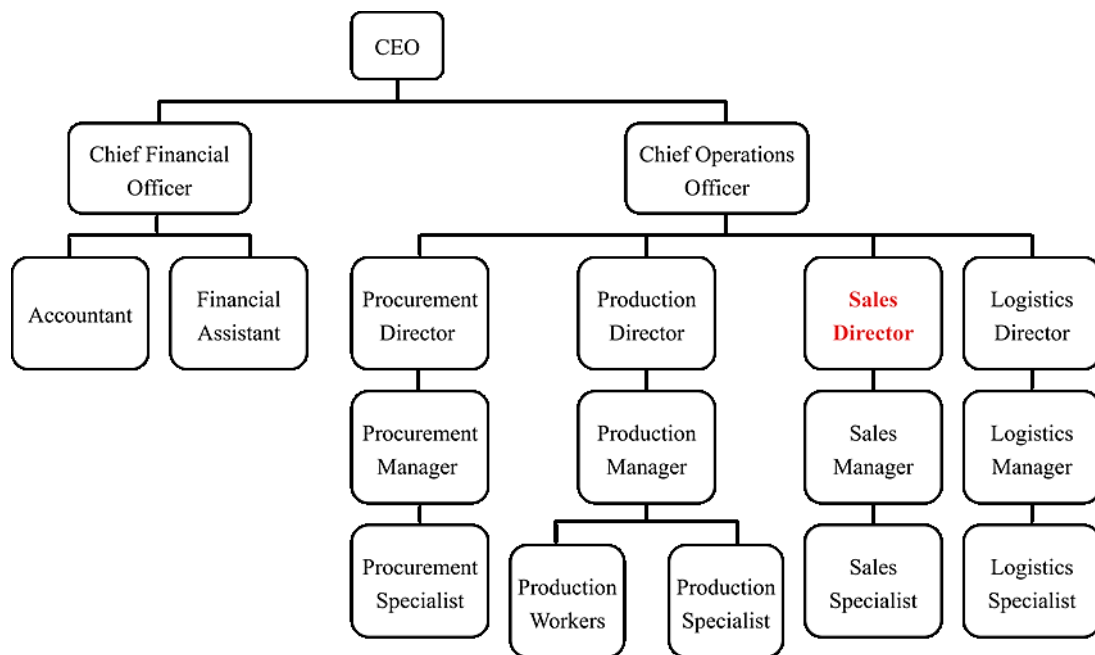


Figure 3. Organisational structure of a German manufacturing company.

Source: Authors' elaboration.

The analysed Polish manufacturing company, which is a customer of both suppliers, operates internationally and has been integrating these components into its products for over 30 years, distributing them on both domestic and international markets. The company is an engineering enterprise engaged in the manufacturing of measuring instruments and the provision of related services. Its products are offered in domestic, European, and Middle Eastern markets. The company places particular emphasis on sustainability in its operations and

decision-making processes, as well as on ensuring proper working conditions not only within the organisation itself but also throughout its supply chain. Procurement activities are focused on optimising processes related to medium-volume production. Raw materials and components used in production must meet the highest quality standards, confirmed by the required certifications.

Prior to the outbreak of the COVID-19 pandemic, cooperation with suppliers proceeded without significant disruptions. At present, the company has not yet fully returned to its pre-pandemic operational conditions, despite having implemented several organisational changes. These include incorporating supply chain risks into production planning, increasing contractual flexibility with suppliers, introducing substitutes for hard-to-source components, and redirecting selected procurement activities to regional markets. Nevertheless, the company continues to face significant challenges due to the unstable external environment, particularly the ongoing war in Ukraine. One of the key issues remains the necessity of maintaining higher inventory levels of strategic materials, such as processors and pressure sensors, which generates additional storage costs and ties up financial resources.

The development of intercultural competencies at the three cooperating companies proceeds differently. In the Polish company, no training was conducted on such topics. In the case of the Chinese supplier, no training related to cultural differences was conducted either, while the main focus is on the development of linguistic competence (English), treated as a key tool in international trade. In contrast, in the case of a German supplier, employees participated in internal trainings on the differences in communication styles of different nations, as well as on the differences regarding the organizational structure of business partners from Central and Eastern Europe (including Poland) and the resulting division of decision-making competencies.

According to the **R. Lewis model**, the German counterpart exemplifies the Linear-active (LA) culture, while the Chinese counterpart represents the Reactive (R) culture. The Polish counterpart, on the other hand, sits roughly in the middle between Multi-active (MA) and Linear-active (LA), suggesting, by far, a greater cultural similarity to the German counterpart than to the Chinese counterpart (Figure 4).

Sales director of the German company during the interview showed characteristics typical of the LA culture. The German company, operating in the electronic components industry, is an example of an organisation that plans its operations step by step, reflecting the German approach to business based on a precise schedule and guidelines. An example situation that illustrates this approach is a conversation about the delivery schedule, in which the German representative repeatedly stressed the need to stick rigidly to deadlines and to follow each step of the process precisely. When asked about the flexibility to adjust deadlines according to circumstances, the representative replied that ‘adherence to deadlines is a key element of our reputation’ – focus on facts and milestones. Furthermore, the German representative's introverted but firm approach indicates attention to detail and a lack of excessive gesticulation. For example, during meetings at the Polish company's headquarters where technical details of

the order were discussed, the German partner focused on facts, presenting arguments based on data and calculations, avoiding unnecessary emotions or distractions. Also during the interview, the answers given precisely referred only to issues of cooperation in terms of supply. Private or general issues concerning the local community or even the functioning of the company as such were not addressed. This approach clearly shows that Germans value privacy and separate their professional and personal lives. It is also worth noting that the German representative valued truth rather than diplomacy, which was evident in the questions regarding potential openness during negotiations on the price of ordered components. Instead of using diplomatic phrases, the interviewee clearly indicated cost limits, arguing decisions with hard financial data. He spoke firmly and categorically, was fact- and data-oriented and at the same time confident in the quality of the products offered to the Polish company.

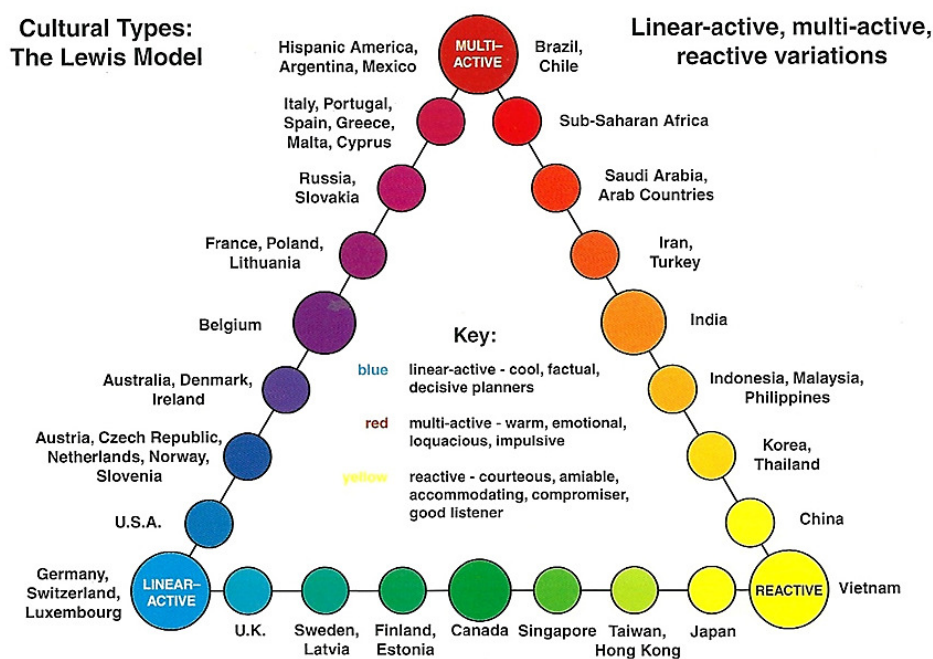


Figure 4. Cultural Types: The Lewis model.

Source: CrossCulture, know culture for better business, <https://www.crossculture.com/about-us/the-model/linear-active/>, 07.09.2024.

The course of the interview with the Chinese sales director was different. He avoided direct answers. He listened patiently to questions and took long pauses, thinking for quite a long time (in the perception of the Polish representative conducting the interview) before giving an answer. During the interview, he repeatedly stressed that “we must first listen to our partners and understand their needs before proposing solutions”. He was composed and avoided excessive emotional expression and did not gesticulate. He spoke in a soft-spoken style - he did not use categorical phrases. In response to questions about price negotiations, the Chinese partner avoided direct and explicit statements, even when the question about willingness to change the price was only hypothetical or conditional. When negotiating a change in the terms of supply, he responded in a diplomatic manner, suggesting that “we need more time to consider

this issue”. This was a subtle way of avoiding conflict. He did not openly object to the Polish recipient's proposed changes, but in the course of further cooperation it became clear that these conditions were not changed on his part. Such a lack of clear expression of disagreement, i.e. open objection, despite disagreement on the content is characteristic of the harmony-focused approach and is a source of conflict in communication with LA and MA representatives. Another important aspect was the clear focus on building and sustaining relationships. Rather than pushing their own negotiating positions in their responses, the Chinese partner focused on building a long-term relationship, mentioning a willingness to organise an additional informal meeting such as a joint dinner or mutual visit, which is typical of a culture that values diplomacy rather than truthfulness. The Chinese representative displayed people-oriented and rapport-oriented traits – as manifested in patiently waiting for answers from the partner, avoiding interrupting the interlocutor, and extreme avoidance of entering into conflict.

According to the **R. Gesteland model** the analysis of cooperation in the area of procurement, allowed for the characterisation of suppliers (Escher, Brzustewicz, 2018; Gesteland, 2002): the Chinese supplier is characterised by a relationship-focused, formal, moderately monochronic, and reserved culture (Table 3); the German supplier is characterised by a deal-focused, moderately formal, monochronic, and reserved culture (Table 4).

Table 3.

Characteristics of a Chinese supplier based on information gathered through observations, interviews and email analysis

The dimensions of culture	Characteristics
Relationship-focused	During the online meetings, the conversations extended beyond business cooperation and also covered personal topics, such as the Polish representative's interests and holiday plans. These informal exchanges contributed to building a relationship and fostering an atmosphere of trust. Establishing an emotional connection with the business partner proved to be a key element in the development of the cooperation.
	The e-mail correspondence from the Chinese partner often included proposals for long-term cooperation, for example, over several years, which indicated a preference for building lasting and stable business relationships rather than pursuing quick, one-time transactions.
	During the visit to China, the representative invited the Polish partner to informal meetings outside the company premises in order to get to know each other better before starting negotiations.
	The Chinese representative avoided putting pressure on quick decisions, allowing the Polish entrepreneur sufficient time (e.g. two weeks or another mutually agreed period) to carefully consider all aspects of the cooperation.
	In the discussions regarding pricing terms, the Chinese representative demonstrated a willingness to make concessions, for example, by offering to send the first trial batch free of charge and agreeing to accept an initial order smaller than the standard minimum order quantity. In doing so, he signalled a focus on long-term benefits and future profits rather than immediate, short-term gains.

Cont. table 3.

Formal	Face-to-face and online meetings were formal in nature and were preceded by structured preparations, such as selecting the venue or online platform, setting the meeting time, and sharing the list of participants in advance.
	The representatives declared that they organise formal contract signing ceremonies, even for smaller orders (e.g. those amounting to half the volume of the initial contract).
	In correspondence and meetings, the representatives consistently addressed the Polish partner using appropriate honorifics and titles (e.g. Dear Sir/Madam), which emphasised the hierarchical structure and formal nature of the relationship.
	During the first meeting, the representative presented the Polish partner with a symbolic gift—a regional set of high-quality teas—which expressed respect, goodwill, and a desire to build the relationship.
Moderately monochronic	During the meetings, representatives often addressed several topics at the same time (e.g. the decision to choose the means of transport for deliveries, the frequency of subsequent orders), without a clear structure in discussing individual points.
	The representatives admitted that priority changes during the implementation of a given project are a frequent element of the cooperation and they do not treat them as a problem.
	Making final decisions in price negotiations, acceptance of final designs taking into account the required technical parameters or terms of delivery required a relatively long time of arrangements (about a month), which was due to the need to involve many people located at different levels of the company's hierarchy.
Reserved	Despite the long-term cooperation, the representative maintained a clear distance in personal relations and avoided making closer social contacts.
	Email correspondence concerned formal matters and did not contain emotional expressions or personal comments.
	The representatives indicated during the interview and ongoing daily conversations that avoiding open expressions of emotion (e.g. smiling frequently, maintaining long eye contact) allows them to remain professional and focus on the formal aspects of the cooperation.
	During face-to-face contact, the Chinese representative remained calm and neutral, showing no emotion. Even in difficult negotiating situations, an attempt to defuse tension on the part of the Polish counterparty by telling a joke was always unsuccessful.

Source: Authors' elaboration based on conducted research.

Table 4.

Characteristics of a German supplier based on information gathered through observations, interviews and email analysis

The dimensions of culture	Characteristics
Deal-focused	Email responses to queries regarding transaction details were substantive (usually within a few hours or by the end of the same working day of the representative at the latest).
	Collaboration was carefully documented in meeting summary reports with a clear focus on measurable results, such as delivery compliance or speed of response to a request.
	Meetings with contractors outside working hours almost never take place (except at a pre-arranged time, e.g. the signing of a contract). Efficiency and direct problem solving during working hours, preferably on a given day, is important.
	The representatives insisted on exact financial terms and delivery dates, and did not raise personal issues at all.
	The representatives repeatedly stressed that, from their point of view, the most important thing was speed of action.

Cont. table 4.

Moderately formal	In email correspondence, titles were used, writing respectfully at the beginning of the cooperation. Currently, representatives address their partners in the Polish company by name.
	The e-mails (if they were not the first, i.e. initiating the conversation, but the next in the discussion, between people working together for a long time, occupying similar positions in both forms in the structure) often did not have courtesy phrases at the beginning and end of the e-mails (only the addressee's name at the beginning and Tschüss at the end).
	No closer personal relationships are established. Joint after-hours outings with contractors do not take place, and procurement matters are dealt with at the company's headquarters or in online meetings.
	During the videoconference, the German representative did not pay much attention to etiquette, did not require a formal dress code, stuck to a formal, pre-established agenda for the meeting, but at the same time allowed for flexibility.
	During the negotiation of key issues (unit price, delivery volumes, delivery dates), the representative was authorised to make decisions independently, without the need to schedule additional meetings or involve higher-level managers, which reduced the formal decision-making process to as little as one day.
Monochronic	The supplier consistently demonstrated strict adherence to the agreed meeting schedules.
	The supplier consistently expected immediate feedback, which was explicitly communicated in messages such as: "please reply today" or "please confirm receipt of our proposal".
	Each meeting had a clearly defined objective (e.g. contract signing), and the time allocated for each activity was carefully planned, leaving no room for spontaneous decisions or discussions on topics not directly related to the meeting's purpose.
	Delivery dates are considered unchangeable and any changes to the contract provisions must be justified and formally accepted by both parties.
	The representative always replied to emails only during working hours, often providing information on when to expect a reply. He never responded spontaneously or outside of designated hours, maintaining a steady, structured rhythm of communication.
Reserved	Meetings and negotiations were conducted in a structured manner, with the expectation that each topic would be discussed in detail before the next topic was raised. Attempts to raise multiple issues on contract provisions at the same time were rebuffed, highlighting the specificity of the step-by-step operation.
	During meetings, representatives kept a professional distance, avoided excessive gesticulation and chose their words carefully.
	When problems arose (e.g. timeliness of payments), they formally signalled irregularities in writing, preferring to resolve them through established procedures rather than through emotional reactions or pressure for immediate action. In doing so, they referred to previous arrangements and documentation, emphasising the importance of adhering to the principles of cooperation to which both parties had agreed.
	E-mail correspondence uses precise but balanced wording, avoiding excessive directness. They present expectations, e.g. regarding payment terms, in a polite manner so as to maintain clarity of communication without imposing their own position. For example, instead of directly stating 'We expect immediate payment', they write: 'We would like to point out that the deadline for payment has passed, therefore we would like to request information regarding the expected date for the transfer.'

Source: Authors' elaboration based on conducted research.

According to the **G. Hofstede model**, numerical indicators for the Polish, German, and Chinese partners were determined using the Country Comparison Tool (Figure 5).

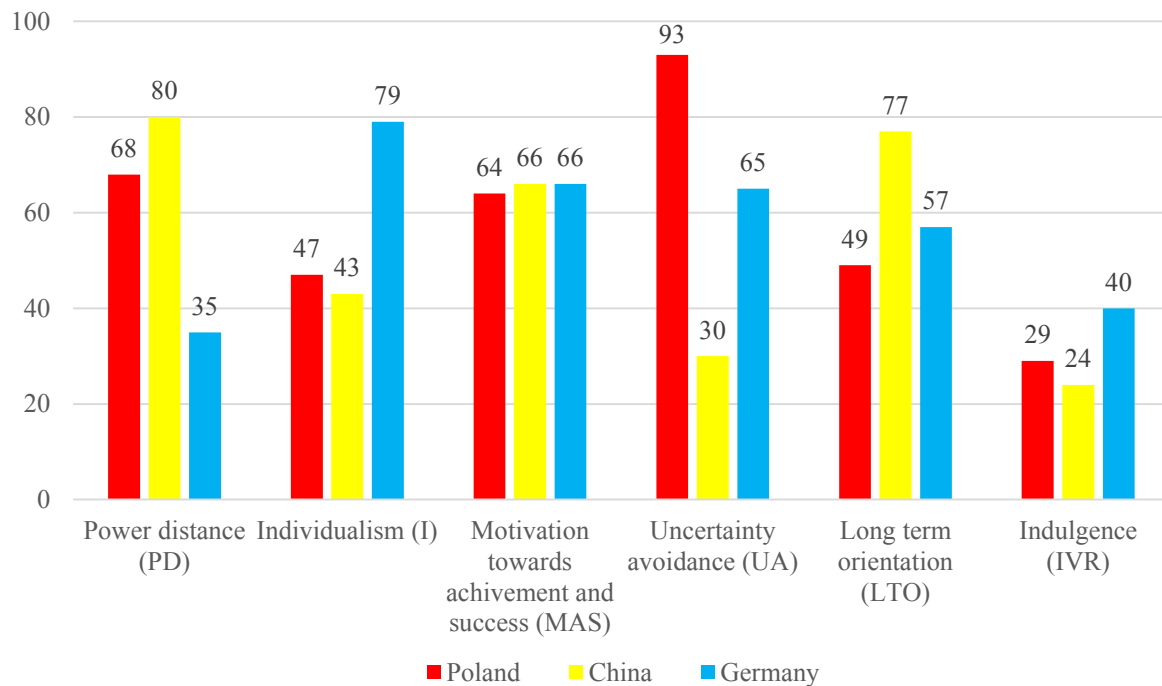


Figure 5. Cultural differentiation of China, Poland and Germany by category G. Hofstede et al. (updated 2023).

Source: Authors' own elaboration based on Country comparison tool, <https://www.theculturefactor.com/>, 07.09.2024.

The obtained empirical data collected during the self-study showed that: cultural differences between business partners are evident in four dimensions (PD, I, UA and LTO), while results are simultaneously very similar in two dimensions (MAS and IVR) (Table 5).

Table 5.

Characteristics of the polish contractor, German and Chinese supplier based on information gathered through observations, interviews and email analysis

The dimensions of culture	Characteristics
Power Distance	Chinese managers expected obedience and acceptance of inequalities in the organisational structure, e.g. not questioning decisions made with a culture in communication, issuing messages of an instructional nature without explaining them (80), which makes direct communication with the Polish partner somewhat difficult (68).
	German managers preferred participative communication (35), which was reflected in the more direct meetings with the Polish partner, where hierarchy is less important. During online working meetings with not only the sales director, but also his subordinates, it could be observed that PD was sometimes visible, for example, in the use of titles (Herr Doktor), but did not block the free and open exchange of arguments, nor did it intimidate those positioned lower in the company hierarchy to express their own observations and comments. Junior professionals used formal titles in relation to their superiors, but this did not interfere with free communication, and the superior encouraged subordinates to express their own opinions.

Cont. table 5.

Individualism	For the Chinese representatives, priority was given to intra-team relations (43), e.g. taking action for the good of the whole team, collective responsibility when mistakes are made or contracts are not honored.
	Polish employees (47) entering into cooperation with them noted a preference for contacts based on trust and a very strong role for personal relationships. In contrast, they themselves did not show such a clear preference in this respect, leading to greater flexibility in adapting to the specificities of the Chinese partner.
	In the German representative's routine, day-to-day dealings with the Polish representative, the emphasis on the autonomy of the handlers and the formalisation of the operations was evident, with each employee involved in a particular transaction acting on the basis of clearly defined written responsibilities and only being held accountable for them.
Masculinity (Motivation towards Achievement and Success)	Chinese, German and Polish contractors show a fairly high and similar level of MAS - achievement orientation or efficiency are more important than e.g.: caring. The suppliers were focused on results, which had a direct impact on the relationship with the Polish company. This was exemplified by the strong commitment of both parties to deliver on time, with the Chinese supplier showing a much higher willingness to work overtime (e.g. staying at work longer or working on days off), which contrasts with the more balanced approach of the Polish and German employees (work-life balance).
	Poles also emphasised achievement, which fostered smooth cooperation, but most often with less intensity and additional commitment (e.g. reluctance to work after working hours or on weekends, possibly demanding/requesting additional gratification than partners).
Uncertainty Avoidance	In the Polish company, clear procedures and rigid rules for internal company processes were perceived (93), which were sometimes perceived as inflexible in view of the decidedly more flexible approach of the Chinese in this sphere (30).
	Chinese flexibility manifested itself in the willingness to modify contracts during the execution of orders (e.g. changing delivery dates due to production delays), which was difficult to accept for Polish employees preferring to stick to pre-established procedures.
	German partners, although avoiding uncertainty (65), showed a considerable willingness to cooperate on the basis of mutual trust in business partners, e.g. by granting trade credits, adjusting the frequency of deliveries to the partners' production needs. Although contracts e.g. clearly regulate the conditions for termination of cooperation with the counterparty, they allow for possible changes.
Long Term Orientation	Working with a Chinese supplier revealed their strong adaptability to changing market conditions (e.g. increasing production volumes in response to component shortages that emerged during the period under review), which allowed for greater flexibility in the sourcing process. This confirms the desire to maintain the business relationship, i.e. the focus on cooperation in the long term (77).
	German partners also demonstrated such an orientation (57), including precise planning of cooperation.
	The Polish customer (49) is far less oriented towards long-term cooperation, which in some cases resulted in a shorter planning horizon (e.g. in terms of demand for a period of one month or a quarter) compared to the planning proposals of the Chinese and German partners.
Indulgence	In the Chinese case, restrictiveness was evident (24), for example, in the low number of days off (one day off a week) and long working hours on weekdays (more than eight hours a day).
	The German partner also showed a rational approach to work organisation (40), although he placed more emphasis on work-life balance than the Chinese.
	The Polish representative has a similarly low level of this indicator (29), which is conducive to understanding in relationships with partners. Nevertheless, there were noticeable differences in the approach to enforcing leisure time through: strictly defined working hours, predetermined and respected rules of not working on days off. These differences were particularly evident in the relationship between the Polish and the Chinese supplier.

Source: Authors' elaboration based on conducted research.

Summarising the own research carried out, it should be said that the triangulation of methods (observation, interviews, content of e-mails) made it possible to collect empirical material that justifies answering the problem questions posed by the authors.

Referring to the main question as follows: What role do cultural differences/dimensions play in the procurement/purchasing process of a manufacturing company for components and raw materials? it should be stated that results were obtained confirming the significant role of cultural differences in the procurement process of a Polish manufacturing company from Chinese and German suppliers.

Specific questions were posed to the general question:

1) In what areas are the difficulties in cooperation most severe?

Key areas where differences are most apparent were identified. In particular, these include communication style, time management, hierarchy and attitudes to paperwork.

Working with a Chinese supplier showed that significant cultural differences affect the degree to which processes are formalised and deadlines are managed – the Polish company had to learn to operate in a more flexible way and accept the hierarchy, which with this contractor is absolute and not subject to change and negotiation.

With the German supplier, on the other hand, differences in the immediacy of communication and timeliness proved crucial. Hierarchy is important, but not so much that it blocks the free exchange of arguments.

The Polish entrepreneur has to adapt his approach depending on the partner he works with in order to manage the procurement process effectively.

2) Did and how did the described difficulties due to differences affect the procurement process of the company under study?

The differences observed did not significantly affect the processes described at the time of the research for this article, as the three companies have been working together for many years. The managers have to a large extent become familiar with the specifics of the other contractors' operations and have learnt to function effectively together. However, what was the biggest challenge for the Polish company at the beginning of the cooperation was, in the case of the German supplier, the timeliness of all joint actions and the demand for immediate feedback, and in the case of the Chinese supplier, the manner of communication – veiled, not explicit (high-context) and the lack of immediate feedback, and sometimes even the lack of any response or answer to questions without further reminders.

3) What actions should the Polish company/s take to make the procurement process more efficient?

From a practical perspective, the results of this study have important implications for entrepreneurs, managers, purchasing specialists, sales executives and others who are involved in the procurement and purchasing activities of companies. Those who manage relationships with suppliers recruited from different cultures should pay attention to differences in paperwork and hierarchical approaches that can affect the speed and efficiency of processes. Sales executives, on the other hand, should strive to adapt communication strategies to the cultural preferences of their business partners.

In the case of China, it's important to understand the importance of ceremoniality, relationship building and *saving face*. In relations with German partners, precision, punctuality, scheduling, and immediate feedback are key. Based on the collected empirical material, recommendations can be made for the described Polish company and other companies (Tables 6 and 7).

Table 6.

Recommendations for the Polish manufacturing enterprise/s (purchasing/procurement departments/staff) for future cooperation with the Chinese supplier/s

The stages of cooperation	An action that can improve cooperation and safeguard the interests of the company/s by minimizing misunderstandings and conflicts
Establishing cooperation with new suppliers	Taking the time to go to China, getting to know your future counterparty, spending time with them in private situations as well. Allowing you to “test yourself” as a potentially trustworthy partner with whom it is worthwhile and profitable to build a long-term relationship. Business transactions in China appear to be settled through negotiation within a system of networked relations based on interpersonal reciprocal obligations <i>guanxi</i> , i.e. relationships understood as treating others warmly, helping, networking. Without this, it is impossible to work effectively with the Chinese.
	Sourcing suppliers with references who have good reviews in online services. The following information is particularly important: punctuality of delivery and how long the company has been in business, i.e. how much experience it has had (to be checked in B2B services).
	Invite a potential Chinese partner to Poland to get to know him better and build a relationship based on trust.
	Organizing online meetings with a potential supplier to build relationships, being cordial, taking an interest in local issues, asking about private life.
	Hire a professional company to verify the quality of the delivery (quantity, quality, visual) while still on site in China, before the order is dispatched/shipped.
	Ask for certification in the case of products; check compliance with quality standards and those required for the EU market. Before placing an order, it is a good idea to order samples of materials, raw materials. Before placing a larger order, it is a good idea to order a sample batch to confirm the quality of the materials/components ordered in Poland.
Routine cooperation	Organizing regular online meetings to maintain and build relationships with the supplier. Contact in the form of video allows both to build closer relationships and to communicate more precisely, clarifying any misunderstandings in real time. Consider using WeChat (1.3 billion active users), one of the most popular in China, used for personal communication, but also by companies for business communication (customer communication, business promotion, customer service, B2C, B2B).
	Active and continuous monitoring of all processes. Frequent e-mail contact, requests for confirmation of all operations (receipt of order, acceptance, shipment preparation, order dispatching, etc.), in order to minimize delays in delivery, which the supplier is unlikely to communicate himself. This also applies to transport or customs documentation (certificates, invoices, waybills).
	Each time a request for clear written confirmation that the arrangements have been accepted and will be carried out, due to the Chinese supplier's avoidance of difficult topics and avoidance of confrontation and conflict. The request to confirm the quantity, quality, technical parameters of the order, as well as the delivery dates should be expressed as concretely as possible (in hours or days).
	Requesting feedback every time – for every operation, as well as for changes in deadline, quantity, quality, etc. Requesting written confirmation every time of messages, requests, orders, dispatches received (worthwhile, e.g.: asking for photos of prepared dispatches and documents).
	Using the same order templates containing: dates, deadlines, standards, parameters, colors, transport conditions, packaging, etc. Use of plain English, asking specific short questions. Demanding clear and precise written replies in the event of defects detected in the delivery, which implies a failure to meet the delivery quality conditions.

Cont. table 6.

	When dynamic, often unexpected changes occur (exchange rates, transport costs, etc.), it is necessary to take the initiative to change arrangements or renegotiate terms and conditions and organize negotiations (the counterparty is unlikely to do so, and will also avoid communicating difficult information that requires open confrontation).
	Avoiding actions that may cause a loss of face in the understanding of the counterparty, which may be triggered by openly disagreeing with someone high up in the hierarchy, openly and publicly rejecting a proposal or being forced to publicly admit a mistake. It is therefore necessary to use conciliatory, non-confrontational language, to ask for clarification, not to make negative judgements, but to make an attempt to communicate. Show and express understanding for the situation and point out circumstances beyond the supplier's control in the event of a delay or a quantitative or qualitative discrepancy in delivery. When criticism is necessary, it is worth 'camouflaging' it and conveying it in polite language such as: 'maybe we could try to organize it differently'.

Source: Authors' elaboration based on conducted research.

Table 7.

Recommendations for the Polish manufacturing enterprise/s (purchasing/procurement departments/staff) for future cooperation with the German supplier/s

The stages of cooperation	An action that can improve cooperation and safeguard the interests of the company/s by minimizing misunderstandings and conflicts
Establishing cooperation with new suppliers	Contact from the outset should be transparent, formal and as precise as possible. An RFI, RFP or RFQ sent to a potential contractor must contain the precise parameters of the item to be ordered in the future, quantity, volume, deadlines, commercial conditions, etc. Otherwise, a response may not be forthcoming. It is also important to individualize the request – not to send massively identical emails to many potential suppliers, as this could be understood as unprofessional treatment of the company in question.
	It is important to take into account the counterparty's past experience – especially those individuals who are positioned high up in the company's hierarchy and have extensive experience and knowledge of working with past counterparties.
	Responsibilities and procedures must be clear from the start of the cooperation. It is necessary to establish precisely who is responsible for what: technical welding, logistics, quality, working contacts.
Routine cooperation	It is extremely important to stick precisely to the established procedures, timetables and not to change them in the course of implementation once an operation has started. If change is necessary – jointly and precisely establish a new recovery plan/schedule and stick to the joint findings, confirmed in writing.
	Replying to emails should be done in real time – preferably immediately or on the same day – a reply sent the next day or after several days may be perceived as disrespectful to the counterparty. Acknowledge receipt of each message (even very briefly), including in situations that seem obvious.
	The order to be placed must be complete and precise – quantity, full technical parameters, attachments, dates, technical data, product codes, Incoterms conditions, forms of order receipt.
	Any changes made by the Polish procurement department after the order has been approved may be seen by the German supplier as a breach of procedures.
	The use of standardized templates for communication with the supplier at all stages of cooperation: preparation, dispatch, confirmation, monitoring, receipt of order complaints, is desirable.
	Receipt of the order should take place at the agreed time, in the event of delays (e.g. unloading problems) it is necessary to inform of the delay, stating the reasons and immediately setting a new appointment.
	For a German supplier, it is important to confirm receipt of the order (delivery note), for two reasons: certainty that the order has arrived and proof in case of disputes (e.g. delivery shortages).
	Any objections should be made formally – in accordance with the established procedure (documents, photos, precisely described objections), without so-called softening comments.

Cont. table 7.

	Written correspondence should be formal and polite – it must include dates, the subject line of the email, the formal number (of the case, invoice, order to which the email relates), the names and position of the person conducting the correspondence, brief courtesy phrases. In contentious situations, emotion and understatement should be avoided and facts, documentation and analysis should be relied upon.

Source: Authors' elaboration based on conducted research.

Due to cultural proximity (also geographic), by far more areas of cooperation between the Polish and German contractors are similar or, in the case of divergence, can be smoothly aligned in strategic decisions and daily operations. Very visible and fundamental differences concern the cooperation with the Chinese contractor – which is confirmed both by the location of the individual nations on the scales in the cultural models, as well as by the information collected during the own research. Poland's rarely extreme, rather middle or near-middle position on the scales of cultural differences can provide a strategic advantage in shaping flexible and adaptive models of cooperation. Their difference from traditional, hierarchical models, consisting of action based on trust, effective communication and joint problem solving, allows for faster reactions to changes in the environment, market conditions or the needs of business partners.

It is worth recommending intercultural communication training to all three companies described in this article. Due to their long-standing cooperation in part (e.g. in the area of general issues of differences and their consequences for cooperation), this could be a joint training of all three cooperating companies taking place online. It is advisable to implement systemic operations to develop Cultural Intelligence (CQ) among employees of purchasing and logistics departments, including above all training in intercultural communication, management of cultural differences in negotiations and adaptation training based on, for example, the models characterised above. Embedding CQ in a company's development strategy could take the form of investment in these trainings as part of implemented diversity management policies. Particularly useful would be peer visits and practical workshops based on case studies, conflict situation simulations and interactive sessions with experts from China, Germany and Poland. It is important to include CQ in the strategic management of companies as a core competence. With the need to work in cross-cultural environments, CQ becomes an important organizational resource that affects the effectiveness of teams, negotiation processes and the quality of diversity management, as well as enhances the adaptability of the company and reduces the risk of wrong decisions due to misunderstandings. CQ can be included in strategic assumptions as an element supporting effective management in a culturally diverse environment. It is worth considering the creation of an international cooperation coordinator position responsible for clarifying cultural differences and mediating disputes. It is also reasonable to consider cultural risks in purchasing and logistics processes, and to include CQ in supplier evaluation, e.g. as a component of assessing the quality of cross-cultural relations in the supplier relationship management system. Indicators that take into account progress in implementation could be the number of employees trained and their evaluation of that training, or the creation of a summary of cultural areas where there is a risk of misunderstanding and its updating as

part of audits. Whereas in the case of creating a position or appointing a person responsible for developing CQ in the company, an indicator could be the number of problems reported and resolved due to cultural differences.

5. Summary

Understanding cultural differences in business operations is essential for successful action in international markets. Failure to understand them leads to misinterpretations and lost productivity. Therefore, conscious management of cultural diversity is a strategic element of competitive advantage. Satisfactory inter-company communication can be decisive in the selection of a supplier if the other conditions are met by other suppliers at a similar level.

In the context of international business cooperation, cultural factors play a key role, although they are often overlooked in favour of financial aspects. In fact, they significantly influence the efficiency and quality of cooperation, especially in the electronics industry, where precision, timeliness and compliance with standards are crucial. When working with overseas suppliers, such as companies in Shenzhen and Dortmund, proper management of these cultural differences has proven to be the key to success. Although the results of the conducted research cannot be generalised, they allow conclusions to be drawn for business and research practice and complement the scientific knowledge accumulated to date.

The proposed method of analysis can be used to analyse cooperation between companies from countries other than Poland, China and Germany. The use of different methods (interview, observation, archival analysis) allows for a better understanding of the meaning of the actions taken, i.e. fulfilling the basic function of science. On the other hand, analysis can support companies in their day-to-day operations so that they can be more effective. The results of this study provide valuable lessons for theory and practice in cross-cultural management in relation to the procurement process. Supplier categorisation, sourcing strategies, the development of guidelines for sharing the benefits of process improvement with suppliers are all strategic challenges for supplier relationship management, which are currently no small task. In view of the decisions taken by the current US administration, e.g. in the area of tariffs, it is worth examining the issues raised in this article in the future. This is important in the context of deciding between local and global suppliers – not relying solely on Asian suppliers.

Research areas where scientific and practical knowledge needs to be complemented are studies of cultural differences in corporate sourcing related to: the use of AI to improve purchasing processes - contract analysis, preparation of data for negotiations, the role of humans and AI in the purchasing process, also from the perspective of suppliers from different cultures, or cultural considerations and supplier selection in the context of sustainability. Culture has a huge impact on how societies treat the environment (Matusiak, 2022; Kozar, 2023),

so understanding local norms and values contributes to better aligning purchasing strategies and supporting suppliers that meet sustainability goals in a way that is compatible with the region's circumstances.

References

1. Abramson, N.R., Moran, R.T. (2017). *Managing Cultural Differences: Global Leadership Skills and Knowledge for the 21st Century*, 1-638. <https://doi.org/10.4324/9781315403984>
2. Acquah, I.S.K. (2023). Modelling the importance of collaborative culture and its dimensions for supply chain collaboration: a necessary condition analysis. *RAUSP Management Journal*, 58(2), 125-142. <https://doi.org/10.1108/RAUSP-05-2022-0153>
3. Adzimah, E.D., Lei, L., Ishawu, M. (2020). Organisational culture influences on corporate social responsibility and sustainable procurement in a service sector industry. *Journal of Psychology in Africa*, 30(5), 390-396. <https://doi.org/10.1080/14330237.2020.1821309>
4. Ahmadi-Gh, Z., Bello-Pintado, A., Bortolotti, T., Boscari, S. (2024). Sustainability drivers and national culture in buyer-supplier environmental practices: an institutional perspective. *European Business Review*, 36(5), 710-724. <https://doi.org/10.1108/EBR-06-2023-0183>
5. Bąkowska-Morawska, U., Witkowski, J. (2015). Kulturowe uwarunkowania zarządzania łańcuchami dostaw w Japonii, Polsce i W. Brytanii. *Organizacja i Kierowanie*, 4, 39-54.
6. Bąkowska-Morawska, U., Witkowski, J. (eds.) (2018). *Japońskie łańcuchy dostaw w Europie. Zarządzanie i rozwój*. Warszawa: PWE.
7. Bargiela-Chiappini, F., Nickerson, C. (2003). Intercultural Business Communication: A Rich Field of Studies. *Journal of Intercultural Studies*, 24(1), 3-15. <https://doi.org/10.1080/07256860305788>
8. Barney, J.B. (1986). Organizational culture: can it be a source of sustained competitive advantage? *Academy of Management Review*, 11(3), 656-665. <https://doi.org/10.2307/258317>
9. Barzykowski, K., Majda A., Przyłęcki P. (2021). Polska adaptacja Skali Inteligencji Kulturowej: prezentacja narzędzia, *Pielęgniarstwo w opiece długoterminowej Kwartalnik międzynarodowy*, 6(1), 25-34. [https://doi.org/10.19251/pwod/2021.1\(3\)](https://doi.org/10.19251/pwod/2021.1(3))
10. Bennett, M.J. (2017). *Development model of intercultural sensitivity*. In: Y. Kim (Ed.), *International encyclopedia of intercultural communication*. Wiley. <https://doi.org/10.1002/9781118783665>
11. Biemans, W., Ulaga, W., Lewin, J.E. (2010). Firm downsizing and satisfaction among United States and European customers. *Journal of Business Research*, 63(7), 697-706. <https://doi.org/10.1016/j.jbusres.2009.05.005>

12. Boroch, M. (2016). A Formal Concept of Culture in the Classification of Alfred L. Kroeber and Clyde Kluckhohn. *Analecta. Studia i Materiały z Dziejów Nauki*, 25, 2(49), 61-101
13. Budzanowska-Drzewiecka, M., Marcinkowski, A.S., Motyl-Adamczyk, A. (2016). *Różnice kulturowe w komunikacji biznesowej*. Kraków: Uniwersytet Jagielloński.
14. Cannon, J.P., Doney, P.M., Mullen, M.R., Petersen, K.J. (2010). Building long-term orientation in buyer-supplier relationships: The moderating role of culture. *Journal of Operations Management*, 28(6), 506-521. <https://doi.org/10.1016/j.jom.2010.02.002>
15. Carter, J.R., Maltz, A., Yan, T., Maltz, E., Goh, M. (2010). Impact of culture on supplier selection decision making. *International Journal of Logistics Management*, 21(3), 353-374. <https://doi.org/10.1108/09574091011089790>
16. Cateora, P., Ghauri, P. (2014). *International marketing*. Edinburgh Business School, Heriot-Watt University.
17. Chunsheng, L., Wong, C.W.Y., Yang, C.-C., Shang, K.-C., Lirn, T.-C. (2020). Value of supply chain resilience: roles of culture, flexibility, and integration. *International Journal of Physical Distribution & Logistics Management*, 50(1), 80-100. <https://doi.org/10.1108/IJPDLM-02-2019-0041>
18. Cooper, M. (2024). *The Influence of Organizational Culture on Procurement Practices: A Multi-Industry Perspective*. Retrieved from: www.preprints.org, 13.06.2025.
19. Dąbrowski, J. (2011). Zakupy a logistyka zaopatrzenia i marketing zakupów. *Współczesna Gospodarka [Contemporary Economy]*, 2(2), 55-66.
20. Deal, T.E., Kennedy, A.A. (1982). *Corporate Cultures: The Rites and Rituals of Corporate Life*. Addison-Wesley Publishing Company. *Business Horizons*, 26(2), 82-85. [https://doi.org/10.1016/0007-6813\(83\)90092-7](https://doi.org/10.1016/0007-6813(83)90092-7)
21. Earley, P.C., Ang, S. (2003). *Cultural Intelligence: Individual Interactions across Cultures*. Stanford University Press. <https://doi.org/10.1515/9780804766005>
22. Easterby-Smith, M., Thorpe, R., Jackson, P. (2012). *Management Research*. London: SAGE.
23. ElBaz, J., Iddik, S. (2022). Green supply chain management and organizational culture: a bibliometric analysis based on Scopus data (2001-2020). *International Journal of Organisational Analysis*, 30(1), 156-179. <https://doi.org/10.1108/IJOA-07-2020-2307>
24. ElBaz, J., Jebli, F., Cherrafi, A., Akenrote, T., Iddik, S. (2022). The cultural dimensions in supply chain management research: a state-of-the-art review and research agenda, Supply chain management research. *European Business Review*, 34(2), 171-190. <https://doi.org/10.1108/EBR-04-2020-0092>
25. Escher, I., Brzustewicz, P. (2018). Przejawy podejścia protransakcyjnego i propartnerskiego w relacjach biznesowych budowanych na polskim rynku. *Handel Wewnętrzny*, 376, 53-60.
26. Faisal Shehzad, H.M., Binti Ibrahim, R., Yusof, A.F., Shawkat, S., Ahmad, S. (2022). Recent developments of BIM adoption based on categorization, identification and factors:

- a systematic literature review. *International Journal of Construction Management*, 22(15), 3001-3013. <https://doi.org/10.1080/15623599.2020.1837719>
27. Gadowska-Lila, K. (2014). Kulturowe aspekty doskonalenia przedsiębiorstwa na przykładzie międzynarodowego koncernu. *Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu*, 358, 49-57. <https://doi.org/10.15611/pn.2014.358.04>
 28. Geert Hofstede. Retrieved from: <https://geerthofstede.com/culture-geert-hofstede-gert-jan-hofstede/6d-model-of-national-culture/>, 08.09.2024.
 29. Gelfand, M.J., Abrahams, M. (2022). *What Is Normal? How Culture Affects Communication Styles*. Culture and Society, Insight by Stanford Business. Retrieved from: <http://www.youtube.com/watch?v=Mom8PuwGJlk&t=6s>, 23.01.2025.
 30. Gesteland, R.R. (2000). *Różnice kulturowe a zachowania w biznesie*. Warszawa: PWN.
 31. Gesteland, R.R. (2002). *Cross-cultural business behavior. Marketing. Negotiating. Sourcing and Managing Across Cultures*. Gylling: Copenhagen Business School Press.
 32. Gowans, G. *Ally-shoring przebuduje globalne łańcuchy dostaw? Globalizacja, jaką znamy, odchodzi do lamusa*, 05.02.2024. Retrieved from: <https://trans.info/pl/ally-shoring-przebuduje-globalne-lancuchy-dostaw-ofni-374075>, 08.09.2024.
 33. Gozdowska, N. (2024). The Power of Diversity: Klucz do efektywności w zespołach. *Strefa PMI, Kwartalnik Project Management Institute Poland Chapter*, 44, 16-17.
 34. Grudzewski, W.M., Hejduk, I. (2006). Współczesne kierunki rozwoju nauk o zarządzaniu. *Prace Naukowe Instytutu Organizacji i Zarządzania Politechniki Wrocławskiej*, 79(21), 283-298.
 35. Haasis, H.-D., Du, J., Sun, X. (2021). *Logistics challenges along the new silk roads, Dynamics in Logistics: Twenty-Five Years of Interdisciplinary Logistics Research in Bremen, Germany*, 295-307. https://doi.org/10.1007/978-3-030-88662-2_14
 36. Hall, E.T. (1976). *Beyond culture*. Garden City, New York: Anchor Press.
 37. Handy, C.B. (1985). *Understanding Organizations*. England: Penguin Books Ltd.
 38. Hashemi Joo, M., Nishikawa, Y., Dandapani, K., Jayaraman, V. (2024). Unlocking the Role of Language and National Culture: Effects on Supply Chain Operations in a Global Context. *Production and Operations Management*, 34(5), 929-948. <https://doi.org/10.1177/10591478241254853>
 39. Hofstede, G. (1984). *Culture's Consequences: International Differences in Work-Related Values*. Newbury Park/London/New Deli: SAGE Publications.
 40. Hofstede, G. (2011). Dimensionalizing Cultures: The Hofstede Model in Context. *Online Readings in Psychology and Culture*, 2(1), 1-26. <https://doi.org/10.9707/2307-0919.1014>
 41. Hofstede, G., Hofstede, G.J. (2007). *Kultura i organizacje*. Warszawa: PWE.
 42. Inoue, Y. (2007). Cultural Fluency as a Guide to Effective Intercultural Communication: The Case of Japan and the U.S. *Journal of Intercultural Communication*, 7(3), 1-13. <https://doi.org/10.36923/jicc.v7i3.444>

43. Jadhav, J.R., Mantha, S.S., Rane, S.B. (2014). Barriers for successful implementation of JIT: A manufacturer perspective. *International Journal of Procurement Management*, 7(3), 316-342. <https://doi.org/10.1504/IJPM.2014.060790>
44. Jensen, L.M., Hilletofth, P. (2022). Sourcing from China: Approaches and Outcomes for Swedish Firms. *Operations and Supply Chain Management*, 15(2), 267-279. <https://doi.org/10.31387/oscm0490346>
45. John, N., Nwaguru, P., Okon, M.G., Tommy, U., Bariate, M. (2024). Managing Materials Vendor Risks for Improved Project Operational Performance: The Role of Risk-Oriented Culture. *Brazilian Journal of Operations & Production Management*, 21(2), 1957. <https://doi.org/10.14488/BJOPM.1957.2024>
46. Kauppi, K., You, W., Salmi, A. (2018). Sourcing from Africa: A Systematic Review and a Research Agenda. *International Journal of Management Reviews*, 20(2), 627-650. <https://doi.org/10.1111/ijmr.12158>
47. Khan, O., Hinterhuber, A. (2024). Antecedents and consequences of procurement managers' willingness to pay for sustainability: a multi-level perspective. *International Journal of Operations & Production Management*, 44(13), 1-33. <https://doi.org/10.1108/IJOPM-02-2023-0135>
48. Klimarczyk, G., Malmon K. (2020). *Jak negocjować zakupy, gdy wybór dostawcy obarczony jest ryzykiem?* Retrieved from: <https://opennexus.com/>, 21.11.2020.
49. Kok, S.K., Akbari, M. (2024). Human resource management in supply chains. In: J. Sarkis (Eds.), *The Palgrave Handbook of Supply Chain Management* (pp. 651-678). https://doi.org/10.1007/978-3-031-19884-7_38
50. Kowalska, K. (2005). *Logistyka zaopatrzenia*. Katowice: Akademia Ekonomiczna.
51. Kozar, Ł. (2023). Toward green social enterprises: identifying key areas of greening and future research directions. *Scientific Papers of Silesian University of Technology, Organisation and Management*, 178(364), 363-384. <http://dx.doi.org/10.29119/1641-3466.2023.178.20>
52. Kroeber, A.L. (1973). *Istota kultury*. Biblioteka Socjologiczna. Warszawa: PWN.
53. Lewis, R.D. (1996). *When Cultures Collide: Leading Across Cultures*. London: Nicholas Brealey Publishing.
54. Liu, A.M.M., Fellows, R. (2001). An Eastern perspective on partnering. *Engineering, Construction and Architectural Management*, 8(1), 9-19. <https://doi.org/10.1108/eb021166>
55. Maszko, I. (2024). Inteligencja kulturowa jako kluczowa kompetencja project managera. *Strefa PMI, Kwartalnik Project Management Institute Poland Chapter*, 46, 16-17.
56. Matusiak, M. (2022). Jakie są kulturowe uwarunkowania postaw proekologicznych? In: M. Burchardt-Dziubińska (ed.), *W poszukiwaniu zielonego ładu* (pp. 13-38). Łódź: Uniwersytet Łódzki. <https://doi.org/10.18788/8220-870-2.01>
57. Matusiak, M. (2022). *Logistyka zaopatrzenia*. Łódź: Uniwersytet Łódzki. <https://doi.org/10.18778/8220-826-9>

58. Matusiak, M., Królikiewicz, B. (2024). Wpływ pandemii Covid-19 oraz wojny w Ukrainie na zarządzanie łańcuchem dostaw w kontekście zaopatrzenia przedsiębiorstwa produkcyjnego z branży energetycznej w latach 2018-2023. In: M. Wodnicka (ed.), *Wielowymiarowość współczesnych wyzwań logistyki i transportu – analiza wybranych aspektów* (pp. 57-90). Łódź: Uniwersytet Łódzki. <https://doi.org/10.18778/8331-637-6.03>
59. Matusiewicz, M. (2024). Physical internet-where are we at? A systematic literature review. *Acta Logistica*, 11(2), 299-316. <https://doi.org/10.22306/al.v11i2.514>
60. Moran, R.T., Abramson, N.R. (2017). *Managing Cultural Differences: Global Leadership Skills and Knowledge for the 21st Century*, 1-638. <https://doi.org/10.4324/9781315403984>
61. Moran, R.T., Abramson, N.R., Chan, A., Sabongui, M.-M. (2023). *Managing Cultural Differences: Global Leadership Skills and Knowledge for the 21st*, 1-560. <https://doi.org/10.4324/9781003297567>
62. Perner, F., Sieweke, J., Werr, A. (2018). The relationship between national culture and the use of professional services: Evidence from two cross-country studies. *Journal of Purchasing and Supply Management*, 24(4), 314-325. <https://doi.org/10.1016/j.pursup.2018.07.002>
63. Philippart, M. (2016). The procurement dilemma: short-term savings or long-term shareholder value? *Journal of Business Strategy*, 37(6), 10-17. <https://doi.org/10.1108/JBS-11-2015-0114>
64. Phua, F.T.T., Rowlinson, S. (2003). *Construction Management and Economics*, 21(7), 777-785. <http://dx.doi.org/10.1080/0144619032000108245>
65. Ping Ho, S., Lin, Y.-H., Wu, H.-L., Chu, W. (2009). Empirical test of a model for organizational governance structure choices in construction joint ventures. *Construction Management and Economics*, 27(3), 315-324. <https://doi.org/10.1080/01446190902725588>
66. Porter, M. (2019). Supply chain integration: Does organizational culture matter? *Operations and Supply Chain Management*, 12(1), 49-59. <http://doi.org/10.31387/oscm0360222>
67. Pothal, L.K., Tripathy, S., Satapathy, S. (2018). Supplier Relationship Management towards Quality Management System of Indian automotive manufacturing industry – A Total Interpretive Structural Modeling approach. *Conference Series Materials Science and Engineering*, 377(1), 012145. <http://doi.org/10.1088/1757-899X/377/1/012145>
68. Quinn, R.E., Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. *Management Science*, 29(3), 363-377. <https://doi.org/10.1287/mnsc.29.3.363>
69. Radziejowska, G. (2005). Kierunki integracji działań w sferze procesów zaopatrzenia. *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie*, 27, 257-264.
70. Reynolds, S. (2024). *Understanding the Role of Culture in Supply Chain Collaboration*. Retrieved from: <https://doi.org/10.20944/preprints202406.0641.v1>, 28.05.2025.
71. Rozkwitalska, M. (2013). Pozytywne aspekty interakcji międzykulturowych w środowisku wielokulturowym. *Zeszyty Naukowe Wyższej Szkoły Bankowej we Wrocławiu*, 4, 211-212.

72. Rutkowski, K. (2013). Zakupy w biznesie – potrzeba strategicznej reorientacji. *Kwartalnik Nauk o Przedsiębiorstwie*, 4, 35-45.
73. Skowronski, K., Benton W.C., Jr., Handley, S. (2022). The moderating influence of supplier culture on the relationship between buyer power and supplier shirking. *Wiley. OnLine Library, Journal of Operations and Management*, 68(3), 270-301. <https://doi.org/10.1002/joom.1178>
74. Smircich, L. (1983). Concepts of Culture and Organizational Analysis. *Administrative Science Quarterly*, 28(3), *Organizational Culture*, 339-358. <https://doi.org/10.2307/2392246>
75. Stek, K., Zunk, B.M., Koch, V., Schiele, H. (2022). Culture's consequences for purchasing: comparing purchasing job ad requirements from different European countries with cultural models. *International Journal of Procurement Management*, 15(3), 305-339. <http://dx.doi.org/10.1504/IJPM.2022.122595>
76. Stevano, S. (2023). The workplace at the bottom of global supply chains as a site of reproduction of colonial relations: Reflections on the cashew-processing industry in Mozambique. *Gender, Work and Organisation*, 30(2), 496-509. <https://doi.org/10.1111/gwao.12757>
77. Tate, W.L., Ellram, L.M., Brown, S.W. (2009). Offshore outsourcing of services: A stakeholder perspective. *Journal of Service Research*, 12(1), 56-72. <https://doi.org/10.1177/1094670509338617>
78. *The Culture Factor group*. Retrieved from: <https://www.theculturefactor.com/>, 08.09.2024.
79. *The Lewis Model – Dimensions of Behaviour* (2015). Retrieved from: <https://www.crossculture.com/the-lewis-model-dimensions-of-behaviour>, 10.09.2021.
80. *The Lewis Model 2015*. Retrieved from: <https://www.https://www.crossculture.com/the-lewis-model-dimensions-of-behaviour/?cn-reloaded=1>, 31.12.2024.
81. Thornton, L.M., Autry, C.W., Gligor, M., Brik, A.B. (2013). Does socially responsible supplier selection pay off for customer firms? A cross-cultural comparison. *Journal of Supply Chain Management*, 49(3), 66-89. <https://doi.org/10.1111/jscm.12014>
82. Toumi, S., Su, Z. (2023). Informal interorganizational business relationships, satisfaction, and firm performance: Case of Arab Maghreb countries. *International Journal of Cross Cultural Management*, 23(2), 467-497. <https://doi.org/10.1177/14705958231191053>
83. Trompenaars, F., Hampden-Turner, C. (1997). *Riding the Waves of Culture*. New York: McGraw-Hill.
84. van Weele, A.J. (2010). *Purchasing and supply chain management*. Cengage Learning, Andover.
85. Wiśniewska, A. (2023). Wyzwania we współpracy w zespole zróżnicowanym kulturowo na przykładzie współpracy przedstawicieli Polski oraz Indii. *Edukacja Ekonomistów i Menedżerów*, 68(2), 95-109. <https://doi.org/10.33119/EEIM.2023.68.6>

86. Wodnicka, M. (2024). Skills Gap and New Technologies: Bibliometric Analysis. *Procedia Computer Science*, 246, 3430-3436. <https://doi.org/10.1016/j.procs.2024.09.214>
87. Yawar, S.A., Seuring, S. (2024). Inside the world of stepsiblings: Linking global production networks to sustainable supply chain management. *Business Strategy and the Environment*, 33(2), 788-805. <https://doi.org/10.1002/bse.3516>
88. Yu, J., Lee, K., Han, K., Cantor, D.E. (2024). How Do National Cultural Differences Affect Cross-Border Acquisitions? Cultural Dimensions, Learning From Supply Chain Partners, and Post-Acquisition Performance. *Production and Operations Management*, 34(5), 1009-1027. <https://doi.org/10.1177/10591478241281495>
89. Ziętała, G.A. (2022). *Język – Kultura – Komunikacja – Biznes w świecie wielokulturowym*. Nowy Sącz: Akademia Nauk Stosowanych w Nowym Sączu, 135-140.

ANALYSIS OF TYPES OF AUDITOR'S OPINION OF COMPANIES LISTED ON THE WARSAW STOCK EXCHANGE FROM 2010 TO 2020

Iwona MAZUR-MAŚLANKA

UEK Cracow, Department of Financial Accounting; maslanki@uek.krakow.pl, ORCID: 0000-0003-1888-9875

Purpose: The purpose of this article is to analyse the types of opinions issued by auditors in the Polish audit market.

Design/methodology/approach: the theoretical considerations presented in this publication are based on a critical analysis of the literature on the subject. The empirical part presents an analysis based on audit reports of companies listed on the Warsaw Stock Exchange in the period 2010 - 2020. A total of 4281 audit reports on 506 listed entities were analysed.

Findings: over the analysed years, the share of modified opinions in the total number of issued opinions is successively reduced. At the same time, the proportion of audit reports containing section concerning material uncertainty regarding the going concern issue is increasing.

Originality/value: The publication presents a detailed analysis of audit reports in Poland. It should be emphasised that the analysis carried covers all audits of individual financial statements of public companies in the period under review.

Keywords: opinion types, unmodified opinion, modified opinion, audit market, Big Four.

Category of the paper: Research paper.

1. Introduction

The purpose of an financial audit is to enhance the degree of confidence of intended users in the financial statements. In accordance to International Standards on Auditing (KSB 200 (Z)), this aim is achieved by the expression of an opinion by the auditor on whether the financial statements are prepared, in all material respects, in accordance with an applicable financial reporting framework. Users of financial statements, including investors trading on the Warsaw Stock Exchange, make their decisions based on the available recommendations of stock market analysts and brokerage houses, but also on the opinion issued by the auditor on the audit of the financial statements (Naruć, 2018)¹. An audit conducted by a certified auditor makes it possible

¹ Compare also: (Pogodzińska-Mizdrak, 2012, p. 12; Wszelaki, 2016).

to eliminate misstatements and frauds in financial statements. The auditor assesses and verifies financial statements impartially, reliably and objectively².

This article presents the results of research on the shape of the auditor's audit opinion. The analysis was carried out on the basis of audit reports of individual financial statements of business entities listed on the Warsaw Stock Exchange. The research included financial data and audit reports of 506 companies, a total of 4281 opinions and audit reports were analysed (opinion and audit report - for audits of financial statements for periods ending before 31.12.2016)³.

Analysed auditors' opinions were divided into unmodified opinions and modified opinions. According to ISA 705 (KSB 705 (Z)) there are three types of modified opinions: qualified opinion, adverse opinion and disclaimer of opinion. In the course of further research, in auditors' reports, containing unmodified opinion and modified opinion, the section concerning material uncertainty regarding the going concern was identified. Additionally, auditors' reports containing unmodified opinion and modified opinion containing emphasis of matter paragraphs concerning other issues than material uncertainty regarding the going concern were distinguished.

The presented results of the analysis are part of a larger study, carried out by the Author of this publication, on the audit market in Poland, covering such issues as: the role of the auditor in making the financial statements credible, concentration of audit market⁴, the inclusion in the opinion and auditor's report of the issue of the threat of going concern⁵, or the importance of key audit matters (KAM)⁶ in communicating to stakeholders the potential risks associated with the operation of the audited business entity.

² Compare also: (Turzyński, 2011).

³ Audits of financial statements prepared for periods ending before December 31, 2016 were conducted in accordance with the requirements of the National Auditing Standards (Krajowe Standardy Rewizji Finansowej, KSRF, adopted by Resolution No. 1608/38/2010 of the National Chamber of Statutory Auditors dated February 16, 2010 on national auditing standards), according to which, on the basis of the audit evidence collected, the auditor prepared an opinion with a report. Audits of the financial statements for periods ending December 31, 2016 and thereafter are conducted in accordance with the National Auditing Standards in the wording of the International Auditing Standards (adopted by Resolution No. 2783/52/2015 of the Polish Chamber of Statutory Auditors dated February 16, 2015 on national auditing standards) and the auditor prepares an independent auditor's report containing the audit opinion.

⁴ Compare also: (Beattie, Goodacre, Fearnley, 2003; Francis, Michas, Seavey, 2013; Groff, Salihovic, 2014; Gad, 2018; Wielgórska-Leszczynska, Zakrzewska, 2020).

⁵ Compare also: (Beaver, 1966; Altman, 1968; Back, Laitinen, Sere, van Wezel, 1996; Hamrol, Czajka, Piechocki, 2004; Korol, 2019).

⁶ Compare also: (Iwanowicz, 2019; Kutera, 2019; Koehler, Ratzinger-Sakel, Theis, 2020; Gold, Heilmann, Pott, Rematzki, 2020; Shao, 2020).

2. Type of the auditor's opinion – audit review

The results of selected studies concerning the shape of the auditor's opinion were presented in the table below, together with an indication of potential factors influencing the auditor's modified opinion.

Table 1.
Selected publications on auditor's modification of opinion

No.	Author/country	Research sample/ years of analysis	Description
1.	E.K. Laitinen, T. Leitinen (Finland)	1992-1994; 37 listed companies, bringing the total to 111 observations	The analysis showed that low profitability, high indebtedness and a decline in the value of the company were the most significant factors having impact on the issuance of a modified opinion by the auditor. Modified opinions accounted for 7.2% of the total respondents.
2.	J.P.S. Ballesta, E. Garcia-Meca (Spain)	Years 1999-2002; 32 companies listed on the Madrid Stock Exchange	The study suggests that having people who are co-owners of an entity on the board of directors has a positive impact on the quality of financial reporting, thereby reducing the likelihood of receiving a modified audit opinion. On the other hand, the presence of family members of co-owners on the board increases the likelihood of a modified opinion.
3.	P.J. Baldacchino, F.H. Bezzina, N. Tabone, J.P. Vassallo (Malta)	Years 2005-2009; auditor's opinions of 374 companies with limited liability	The study indicated that the average modification rate between 2005 and 2009 in Malta was 22.4%, an increase from earlier periods. Research also indicates that the quality of the audit report is lower when the financial statements are audited by an expert from a small (local) audit firm. In addition, the authors analysed repeated in the same companies, in following years, modifications concerning the same areas of the financial statements.
4.	L. Damascene, E. Paulo (Brazil)	Years 2006-2008; 1466 reports on the audit of the financial statements of entities listed on the Sao Paulo Stock Exchange	Among other things, the study indicated that audit firms outside the Big Four were more likely to issue non-modified opinions. The publication also points out that as the market value of audited entity increases, the probability of a modified opinion decreases.
5.	D. Zdolsek, T. Jagric, M. Odar (Slovenia)	Year 2009; 295 large enterprises	The authors indicated that for companies characterized by high debt, low liquidity, efficiency and profitability, the probability of a modified opinion increases. On the other hand, it was revealed that there is no statistical relationship between the analysed metrics individually and the fact of the occurrence of a modified opinion. Modified opinions accounted for 4.5% of the total opinions analysed.
6.	A. Yasar, E. Yakut, M. Murat Gutnu (Turkey)	Years 2010-2013; Data from 130 companies listed on the Istanbul Stock Exchange were analysed Istanbul, making a total of 520 observations.	The study showed that entities with a modified opinion were characterized by lower liquidity ratios, a lower share of equity in assets and lower profitability.

Cont. table 1.

7.	A.M. Włodarczyk, A. Białek-Jaworska (Poland)	Years 2010-2013; 245 companies, total 980 observations	The study showed that the occurrence of a modified opinion is significantly influenced by liquidity, debt, quality of corporate governance, profitability, size of the audited entity and risk of entity bankruptcy, among other factors.
8.	D.H. Pham (Vietnam)	Years 2010-2019; 268 observations - companies listed on the Stock Exchange in Vietnam	The research conducted indicates that among the main factors determining the issuance of an opinion indicating a threat to the entity's going concern can be found (among others): the level of Altman's Z-score model or the incurrence of a loss by the entity.
9.	J.L. Gallizo, R. Saladríguez (Spain)	Year 2012; 48 companies (including 24 entities at risk of collapse)	Among the most significant factors that increase the likelihood of a modified opinion are the persistence of losses and being audited by a small auditing firm. The authors of the study noted that the larger the audit firm, the less likely a modified opinion appears. This fact may indicate that larger audit firms have a greater ability to choose their clients.
10.	M. Moradi, A. Abolghasemi, H. Aghaei, S.D. Ghashti (Iran)	Years 2013-2020; 146 entities listed on the Tehran Stock Exchange throughout the period under review	The authors analysed the issue of the influence of the composition of the Board of Directors of a business entity on the final form of the auditor's opinion. Among other things, the study found that a large number of board members leads to an increase of number of modified opinions. On the other hand, greater independence of the Directorate from the owners results in a decrease of number of modified opinions. At the same time, there was no statistically significant relationship between the number of board terms and the gender of the managers and the shape of the expert opinion.
11.	M. Saaydah, (Jordan)	Year 2015; 104 entities listed on the Amman Stock Exchange	The author analysed the impact of corporate governance on the potential modification of auditor's opinions. The research showed that as the importance of institutional investors in an entity increases, the number of modified opinions decreases. At the same time, it was shown that too many people on the board of directors have a negative impact on the quality of the financial statements, thus raising the threat of modified opinions. In addition, studies have shown that higher subject profitability reduces the risk of a modified opinion.
12.	B. Adiloglu, B. Vuran, (Turkey)	Year 2016; Financial data and audit opinions of 263 non-financial entities listed on the Istanbul Stock Exchange were examined	The authors of the analysis focus on the relationship between financial indicators and the type of auditor's opinion. Among the factors limiting the risk of a modified opinion were identified: - An increase in ROE or ROA ratios, - audit of financial statements by an auditor from the BIG 5 (the phrase used by the study's authors).
13.	A. Pabrić (Bosnia and Herzegovina)	Years 2018-2021; 689 audit reports were examined.	Within the framework of the conducted research, the author analysed the frequency of occurrence in the audit report - the emphasis of matter paragraph. Among the analysed audit reports, this paragraph appeared in 22.5% of cases. More often the mentioned paragraph occurred in the case of the issuance of a modified opinion by the auditor. The analysis further revealed that in some cases the expert replaced the modified opinion - with an emphasis of matter paragraph.

Source: own compilation based on: (Adiloglu, Vuran, 2017; Baldacchino, Bezzina, Tabone, Vassallo, 2020; Ballesta, Garcia-Meca, 2005; Damascena, Paulo, 2013; Gallizo, Saladríguez, 2016; Laitinen, Leitinen, 1998; Moradi, Abolghasemi, Aghaei, Ghashti, 2024; Pham, 2022; Pabrić, 2024; Saaydah, 2020; Włodarczyk, Białek-Jaworska, 2018; Yasar, Yakut, Gutnu, 2015; Zdolsek, Jagric, Odar, 2015).

Modified opinions in the audit reports, depending on the country and the analysed period, usually occur in a few (Laitinen, Leitinen, 1998; Zdolsek, Jagric, Odar, 2015; Adiloglu, Vuran, 2017) to a dozen percent of the analysed cases (Baldacchino, Bezzina, Tabone, Vassallo, 2020). Among the factors raising the probability of occurrence of modified opinion, the authors of selected publications point to low profitability (losses, persistent negative financial results), high debt or low liquidity (Laitinen, Leitinen, 1998; Zdolsek, Jagric, Odar, 2015; Włodarczyk, Białek-Jaworska, 2018). On the other hand, in selected studies (Adiloglu, Vuran, 2017) (Saaydah, 2020) it was confirmed that as profitability indicators increase, the percentage of modified opinions decreases.

The analyses also indicate that modified opinions occur more frequently in the case of audits by auditors outside the "Big Four" (Damascena, Paulo, 2013; Gallizo, Saladrigues, 2016; Adiloglu, Vuran, 2017; Baldacchino, Bezzina, Tabone, Vassallo, 2020). Such an observation may indicate that larger audit firms have a greater ability to choose their clients.

A separate group of studies concerns the relationship between the quality of a business entity's management and the shape of the auditor's opinion on the financial statements. Selected studies present that the independence of the management from the owners reduces the occurrence of modified opinions (Moradi, Abolghasemi, Aghaei, Ghashti, 2024).

3. Research sample and methodology of the study

The independent auditor's audit reports and financial statements of the analysed business entities were obtained from the following sources:

- The websites of individual public companies.
- EMIS Intelligence Region database.
- Notoria Online databases.
- Public company announcements from ESPI/EBI systems available to the Economic Service of the Polish Press Agency (www.biznes.pap.pl/pl/reports).
- Warsaw Stock Exchange website.

The analyses carried out were based on the independent auditors' reports on audits of individual financial statements (audit opinions and reports - for audits of financial statements for periods ending before December 31, 2016) and individual financial statements of companies listed on the Warsaw Stock Exchange from 2010 to 2020. The auditors' reports were obtained manually in each case.

As a result of the initial selection, audit reports and financial statements of business entities based outside Poland and listed on the Warsaw Stock Exchange were omitted. Such entities were omitted because their financial statements were subject to audit conducted by an auditor in the country where the entity's headquarters are located. In addition, it should be pointed out

that in the case of small group of observations during the period under review, audit reports (or opinions with report) were not available.

Finally, auditors' reports of 506 entities that were listed on the Warsaw Stock Exchange for at least one year in the mentioned period, i.e. from 2010 to 2020, were analysed. It should be noted that some of the entities were listed on the WSE during the entire analysed period (thus, auditors' reports and financial statements of these entities for 11 years were available)⁷, some of the entities only in selected years. A total of 4281 auditors' reports were analysed.

The table below summarizes the number of auditors' reports analysed in each of the years under review.

Table 2.

Number of auditors' reports of listed companies analysed for 2010-2020

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Number of auditors' reports *	350	373	376	381	398	413	420	408	396	391	375	4281

* for audits of financial statements of public interest entities covering periods ending before December 31, 2016 - opinion with report).

Source: own compilation.

4. The results of the research conducted

In this section the Author presents and analyses the structure of the auditor's opinions on individual financial statements of companies listed on the Warsaw Stock Exchange in the period 2010-2020, divided into unmodified and modified opinions.

Over the 11 years, 3988 unmodified opinions and 293 modified opinions were identified, representing 93.2% and 6.8% of the total opinions issued, respectively.

The following tables show the share of unmodified and modified opinions in each year of the analysed period. As can be observed, the share of modified opinions among the total opinions over the analysed period ranged from 4.1% in 2019 to 8.5% in 2012.

Table 1.

Unmodified and modified auditor's opinions on individual financial statements of entities listed on the Warsaw Stock Exchange for 2010-2020

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Unmodified	323	347	344	349	371	381	390	383	367	375	358	3988
Modified	27	26	32	32	27	32	30	25	29	16	17	293
Total	350	373	376	381	398	413	420	408	396	391	375	4281

Source: own elaboration.

⁷ Among the entities that have been listed on the Warsaw Stock Exchange throughout the period under consideration, i.e. 2010-2020, and thus their financial statements and audit reports (previously opinion and report) are available, for example: Agora SA, Apator SA, CD Projekt SA, Fabryka Mebli Forte SA, Giełda Papierów Wartościowych SA.

Table 2.

Unmodified and modified auditor's opinions on individual financial statements of entities listed on the Warsaw Stock Exchange for 2010-2020 (%)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Unmodified	92,3	93,0	91,5	91,6	93,2	92,3	92,9	93,9	92,7	95,9	95,5	93,2
Modified	7,7	7,0	8,5	8,4	6,8	7,7	7,1	6,1	7,3	4,1	4,5	6,8
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: own elaboration.

Analysing the above data, it should be noted that after the implementation of the International Standards on Auditing into the Polish legal system (the period ending December 31, 2016 was the first period in which audit firms auditing public interest entities obligatorily applied the National Auditing Standards in the wording of the International Standards on Auditing), the share of modified opinions is decreasing. Among audit opinions for the period from 2010 to 2015, modified opinions accounted for 7.7% of total opinions, while in the period from 2016 to 2020 they accounted for 5.9% of total opinions. It should be noted that in the case of audit reports for 2019-2020, there was a significant decrease in the share of modified opinions in the total number of opinions issued, which amounted to 4.1% and 4.5%, respectively, which could indicate an improvement in the quality of the audited individual financial statements.

Table 3.

Structure of unmodified and modified opinions expressed on the individual financial statements of entities listed on the Warsaw Stock Exchange in the periods 2010-2015 and 2016-2020 (in %)

	2010-2015	2016-2020
Unmodified opinions	92,3	94,1
Modified opinions	7,7	5,9
Total	100,0	100,0

Source: own elaboration.

The types of opinions are presented below, along with an indication of in which case the auditor expresses an unmodified opinion and in which case modifies the audit opinion.

Table 4.

Types of opinions expressed by the auditor on financial statements

Opinion	Modification type	KSB 700, 705
unmodified	lack of modifications	The auditor expresses an unmodified opinion when he concludes that the financial statements have been prepared, in all material respects, in accordance with the applicable financial reporting framework.
modified	qualified opinion	The auditor expresses a qualified opinion when: - having obtained sufficient and appropriate audit evidence, the auditor concludes that misstatements individually or in the aggregate are material, but not pervasive to the financial statements or - the auditor is unable to obtain sufficient and appropriate audit evidence on which to base the opinion, but auditor concludes that the possible impact on the financial statements of any undetected misstatements, if any, could be material, but not pervasive.

Cont. table 6.

	adverse opinion	The auditor expresses an adverse opinion when, having obtained sufficient and appropriate audit evidence, the auditor concludes that the misstatements, individually or in the aggregate, are both material and pervasive to the financial statements.
	disclaimer of opinion	The auditor disclaims an opinion when auditor is unable to able to obtain sufficient and appropriate audit evidence on which to base the opinion, and auditor concludes that the possible impact on the financial statements of undetected misstatements, if any, could be both material and pervasive.

Source: own compilation based on KSB 700 and KSB 705 (Z).

In the next table, the structure of modified opinions on the audited financial statements of the analysed entities over the period 2010-2020 is presented.

During the period under review, 202 qualified opinions, 6 adverse opinions and 85 disclaimer of opinions were identified. It should be noted that adverse opinions were identified in the 2017-2020 audit reports.

Table 5.

Unmodified and modified opinions (distinguishing qualified opinion, adverse opinion and disclaimer of opinion) expressed on the individual financial statements of companies listed on the Warsaw Stock Exchange in the period 2010-2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Opinion unmodified	323	347	344	349	371	381	390	383	367	375	358	3988
Qualified opinion	26	21	20	19	17	24	19	17	19	10	10	202
Adverse opinion	0	0	0	0	0	0	0	1	2	2	1	6
Disclaimer of opinion	1	5	12	13	10	8	11	7	8	4	6	85
Total	350	373	376	381	398	413	420	408	396	391	375	4281

Source: own elaboration.

At the same time, it should be pointed out that modified opinions (293) over the years 2010-2020 occurred in 120 analysed entities, which is nearly 2.5 modified opinions per entity. Thus, it should be pointed out that in the case of 76.3% of the considered companies listed on the Warsaw Stock Exchange, in all the years under analysis, the auditor expressed an unmodified opinion on the individual financial statements.

In the analysed population, there were cases where the audited entity received a modified opinion only once during the period. Examples of such entities include Grupa Żywiec SA, which received an qualified opinion on the separate financial statements for 2010, or Decora SA also for 2010, Makarony Polskie SA for 2011 and Kino Polska TV SA for 2015. On the other hand, it should be emphasized that in the population of analysed entities there were such entities that received a modified opinion for several consecutive years. Among them, there are also those that received an qualified opinion concerning the same area in consecutive periods. Examples of such entities include: Bioton SA, Orbis SA, Mostostal Warszawa SA, Scotan SA⁸.

⁸ The issue of reproducibility of modifications has been analysed in publications such as: (Baldacchino, Bezzina, Tabone, Vassallo, 2020).

In the course of the analysis, the audit reports were further subdivided due to the audit reports containing emphasis of matter paragraphs and audit reports including section concerning material uncertainty regarding the going concern⁹.

According to KSB 706 (KSB 706 (Z)), the auditor shall include an emphasis of matter paragraph in the audit report in which auditor includes a reference to a matter that auditor believes is so important that it is fundamental to users' understanding of the financial statements. It should be emphasized that such a paragraph does not constitute a modification of the opinion. Thus, in the course of the analyses, audit reports containing an unmodified opinion and a qualified opinion, which additionally contain the above-described paragraph, were identified.

As required by KSB 700 "Formulation of Opinions and Reporting on Financial Statements" (KSB 700 (Z)), going concern matters must be reported by the auditor in accordance with KSB 570 "Going Concern" (KSB 570 (Z)). If, in the auditor's opinion, the going concern assumption is reasonable, but there is significant uncertainty about going concern, the audit report shall include a section titled "Existence of significant uncertainty about going concern", in which the auditor shall draw attention to a note in the financial statements in which the entity's management has made an appropriate disclosure. In this section, the auditor includes a statement that the circumstances or conditions described indicate that there is a material uncertainty that may cast significant doubt on the entity's ability to continue as a going concern. It should be emphasized that drawing attention to a note that discloses a significant uncertainty does not constitute a modification of the opinion.

In the course of the analysis, among the audit reports containing an unmodified opinion and a qualified opinion, audit reports were distinguished that additionally contain the aforementioned section concerning the existence of a material uncertainty regarding going concern, in which the auditor draws attention to this information. Taking into account the above analysis, the following types were distinguished among the audit reports containing an unmodified opinion in the course of the study:

- unmodified opinion without drawing attention,
- opinion unmodified with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding going concern),
- opinion unmodified with drawing attention to the material uncertainty regarding going concern.

In the case, where the audit report included attention to both material going concern uncertainty and an issue other than material going concern uncertainty, in such a situation, the auditor's report was classified for audit purposes as a report containing an unmodified opinion with attention to material going concern uncertainty.

⁹ The frequency of occurrence in the study report - explanatory paragraph, among other things, was the subject of the following studies: (Pabrić, 2024).

As for modified opinions, in the course of the research, the following types were distinguished among the audit reports containing a modified opinion:

- a qualified opinion,
- a qualified opinion with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding the going concern),
- a qualified opinion with drawing attention to the material uncertainty regarding the going concern,
- adverse opinion,
- disclaimer of opinion.

Where an audit report containing a qualified opinion included attention to both material going concern uncertainty and an issue other than material going concern uncertainty, in such a situation the auditor's report was classified as a qualified opinion report with attention to material going concern uncertainty.

With regard to the proposed breakdown, among the audit reports containing unmodified opinions, there were 3,043 unmodified opinions without any additional paragraphs, 621 unmodified opinions with attention to an issue other than material uncertainty about the entity's ability to continue as a going concern, and 324 unmodified opinions with attention to material uncertainty about the entity's ability to continue as a going concern.

The following section presents the percentage share of adopted types of unmodified opinions in total unmodified opinions by two sub-periods, that is, 2010-2015 and 2016-2020. As can be observed, comparing the two sub-periods, the shares of unmodified opinions containing additional paragraphs changed significantly. Thus, the percentage share of unmodified opinions with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding going concern) decreased (from 18.4% to 12.3%). At the same time, in the case of unmodified opinions, the occurrence of paragraph concerning material uncertainty regarding going concern increased (from 6.3% to 10.2%).

Table 6.

Structure of unmodified opinions expressed on the individual financial statements of entities listed on the Warsaw Stock Exchange for 2010-2015 and 2016-2020 in percentage terms

Opinion unmodified	2010-2015	2016-2020
Opinion unmodified without drawing attention	75,3%	77,5%
Opinion unmodified with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding the going concern)	18,4%	12,3%
Opinion unmodified with drawing attention to material uncertainty regarding going concern	6,3%	10,2%
Total	100,0%	100,0%

Source: own elaboration.

With reference to the breakdown presented earlier, among the audit reports (formerly opinions and reports) containing modified opinions, there were 102 qualified opinions without any attention drawn, 36 qualified opinions with emphasis of matter paragraph, and 64 qualified opinions with drawing attention to material uncertainty regarding going concern. In addition, as previously indicated, 6 adverse opinions and 85 cases of Disclaimer of opinion were identified in the period from 2010 to 2020.

Table 7.

Modified opinions on separate financial statements of entities listed on the Warsaw Stock Exchange for 2010-2020

Opinion modified	Number of opinions for 2010-2020
Qualified opinion without drawing attention	102
Qualified opinion with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding the going concern)	36
Qualified opinion with drawing attention to material uncertainty regarding going concern	64
Adverse opinion	6
Disclaimer of opinion	85
Total	293

Source: own elaboration.

The next table shows the percentage share of the types of modified opinions adopted in this study in the total modified opinions by two sub-periods, that is, 2010-2015 and 2016-2020. As can be observed, comparing the two sub-periods, among the modified opinions, the percentage of opinions without drawing attention significantly decreased (from 39.8% to 27.4%). Similarly, the percentage of qualified opinions with emphasis of matter paragraph declined (from 15.9% to 6.8%). At the same time, the frequency of the occurrence of drawing attention to material uncertainty regarding going concern significantly increased for qualified opinions (from 16.5% to 29.9%).

Summarizing the analysis carried out, it should be emphasized that, both in the case of unmodified and qualified opinions, an increase in the incidence of audit reports containing attention to material uncertainty regarding going concern is observed. This increase was particularly evident in the audit reports for 2019, which was the first year of the COVID-19 pandemic and, consequently, for many business entities, a going concern risk was identified, resulting mainly from the occurrence of external macroeconomic factors¹⁰.

As for adverse opinions, no such type was identified in the period 2010-2015, while in the period from 2016 to 2020, 6 negative opinions on individual financial statements were identified (and in this period they accounted for 5.1% of the total modified opinions).

¹⁰ Similar conclusions can be found in a report prepared by Grant Thornton titled (*Audit of listed companies...*, 2021).

Table 8.

Structure of modified opinions expressed on separate financial statements of companies listed on the Warsaw Stock Exchange for 2010-2015 and 2016-2020 (in %)

Opinion modified	2010-2015	2016-2020
Qualified opinion without drawing attention	39,8	27,4
Qualified opinion with emphasis of matter paragraph (drawing attention to an issue other than material uncertainty regarding the going concern)	15,9	6,8
Qualified opinion with drawing attention to material uncertainty regarding going concern	16,5	29,9
Adverse opinion	0,0	5,1
Disclaimer of opinion	27,8	30,8
Total	100,0	100,0

Source: own elaboration.

5. Conclusions

In the study 4,281 audit reports (formerly audit opinions and reports) were analysed. They concerned 506 joint stock companies.

The research identified 3988 unmodified opinions and 293 modified opinions. The percentage of modified opinions accounted for 6.8% of total number of opinions. This percentage is similar to the results of studies cited by other authors (see: Laitinen, Leitinen, 1998; Zdolsek, Jagric, Odar, 2015).

However, it should be emphasised that in recent years, following the implementation of International Standards on Auditing into the Polish legal system, the proportion of modified opinions was gradually decreasing. On the other hand, in 2016-2020, the percentage of audit reports including attention to material uncertainty regarding going concern was increasing.

Further research by the author of this publication will focus on the interdependencies between the development of financial analysis indicators (including financial liquidity, profitability, debt, and bankruptcy prediction models) and the frequency of occurrence of modified opinions in audit reports.

References

1. Adiloglu, B., Vuran B. (2017). Identification of key performance indicators of auditor's report: evidence from Borsa Istanbul. *Press Academia Procedia (PAP)*, vol. 3, pp. 854-859.
2. Altman, E. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance*, 4, pp. 589-609.

3. Audyt spółek giełdowych w Polsce z czerwca 2021, <https://grantthornton.pl/wp-content/uploads/2021/06/Rynek-audytorski-w-Polsce-RAPORT-Grant-Thornton.pdf>, 15.04.2023.
4. Back, B., Laitinen, T., Sere, K., van Wezel, M. (1996). Choosing Bankruptcy Predictors Using Discriminant Analysis, Logit Analysis and Genetic Algorithms. *Technical Report No. 40*, pp. 1-18.
5. Baldacchino, P.J., Bezzina, F.H., Tabone, N., Vassallo, J.P. (2020). Financial Audit Report Modifications in Malta. *Journal of Corporate Governance, Insurance, and Risk Management (JCGIRM), Vol. 1, Series 1*, pp. 107-124.
6. Ballesta, J.P.S., Garcia-Meca, E. (2005). Audit qualifications and corporate governance in Spanish listed firms. *Managerial Auditing Journal*, 20(7), pp. 725-738.
7. Beattie, V., Goodacre, A., Fearnley, S. (2003). And Then There Were Four: A Study of UK Audit Market Concentration – Causes, Consequences and the Scope for Market Adjustment. *Journal of Financial Regulation and Compliance*, Vol. 11(3), pp. 250-265.
8. Beaver, W.H. (1966). Financial Ratios as Predictors of Failure. *Journal of Accounting Research*, Vol. 4, *Empirical Research in Accounting: Selected Studies*, pp. 71-111.
9. Damascena, L.G., Paulo, E. (2013). Audit opinion: A study of qualification opinion and paragraphs of emphasis on the financial statements of Brazilian public firms. *Revista Universo Contabil, Blumenau*, vol. 9, no. 3, pp. 104-127.
10. Francis, J.R., Michas, P.N., Seavey, S.E. (2013). Does audit market concentration harm the quality of audited earnings? Evidence from audit markets in 42 countries. *Contemporary Accounting Research*, 30(1), pp. 325-355.
11. Gad, J. (2018). Rynek usług audytorskich świadczonych na rzecz spółek publicznych notowanych na polskim rynku kapitałowym. *Zeszyty Teoretyczne Rachunkowości*, 97(153), SKwP, pp. 9-30.
12. Gallizo, J.L., Saladrigues, R. (2016). An analysis of determinants of going concern audit opinion: Evidence from Spain stock exchange. *Intangible Capital*, Vol. 12, No. 1, pp. 1-16, <http://dx.doi.org/10.3926/ic.683>, 12.04.2023.
13. Gold, A., Heilmann, M., Pott, C., Rematzki, J. (2020). Do key audit matters impact financial reporting behavior? *Int. J. Audit*, 24, pp. 232-244.
14. Groff, M.Z., Salihovic, A. (2014). Audit market concentration of listed and non-listed auditees in Slovenia. *East-West Journal of Economics and Business*, Vol. XIX, No. 1, pp. 31-49.
15. Hamrol, M., Czajka, B., Piechocki, M. (2004). Upadłość przedsiębiorstwa – model analizy dyskryminacyjnej. *Przegląd Organizacji*, No. 6, pp. 35-39.
16. Iwanowicz, B. (2019). Kluczowe sprawy audytu w sprawozdaniach z badania wybranych spółek giełdowych. *Zeszyty Teoretyczne Rachunkowości*, 105(161), SKwP, pp. 9-16.
17. Koehler, A., Ratzinger-Sakel, N., Theis, J. (2020). The effects of key audit matters on the auditor's report's communicative value? Experimental evidence from investment

- professionals and non-professional investors. *Accounting in Europe*, 17(2), pp. 105-128, <https://doi.org/10.1080/17449480.2020.1726420>, 12.04.2024.
18. Korol, T. (2019). Dynamic Bankruptcy Prediction Models for European Enterprises. *Journal of Risk and Financial Management*, 12(4), 185, pp. 1-15.
 19. Krajowy Standard Badania 200 (Z) w brzmieniu Międzynarodowego Standardu Badania 200 (Zmienionego). Ogólne cele niezależnego biegłego rewidenta oraz przeprowadzanie badania zgodnie z międzynarodowymi standardami badania (Załącznik nr 1.1 do Uchwały Nr 3430/52a/2019 Krajowej Rady Biegłych Rewidentów z dnia 21 marca 2019 r.).
 20. Krajowy Standard Badania 570 (Z) w brzmieniu Międzynarodowego Standardu Badania 570 (Zmienionego). Kontynuacja działalności (Załącznik nr 1.24 do uchwały Nr 3430/52a/2019 Krajowej Rady Biegłych Rewidentów z dnia 21 marca 2019 r.).
 21. Krajowy Standard Badania 700 (Z) w brzmieniu Międzynarodowego Standardu Badania 700 (Zmienionego). Formułowanie opinii oraz sprawozdawczość na temat sprawozdania finansowego (Załącznik nr 1.29 do Uchwały Nr 3430/52a/2019 Krajowej Rady Biegłych Rewidentów z dnia 21 marca 2019 r.).
 22. Krajowy Standard Badania 705 (Z) w brzmieniu Międzynarodowego Standardu Badania 705 (Zmienionego). Modyfikacje opinii w sprawozdaniu niezależnego biegłego rewidenta (Załącznik nr 1.31 do Uchwały Nr 3430/52a/2019 Krajowej Rady Biegłych Rewidentów z dnia 21 marca 2019 r.).
 23. Krajowy Standard Badania 706 (Z) w brzmieniu Międzynarodowego Standardu Badania 706 (Zmienionego). Akapity objaśniające ze zwróceniem uwagi oraz akapity zawierające inne sprawy w sprawozdaniu niezależnego biegłego rewidenta (Załącznik nr 1.32 do Uchwały Nr 3430/52a/2019 Krajowej Rady Biegłych Rewidentów z dnia 21 marca 2019 r.).
 24. Kuter, M. (2019). Kluczowe kwestie badania – nowy element w raportowaniu biegłych rewidentów. *Zeszyty Teoretyczne Rachunkowości*, 101(157). SKwP, pp. 79-94.
 25. Laitinen, E.K., Leitinen, T. (1998). Qualified audit reports in Finland: evidence from large companies. *European Accounting Review*, Vol. 7, Iss. 4, pp. 639-653.
 26. Moradi, M., Abolghasemi, A., Aghaei, H., Ghashti, S.D. (2024). The effect of board characteristics on modified audit opinion. *New Applied Studies in Management, Economics & Accounting*, Vol. 7, No. 1(25), pp. 67-78.
 27. Naruć, W. (2018). Zwiększenie roli i odpowiedzialności biegłych rewidentów w ograniczaniu manipulowania sprawozdaniami finansowymi. *Finanse, Rynki Finansowe, Ubezpieczenia*, 3(93), pp. 67-84.
 28. Pham, D.H. (2022). Determinants of going-concern audit opinions: evidence from Vietnam stock exchange-listed companies. *Cogent Economics & Finance*, 10, <https://doi.org/10.1080/23322039.2022.2145749>, 14.04.2023.

29. Pobrić, A. (2024). Emphasis of matter paragraph in auditor's reports on financial statements of listed companies in Bosnia and Herzegovina. *Economic Challenges, Year 13, no. 25*, pp. 45-56.
30. Pogodzińska-Mizdrak, E. (2012). Zasady wykonywania zawodu biegłego rewidenta. In: D. Krzywda (ed.), *Rewizja sprawozdań finansowych*. Warszawa: SKwP.
31. Saaydah, M. (2020). Corporate Governance and The Modification of Audit Opinion: A Study in The Jordanian Market. *International Journal of Applied Research in Management and Economics Vol. 2*, pp. 28-46.
32. Shao, X. (2020). Research on disclosure status and influencing factors of key audit matters. *Modern Economy, Vol. 11, No. 03*, pp. 701-725.
33. Turzyński, M. (2011). O transparentności działania biegłych rewidentów. *Zeszyty Naukowe Uniwersytetu Szczecińskiego, Finanse, Rynki Finansowe, Ubezpieczenia, no. 41*, pp. 693-701.
34. Wielgórska-Leszczynska, J., Zakrzewska, J.B. (2020). Wpływ wprowadzenia międzynarodowych standardów badania w Polsce na małe i średnie firmy audytorskie. *Zeszyty Naukowe, No. 4(988)*. Uniwersytet Ekonomiczny w Krakowie, pp. 25-43.
35. Włodarczyk, A.M., Białek-Jaworska, A. (2018). Determinanty zastrzeżeń w opinii biegłego rewidenta z badania sprawozdania finansowego. *Folia Oeconomica, Acta Universitatis Lodzensis, 5(338)*, pp. 157-182.
36. Wszelaki, A. (2016). Zasady i etyka wykonywania zawodu biegłego rewidenta w regulacjach prawa polskiego. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, No. 274*. Katowice, pp. 114-121.
37. Yasar, A., Yakut, E., Gutnu, M.M. (2015). Predicting Qualified Audit Opinions Using Financial Ratios: Evidence from the Istanbul Stock Exchange. *International Journal of Business and Social Science, Vol. 6, No. 8(1)*, pp. 57-67.
38. Zdolsek, D., Jagric, T., Odar, M. (2015). Identification of auditor's report qualifications: an empirical analysis for Slovenia. *Economic Research [Ekonomika Istraživanja], Vol. 28, No. 1*, pp. 994-1005.

THE ESSENCE OF BEPS IN THE LIGHT OF THE OECD REFORM OF THE INTERNATIONAL TAX SYSTEM

Monika ODLANICKA-POCZOBUTT

Silesian University of Technology; modlanicka@polsl.pl, ORCID: 0000-0001-7834-1188

Purpose: The objective of this paper is to present the fundamental concepts and initiatives of the *Base Erosion and Profit Shifting* (BEPS) project, which is designed to reform the international tax system.

Design/methodology/approach: A critical analysis method was employed to review legislation, international reports and industry reports. The present paper employs a qualitative approach, underpinned by an extensive review of extant literature on the subject, in addition to pertinent OECD (Organisation for Economic Co-operation and Development) documents and reports concerning BEPS (*Base Erosion and Profit Shifting*) activities. The key elements of the reform of the international tax system are analysed, including the BEPS 1.0 actions and the so-called BEPS 2.0 initiatives, particularly Pillar I and Pillar II. The methodology also includes a critical analysis of the implications of the proposed solutions for the tax sovereignty of states and the operation of multinational companies. This article employs a qualitative legal and doctrinal analysis method. Primary data sources include OECD reports, international legal acts, and expert legal commentary. Comparative analysis is applied to selected jurisdictions (Austria, Italy, Poland) using the International Tax Competitiveness Index. A critical approach is adopted to evaluate the implications of the BEPS 2.0 regulations for tax sovereignty and policy efficiency.

Findings: The main objectives and activities of the *Base Erosion and Profit Shifting* project are presented, introducing the concept of a global minimum tax and the phenomenon of losses incurred by public finance systems. The essence of this initiative to prevent base erosion and profit shifting to low tax jurisdictions is outlined.

Social implications: The OECD's BEPS initiative represents a seminal contemporary project with the objective of reforming the international tax system. The initiative comprises a broad spectrum of actions and recommendations that are designed to establish a fairer and more efficient international taxation system.

Originality/value: The objective of BEPS is to establish mechanisms for states to respond to activities that result in a reduction of the tax base (*base erosion*) and the transfer of income to low-tax or non-taxing jurisdictions (*profit shifting*). This knowledge can be utilised by managers of multinational companies in the conduct of their business.

Keywords: Base Erosion and Profit Shifting, international tax system, global corporations, global minimum tax, Organisation for Economic Co-operation and Development.

Category of the paper: Conceptual paper.

1. Introduction

The reform of the OECD (Organisation for Economic Co-operation and Development) international tax system has had a considerable impact on global corporations, necessitating greater transparency, a change in tax strategies, adaptation to new rules and specific investment and operational decisions. The implementation of the aforementioned changes is associated with financial implications and challenges. However, the objective is to establish a tax system that is both equitable and efficient, thereby yielding benefits for both nations and commercial entities.

Recent attention has been directed towards transactions exhibiting characteristics of aggressive tax optimisation, facilitating full or partial avoidance of tax liability, by international organisations such as the OECD (Organisation for Economic Co-operation and Development). Multinational corporations with representative offices in countries that apply preferential tax regimes are attracting particular attention. A pivotal concern in this regard pertains to the issue of reciprocal non-taxation. The OECD has expressed concerns regarding the efficacy of prevailing international regulations, underscoring the necessity for consultation at the supranational level. The intricate interweaving of national tax provisions within global transactions has been identified as a primary concern, as it gives rise to loopholes that are being exploited by taxpayers. These loopholes frequently result in reciprocal non-taxation, thereby enabling multinational corporations to generate profits that are not subject to taxation in either the country of the company's headquarters or in the country where its operations are based. Consequently, considerable emphasis is placed on the issue of profit shifting to countries with low tax rates, as well as on the shifting of costs to countries offering the highest deductions or high tax rates.

The objective of this paper is to present the primary objectives and activities of the BEPS (Base Erosion and Profit Shifting) project and BEPS 2.0. The OECD initiative BEPS (Base Erosion and Profit Shifting) is regarded as one of the most significant projects in the field of international tax system reform. Its fundamental objective is to prevent the erosion of tax bases and the shifting of profits to low-tax jurisdictions. However, when examined in greater detail, the BEPS project has two overarching aims. Firstly, it seeks to identify and address any gaps and inaccuracies in tax laws that allow profits to be artificially shifted to low-tax countries. By increasing transparency, there should be improved exchange of tax information between countries to prevent multinational corporations from concealing income and profits. The establishment of uniform standards and guidelines to be applied globally, meanwhile, should provide greater legal certainty for both governments and businesses.

The present paper addresses the essence of the BEPS initiative in the context of the reform of the international tax system conducted under the auspices of the OECD. The research approach is founded upon normative and doctrinal analysis, utilising sources of international

law, OECD documents, expert commentaries, and existing national regulations implementing BEPS measures. The material scope of the work encompasses both the initial phase of the BEPS project (formally referred to as BEPS 1.0), which is centred on the mitigation of aggressive tax optimisation, and the subsequent phase (BEPS 2.0), which encompasses the establishment of new regulations concerning the allocation of taxing rights and the global minimum tax (Pillar I and Pillar II). The work is theoretically embedded in the framework of international tax law and theories of tax sovereignty and tax justice.

This article employs a qualitative legal and doctrinal analysis method. Primary data sources include OECD reports, international legal acts, and expert legal commentary. A critical approach is adopted to evaluate the implications of the BEPS 2.0 regulations for tax sovereignty and policy efficiency.

Identified research gap – lack of a unified approach to the effects of BEPS 2.0 on developing countries, allows to formulate research questions: How does the implementation of Pillar II affect the tax sovereignty of states? and “Is the QDMTT mechanism effective in counteracting tax avoidance?” The article reviews the literature on the OECD international tax system reform, presents the results of the introduction of the global minimum income tax - Pillar II regulation, discusses losses in public finance systems and presents conclusions.

2. Reform of the OECD international tax system – literature review

The OECD's reform of the international tax system has had a significant impact on global corporations. The recent advent of the Base Erosion and Profit Shifting (BEPS) (Webinar PwC, 2016) initiative is indicative of a concerted effort to address the issue of corporate tax avoidance through the strategic relocation of profits to low-tax jurisdictions. In addition, the issue of global minimum income tax is of particular pertinence. This was evidenced by a 2021 agreement which saw over 130 countries adopt a 15% tax on multinational corporations. Country responses and adaptation of national rules vary, as countries adapt their tax rules to maximise tax revenues in line with the new OECD standards. It will also be interesting to see how the new rules affect corporations' tax planning and profit optimisation strategies. It is imperative to consider the repercussions of the reform of the international tax system on developing countries, which may not possess the same resources as developed countries to pursue tax avoidance.

In the contemporary global context, characterised by the forces of globalisation and digitalisation, government tax policymakers worldwide are engaged in collaborative efforts to propose substantial amendments to international tax regulations. The G20/OECD project on the taxation of the digital economy was initiated in 2019, building on the findings of the final reports issued in 2015 under the earlier BEPS project.

The current project, referred to as BEPS 2.0, has two components:

- Pillar I on the new rules of nexus and profit allocation, which aim to attribute a greater share of tax rights on global business income to market countries, and
- Pillar II rules for a new global minimum tax, endorsed in December 2021 by the 141 jurisdictions participating in BEPS 2.0.

The Pillar 2 model rules stipulate a global minimum tax of 15%, applicable to multinational enterprise (MNE) groups with a global turnover of €750 million or more.

As part of the BEPS 2.0 initiative, a global reform in income taxes is being implemented. The fundamental principle underpinning this concept is the obligation to contribute an additional tax surcharge, known as a 'top-up tax', in instances where the effective tax rate within a specific tax jurisdiction falls below 15%.

As previously stated, the objective of this initiative is to prevent corporations from avoiding tax by shifting profits to low-tax jurisdictions. Following the publication of the OECD Anti-BePS Report in 2013, the term has become synonymous with the OECD and G20 global project. The 15 actions proposed by the OECD (often referred to as the BEPS Project) are intended to implement uniform international taxation rules adapted to the challenges of the 21st century.

A series of reports have outlined 15 actions that countries should take in order to prevent unfair tax avoidance and the shifting of profits to tax havens:

1. **The digital economy:** Addressing tax challenges related to the digitalisation of the economy.
2. **Hybrid mechanisms:** Elimination of the effects of hybrid structures used for tax avoidance.
3. **CFC (Controlled Foreign Companies):** Rules on the taxation of foreign controlled companies.
4. **Interest deductions and other financial payments:** Limiting the deductibility of interest and other financial payments that can be used to carry forward profits.
5. **Estimating profits:** Create rules to ensure that profits are taxed where the actual economic activity takes place.
6. **Financial instruments:** Principles on transparency and reporting of financial instruments used.
7. **Tax treaties:** principles to prevent abuse of tax treaties.
8. **Risk management:** Creating a framework for corporate tax risk management.
9. **Transparency and reporting:** Introduction of Country-by-Country Reporting (CbCR).
10. **Transfer pricing documentation:** Rules on transfer pricing documentation and monitoring.
11. **Profit issues:** Defining rules for profits that are the result of artificial structures.
12. **Anti-abuse rules:** Implementation of general anti-abuse rules in national legislation.
13. **Transfer pricing documentation and reporting by country.**
14. **Dispute procedures:** Introduction of tax dispute resolution mechanisms.

15. Legislative effectiveness: Ensuring that legislative changes are effectively implemented.

For instance, the Action 13 Report establishes novel documentation standards and instigates a model form for reporting by country the value of revenues, profits, taxes paid and other measures of economic activity to be completed by multinational enterprises (MNEs) (Janowski, 2017). In this particular instance, the OECD proposes the implementation of a three-tiered reporting system:

- *master file* - designed to provide general information on global business activities and the group's transfer pricing policy (this report would be intended by the OECD to be available to any tax administration),
- *local file* - documenting in detail the transactional transfer prices applied by each country in the group, in particular the parties to the transaction, the amount of the transaction and the analysis of the determinants of transfer prices,
- *Country-by-Country Report* - an annual report provided for the largest multinational corporations with revenues in excess of €750 million presenting to each tax jurisdiction in which the group has any operations the amounts of sales revenue, pre-tax profits, income tax, number of employees, amount of capital, retained earnings and value of assets in each tax jurisdiction (OECD, 2015).

It is vital to consider all three reports when analysing transfer pricing. This will allow taxpayers to demonstrate a consistent picture of the items subject to transfer pricing. In turn, this will provide tax administrations with useful information for assessing transfer pricing risks. Furthermore, it will facilitate the identification of aggressive tax optimisation policies during audits. Such policies are those which involve the transfer of significant amounts of income to tax-advantaged environments (OECD, 2015).

3. Results

The calculation of corporate income tax liability for companies is determined by the provisions set out in the Corporate Income Tax Act of 15 February 1992, as subsequently amended, in addition to various EU regulations (Dz.U.2023.2805). By the end of 2023, Poland was obliged to enact legislation implementing the EU Directive on ensuring a global minimum level of 15% taxation of domestic and international capital groups (the so-called Pillar II Directive) (OJ.EU.L.2022.328.1). It is recommended that these provisions extend to capital groups with consolidated revenues of a minimum of EUR 750 million, with the initial period potentially subject to settlement commencing in 2024. In a manner consistent with the majority of other EU countries, Poland will opt to implement a national top-up tax that will satisfy the minimum requirements of the directive (classifying it as a qualifying top-up tax). In essence,

this signifies that any Polish company or group bound by the stipulations of Pillar II is obligated to compute its effective tax rate and arrive at a settlement with the relevant Polish tax authorities in accordance with domestic regulations. This obligation stands irrespective of any supplementary responsibilities that may be incumbent upon the group's foreign headquarters with regard to this matter (<https://www2.deloitte.com>, 2024).

In December 2022, the Council of the European Union adopted a directive, obliging Poland, in line with other EU countries, to implement the new regulations.

The Republic of Poland is implementing a top-up tax at a national level. This means that any Polish company or group subject to Pillar II requirements will have to calculate its effective tax rate and pay the top-up tax in Poland, regardless of any additional obligations on the parent company in this respect.

The objectives of Pillar II will be realised through two main principles of income taxation:

1. The *Income Inclusion Rule* (IIR) and
2. The principle of *under-taxed* profits - the so-called *Undertaxed Profit Rule* (UTPR).

The IIR Rule is considered to take precedence over the UTPR Rule, and its application is focused on parent entities, with the initial focus being on the Ultimate Parent Entity (UPE).

The IIR principle, as outlined in the Directive, stipulates that the UPE is responsible for regulating the top-up tax on all low-tax constituent units, both within and outside the European Union.

In the event that the UPE elects not to implement the IIR Principle with regard to its constituent units, Member States are responsible for ensuring the collection of the top-up tax in accordance with the UTPR Principle. It can thus be posited that the UTPR principle functions as a backstop mechanism for the IIR principle.

The fundamental principle of the UTPR is to allocate compensatory tax amounts to other component units in the group, thereby ensuring that taxation is minimised at the appropriate level.

In accordance with the recently implemented regulatory framework, the following two tax regulations will come into effect: STTR and QDMTT.

STTR (Subject To Tax Rule) is otherwise known as the taxability rule. The introduction of this convention into double taxation treaties will be achieved by means of a multilateral convention. In accordance with the stipulated regulation, specific payments to associated entities overseas will be liable for taxation, should the recipient be subject to insufficient taxation.

Conversely, the QDMTT (Qualifying Domestic Minimum Income Tax) constitutes a mechanism that enables the payment of a top-up tax in the jurisdiction where the income was generated. In certain situations, the QDMTT has been shown to neutralise the application of the IIR principle at the UPE level (<https://kpmg.com/pl>).

However, the regulation of the minimum corporate income tax structure fulfils the task of sealing the tax system with different effects depending on the country. Z. Klimaszewska's comparative analysis of the subjective scope of the regulation, the tax rate, the manner of its calculation and the exemptions applied in Austria, Italy and Poland indicates fundamental differences in the area of function, efficiency and the manner in which the tax corresponds to the realities and challenges posed by the free market to state tax systems (Klimaszewska, 2022). The author draws attention to the specific features of the regulations of the analysed systems, such as the wide scope of subjects in the Austrian system, the narrower scope of subjects and the higher tax rate in the Italian system, as well as the problem of introducing a new regulation in the Polish system. The utilisation of the International Tax Competitiveness Index 2021, a metric developed by the Tax Foundation, facilitated the conclusion that the solution implemented in Austria exhibits limited utilisation of the potential offered by this particular tax instrument. In contrast, the Italian system appears to employ this potential more effectively, though it grapples with tax avoidance on a more extensive scale. With regard to the Polish minimum CIT, the paucity of data hinders a comprehensive analysis. Nonetheless, the index suggests that the challenge of fortifying the tax system is less pronounced in this instance, thereby creating an opportunity to refine the tax structure and achieve the delineated objectives with greater efficacy (Klimaszewska, 2022).

The notion of implementing a minimum tax on revenue in the real estate industry has been demonstrated to engender favourable outcomes. The assessment of the aforementioned regulatory measure has enabled researchers to formulate *de lege ferenda* postulates (Jamróży, Łożykowski, 2021). The authors posit that the imposition of a minimum tax, in the form of a tax on income derived from commercial buildings, does not constitute an excessive anti-abuse measure. A key objective of this tax is to prevent tax avoidance and profit shifting by large real estate companies owning commercial properties of significant value. It has been determined that approximately one third of taxpayers have not fully deducted the minimum tax due on commercial buildings from their corporation tax calculated on a general basis. The impact of the augmented tax obligation is mitigated, at least in the short term, by a series of measures designed to ensure the neutrality of this tax and the relatively modest level of the minimum tax.

4. Discussion

A significant challenge arising from the presence of inequitable tax competition pertains to the financial setbacks experienced by public finance systems. The diminution in the capacity to finance public expenditure from tax revenues signifies that an augmented amount of public debt must be incurred, and the cost of its servicing is elevated due to the escalating cost of money in recent years. In 2015, it was estimated that 36 per cent of profits made by multinational

corporations outside their country of domicile were transferred to tax havens (Torslov, Wier, Zucman, 2022). In the European Union, the countries that are most adversely affected by this situation are those that impose high taxes on corporate profits. A comparative analysis of the period 2015 to subsequent years reveals an increase in the scale of lost CIT revenue, calculated as a percentage of total CIT revenue, in most countries. The most substantial increase in lost revenue was observed in the UK (from 18 to 32 per cent), but the phenomenon is also significant in the largest EU economies: Germany, France, Italy and Spain, as well as Hungary. In the case of Poland, the lost revenue constituted 8 per cent of the total CIT revenue, and this figure remained stable.

It is evident that a select number of countries within the European Union are beneficiaries of inequitable tax competition and derive financial benefit from artificial profit transfers. In 2019, in comparison with the situation in 2015, tax revenue from artificial profit transfers increased in Ireland, Luxembourg and Belgium, reaching 59, 56 and 38 per cent of total CIT revenue in these countries, respectively.

The highest tax losses in terms of amount can be observed in Germany (USD 22.63 billion) or the UK (USD 20.83 million). The phenomenon has been found to result in a deficit of more than 20 per cent in the UK, Germany, France and Hungary. In Poland, the estimated annual financial losses resulting from this competitive tax environment amount to an average of approximately USD 1 billion, which corresponds to approximately 7 per cent of CIT revenues. This figure is lower than the average annual losses experienced during the 2015-2019 period, when losses reached 8 per cent on average. An analysis of the effects of tax competition on Poland reveals that in 2018, a total of PLN 82 billion (equivalent to 3.86% of Poland's GDP) flowed from Poland to other EU countries. This figure stands in contrast to the amount recorded in 2005, when a mere PLN 26.5 billion (equivalent to 2.7% of GDP) was recorded as flowing from interest mechanisms, royalties, dividends and certain services (including advisory services) (Jamrózy, Janiszewska, Łożykowski, 2023). It is evident that there has been a shift in the methods employed for the transfer of profits. While in 2005 payments other than dividends accounted for 44.5 per cent of the total amount of transferred profits, in 2018 it was already more than 57 per cent. It is evident that transferred profits have been allocated to Poland's primary trading partners, namely Germany, France and the Netherlands. However, it is noteworthy that these profits have also been directed to Ireland and Luxembourg, despite the fact that Poland maintains comparatively weaker economic ties with these countries.

5. Summary

In summary, it should be stated that the BEPS (Base Erosion Profit Shifting) project under the G20/OECD convention, in the work on which Poland actively participated, is aimed at creating mechanisms for states to respond to activities that lead to a shrinking of the tax base (base erosion) and the transfer of income to low-tax or non-tax jurisdictions (profit shifting). These issues have been identified, particularly in the context of the operations of multinational corporations, where they have resulted in a reduction of government revenue and an increase in the tax burden on citizens and smaller businesses, consequently reducing their competitiveness against multinational corporations. The BEPS project is intended to achieve international harmonisation of measures aimed at countering the phenomena of aggressive tax optimisation and tax avoidance, and to create tools for tax administrations to combat these phenomena.

Despite the fact that OECD reports are not a source of universally binding law in the Polish legal system, they nevertheless constitute an important interpretative guideline for both the practice of international entrepreneurs and tax authorities. The BEPS project has been evaluated as a significant initiative with the potential to yield long-term tangible outcomes, particularly in establishing the foundations for effective activities at both the national and international levels, thereby preventing the loss of tax revenues.

It is evident that the BEPS project and its recommendations will have a substantial impact on the tax system in Poland, as well as in other OECD countries. It is indisputable that the initiative to tighten tax systems is of significant importance, and it is imperative that all stakeholders adapt accordingly. The BEPS project has been developed to address the global issue of tax base erosion and profit shifting, with the objective of contributing to the stabilisation of tax systems worldwide. This ambitious undertaking involves a wide range of activities and cooperative efforts at the global level.

In light of the solutions implemented into the Polish legal order, which find their source in BEPS, it is incumbent upon taxpayers to analyse their existing capital and organisational structures in terms of the identified mechanisms leading to the reduction of the tax base. Furthermore, taxpayers should be prepared to adapt to the changes in transfer pricing documentation, especially the development of comparative analyses and strategies for obtaining the necessary information from parent companies and the principles of liability in this respect.

In an effort to harmonise the taxation of MNE groups, tax fairness is aptly highlighted. In the majority of the countries under scrutiny, the average effective tax on companies operating within a nation is higher than the tax on MNE groups calculated at the level of the entire MNE group. This indicates that the financing of public needs is disproportionately achieved through taxes levied on domestic companies and individuals, and through debt incurred. The unification of the tax system at European level represents a significant opportunity to

address this issue. It is imperative that multinational enterprise groups, which generate substantial profits in multiple countries, contribute more significantly to the budgets of the countries whose infrastructure and market they utilise.

Multinational enterprises (MNEs) must closely monitor developments in their respective jurisdictions when implementing global minimum tax rules into their domestic legislation. The majority of prominent organisations have only recently embarked on the initial phase of their endeavour to implement a global minimum tax. Organisations will be required to calculate their new taxes, assess the impact on their financial statements and report to relevant tax authorities around the world. It is imperative that organisations adapt their internal processes and systems in order to manage the new calculations and data, calculate their tax liabilities, and meet their reporting obligations.

6. Conclusions

The BEPS project—led by the OECD and G20—has become a central pillar in the reform of the international tax system. It aims to prevent the erosion of national tax bases and the artificial shifting of profits by multinational corporations. This is particularly relevant in the digital economy, where traditional tax concepts such as physical presence and permanent establishment are no longer sufficient.

The implementation of BEPS recommendations is expected to have a long-term impact on Poland's tax system. New rules—such as the global minimum tax and improved transfer pricing standards—will require significant adjustments in corporate behavior and tax administration practices. While this transition poses challenges, it also offers the prospect of greater fairness, efficiency, and transparency in corporate taxation.

The analysis shows that MNEs tend to benefit from the current system by paying lower effective tax rates than domestic firms, which distorts competition and shifts the tax burden onto individuals and SMEs. This trend underscores the need for coordinated international action and a unified European approach to corporate taxation. Ensuring that companies contribute fairly to the countries in which they operate is essential for maintaining sustainable public finances and preserving trust in tax systems.

Going forward, MNEs must carefully monitor developments in their jurisdictions as global minimum tax rules are transposed into domestic law. The complexity of calculating top-up taxes, understanding QDMTT (Qualified Domestic Minimum Top-up Tax) provisions, and meeting enhanced reporting requirements necessitates internal process redesign and investment in tax technology and expertise.

Ultimately, the success of the BEPS initiative will depend on sustained international cooperation and the political will to enforce its principles. If effectively implemented, it has the potential to reshape the global tax architecture in a way that better aligns with modern economic realities and reduces the incentives for profit shifting.

References

1. *BEPS – czy czekają nas kolejne zmiany w podatkach i jak się do nich przygotować?* (2015). Webinarium PwC. Warszawa, s. 4.
2. Dyrektywa 2022/2523 w sprawie zapewnienia globalnego minimalnego poziomu opodatkowania międzynarodowych grup przedsiębiorstw oraz dużych grup krajowych w Unii, Dz.U.UE.L.2022.328.1
3. Dyrektywa Rady 2003/123/WE z dnia 22 grudnia 2003 r. zmieniającej dyrektywę 90/435/EWG w sprawie wspólnego systemu opodatkowania stosowanego w przypadku spółek dominujących i spółek zależnych różnych Państw Członkowskich (Dz. Urz. UE L 7 z 13.01.2004, s. 41; Polskie wydanie specjalne, rozdz. 09, t. 2, s. 3).
4. Dyrektywa Rady 2003/49/WE z dnia 3 czerwca 2003 r. w sprawie wspólnego systemu opodatkowania stosowanego do odsetek oraz należności licencyjnych między powiązаныmi spółkami różnych państw członkowskich (Dz. Urz. UE L 157 z 26.06.2003, s. 49; Polskie wydanie specjalne, rozdz. 09, t. 1, s. 380).
5. Dyrektywa Rady 2004/66/WE z dnia 26 kwietnia 2004 r. dostosowującej dyrektywy 1999/45/WE, 2002/83/WE, 2003/37/WE i 2003/59/WE Parlamentu Europejskiego i Rady oraz dyrektywy 77/388/EWG, 91/414/EWG, 96/26/EWG, 2003/48/WE i 2003/49/WE Rady w zakresie swobodnego przepływu towarów, swobody świadczenia usług, rolnictwa, polityki transportowej, opodatkowania, w następstwie przystąpienia Republiki Czeskiej, Estonii, Cypru, Łotwy, Litwy, Węgier, Malty, Polski, Słowenii i Słowacji (Dz. Urz. UE L 168 z 01.05.2004, s. 35).
6. Dyrektywa Rady 2004/76/WE z dnia 29 kwietnia 2004 r. zmieniającej dyrektywę 2003/49/WE w odniesieniu do możliwości stosowania przez niektóre Państwa Członkowskie okresów przejściowych dla stosowania wspólnego systemu opodatkowania stosowanego do odsetek oraz należności licencyjnych między powiązаныmi spółkami różnych Państw Członkowskich (Dz. Urz. UE L 195 z 02.06.2004, s. 33; Polskie wydanie specjalne, rozdz. 09, t. 2, s. 23).
7. Dyrektywa Rady 2005/19/WE z dnia 17 lutego 2005 r. zmieniającej dyrektywę Rady 90/434/EWG w sprawie wspólnego systemu opodatkowania mającego zastosowanie w przypadku łączenia, podziałów, wnoszenia aktywów i wymiany udziałów, dotyczących spółek różnych Państw Członkowskich (Dz. Urz. UE L 058 z 04.03.2005, s. 19).

8. Dyrektywa Rady 2006/98/WE z dnia 20 listopada 2006 r. dostosowującej niektóre dyrektywy w dziedzinie opodatkowania, w związku z przystąpieniem Bułgarii i Rumunii (Dz. Urz. UE L 363 z 20.12.2006, s. 129).
9. Dyrektywa Rady 2011/96/UE z dnia 30 listopada 2011 r. w sprawie wspólnego systemu opodatkowania mającego zastosowanie w przypadku spółek dominujących i spółek zależnych różnych państw członkowskich (Dz. Urz. UE L 345 z 29.12.2011, s. 8, z późn. zm.).
10. Dyrektywa Rady 2013/13/UE z dnia 13 maja 2013 r. dostosowującej niektóre dyrektywy w dziedzinie podatków w związku z przystąpieniem Republiki Chorwacji (Dz. Urz. UE L 141 z 28.05.2013, s. 30).
11. Dyrektywa Rady 90/434/EWG z dnia 23 lipca 1990 r. w sprawie wspólnego systemu opodatkowania mającego zastosowanie w przypadku łączenia, podziałów, wnoszenia aktywów i wymiany udziałów, dotyczących spółek różnych państw członkowskich (Dz. Urz. UE L 225 z 20.08.1990, s. 1; Polskie wydanie specjalne, rozdz. 09, t. 1, s. 142).
12. Dyrektywa Rady 90/435/EWG z dnia 23 lipca 1990 r. w sprawie wspólnego systemu opodatkowania stosowanego w przypadku spółek dominujących i spółek zależnych różnych państw członkowskich (Dz. Urz. UE L 225 z 20.08.1990, s. 6; Polskie wydanie specjalne, rozdz. 09, t. 1, s. 147).
13. <https://kpmg.com/pl/pl/home/services/doradztwo-podatkowe/obszary-podatkowe/pillar-2-globalny-podatek-minimalny-wdrozenie-filar-ii.html>
14. <https://www2.deloitte.com/pl/pl/pages/tax/articles/Globalny-podatek-minimalny-Pillar-2-wylaczenia-korekty-oraz-dostepne-Safe-Harbours.html>
15. Jamróży, M., Łożykowski, A. (2021). Doświadczenia polskie w minimalnym opodatkowaniu: podatek od przychodów z budynków. *Finanse i Prawo Finansowe*, 2(30), pp. 61-73.
16. Jamróży, M., Janiszewska, M., Łożykowski, A. (2023). Holding company location: a Polish tax perspective. *Ruch Prawniczy, Ekonomiczny i Społeczny*, no. 1, <https://doi.org/10.14746/rpeis.2023.85.1.18>
17. Janowski, G. (2017). Wpływ BEPS na polski system podatkowy. *Zeszyty Naukowe Wydziału Nauk Ekonomicznych*, 1(20), pp. 129-140.
18. Klimaszcwska, Z. (2022). Minimalny podatek dochodowy od osób prawnych w świetle prawnoporównawczym (Polska, Włochy, Austria). *Doradztwo Podatkowe - Biuletyn Instytutu Studiów Podatkowych*, 8(312), pp. 13-20.
19. OECD (2015). *Guidance on Transfer Pricing Documentation and Country-by-Country Reporting, Action 13 – 2015 Final Report*. Paris, p. 10.
20. OECD (2015). *OECD/G20 Base Erosion and Profit Shifting Project: 2015 Final Reports Executive Summaries*. Paris, pp. 37-39.

21. Torslov, T., Wier, L., Zucman, G. (2022). The Missing Profits of Nations, <https://missingprofits.world/>, 05.2024.
22. Ustawa z dnia 15 lutego 1992 r. o podatku dochodowym od osób prawnych, Art. 24ca, Dz.U.2023.2805.

HYPOTHETICO-DEDUCTIVE METHOD IN MANAGEMENT SCIENCES: ITS DEVELOPMENT AND APPLICATION

Zbigniew ORBIK

Silesian University of Technology, Faculty of Organization and Management;
zbigniew.orbik@polsl.pl, ORCID:0000-0001-7092-1567

Purpose: The aim of this article is to analyze the hypothetical-deductive method (HD) in its applications in management sciences. This method is studied from the perspective of the general methodology of sciences, with particular emphasis on the specificity of management sciences. The path that led to the development of the HD method is also outlined.

Design/methodology/approach: The article analyzes selected literature on both general methodology of science and works in which the subject of analysis is the hypothetical-deductive method applied to research in management sciences.

Findings: The hypothetico-deductive method is a cornerstone of scientific inquiry, including in management sciences, where it facilitates structured hypothesis testing and decision-making. This method involves formulating hypotheses based on observations and then testing these through experiments or further observations to confirm or falsify them. Its application in management sciences has been pivotal in advancing the field, providing a systematic approach to problem-solving and decision-making.

Research limitations/implications: The article refers to a limited number of studies. Historically, the hypothetico-deductive method has dominated management and organizational studies, driving significant progress by providing a structured framework for research and analysis.

Originality/value: The article is devoted to the analysis of the hypothetico-deductive method as, on the one hand, one of the basic methods used in the general methodology of sciences and, on the other hand, as a basic method also used in management science. The scientific status of management sciences is mainly based on the application of this method although it is not the only method used in these sciences. The analyses conducted indicate the place of management sciences in the whole of science understood as a certain historical product.

Keywords: Methodology of sciences, management sciences, hypothetico-deductive method, induction.

Category of the paper: Conceptual paper.

1. Introduction

Method is the determinant of every science. It determines its nature. Reflections on the scientific method as an instrument for understanding each scientific discipline, including management sciences, will be mainly theoretical in nature. The aim of this article is to characterize one of the basic scientific methods used in empirical sciences, including management sciences. This is the hypothetical-deductive method (HD). The path that led to the development of the HD method also needs to be briefly described.

There are at least several reasons why we should, at least as scientists, understand the methods used in scientific knowledge. One of the most important is the desire to understand. We need to know the essence of the scientific method in order to understand how new knowledge is created and distributed (Gower, 2012). The historical reflections on the development of scientific methodology, as stated above, made here in outline only serve to show that the methodology of science is the result of a long process of development that began in antiquity. It developed together with science and is one of its most important elements.

The beginning of reflection on the scientific method date back to ancient Greece. Greek philosophers were the first who, trying to explain the nature of the world, gave up referring to myths and supernatural explanations, but instead referred to reason and experience (Vignais, Vignais, 2010). Already in Greek times, a very important methodological motif emerged: the idea of systematized knowledge (Teplow, 2023). In the most general sense, scientific method is the combination of reason and experience in the process of acquiring scientific knowledge. In a more specific sense, the scientific method in empirical sciences is understood as a way of solving problems in which experiment, observation, and induction are combined with experience and reasoning.

After centuries of oblivion, the scientific thought of the Greeks was revived in the late Middle Ages. The first European universities were founded in the era as well. Although it was a period dominated by philosophical and theological thought, already then there appeared scientists who postulated that when studying nature we should also refer to experience. The main representative of medieval empiricism was Roger Bacon.

In the Renaissance, as the name suggests, there was a clear return to the achievements of classical thinkers. In the seventeenth century, Francis Bacon in his work entitled *Novum Organum* formulated one of the key problems for the new methodology of science – the problem of induction (Bacon, 1878). It was later taken up by David Hume in his *A Treatise of Human Nature* (Hume, 2000). The problem of induction is that even if the premises are true, it does not guarantee the truth of the conclusions. In other words, induction is fallible reasoning. Attempts to solve this problem led to the formulation of many methodological concepts in subsequent centuries. The most important include, among others, Carnap's program,

Bayesianism, and Popper's falsifications. One of the answers to the above mentioned problem is HD method.

Methods used in management sciences belong to the class of empirical sciences. In management sciences, as in all empirical ones, research conducted according to a specific method is aimed at achieving progress in scientific knowledge, establishing new statements, theses, generalizations or definitions.

Management sciences are empirical disciplines. They are also characterized by interdisciplinarity. This article attempts to demonstrate the place of the HD method in management sciences. This is, of course, only an outline of the topic. The aim is both to outline the historical development of the titular method in these sciences and to indicate its place in the methodology of contemporary management sciences. Currently, these sciences reject methodological fundamentalism, which assumes a neo-positivist model drawn exclusively from the natural sciences (Dźwigoł, 2019). Moreover, methodological studies emphasize the need to use various research methods (Harrington, Voehl, 2016; Midgley et al., 2017; Streicher et al., 2025; Moreira et al., 2025). Contemporary management sciences are therefore characterized by methodological pluralism. However, the HD method is still used.

The originality of the material presented in this work lies primarily in demonstrating the importance of the hypothetical-deductive method for management sciences. There is a gap in the literature regarding the importance of this method for research conducted within these sciences.

2. Methods

The article uses a literature review research technique to collect, analyze, and synthesize relevant information from a wide range of sources. A literature review is a fully-fledged research method (Hadi, Afandi, 2021). A well-conducted literature review allows you to get acquainted with the current state of knowledge in a given field and provide reliable answers to research questions (Snyder, 2019). It summarizes and evaluates a set of writings about a specific topic (Knopf, 2006). This is an excellent method for analyzing interdisciplinary research. It also allows for the synthesis of research results and the discovery of areas where further research is necessary. The literature review was conducted on the Google Scholar and Science Direct platforms. The databases were searched based on the following keywords: Methodology of sciences, management sciences, hypothetico-deductive method, induction.

The table 1 below summarizes the different types of literature review.

Table 1.
Types of Literature Review

Type	Systematic	Semi-systematic	Integrative
Typical purpose	Synthesize and compare evidence	Overview research area and track development over time	Critique and synthesize
Search strategy	Systematic	May or may not be systematic	Usually not systematic
Research questions	Specific	Broad	Narrow or broad
Analysis and evaluation	Quantitative	Qualitative/quantitative	Qualitative
Sample characteristics	Quantitative articles	Research articles	Research articles, books, and other published texts
Examples of contribution	Evidence of effect. Inform policy and practice	State of knowledge. Themes in literature. Historical overview. Research agenda. Theoretical model	Taxonomy or classification. Theoretical model or framework

Source: own elaboration based on: Snyder, 2019.

The other method used in this article is the method of logical analysis. This method involves the use of logical tools to distinguish correct arguments, i.e. those that are consistent with the laws of logic, from those that violate the rules. The laws of logic determine the correctness of reasoning used in all sciences. Logic and its methods also allow to discover the most general structural aspects of our thinking and actions (Peregrin, Svoboda, 2017). A version of logical analysis is a thought experiment. The application of the tools of logical analysis to propositions expressed in natural language is justified by the fact that the rules of such a language are also subject to the laws of logic.

Logical analysis is also helpful in research conducted in management sciences. It enables better understanding of their theories and conceptual framework (Ngulube et al., 2015). Management sciences, like any other scientific disciplines, have their own research methods and are characterized by interdisciplinarity. For this reason, some kind of methodological eclecticism can be attributed to these sciences. It allows to combine methods from various disciplines, paradigms and approaches, ensuring their cognitive and pragmatic efficiency. These are both quantitative and qualitative methods. The research process in management sciences is often accompanied by various types of models, including: theoretical and conceptual, research or statistical. The model, in general, means a hypothetical thought structure, i.e. the arrangement of assumptions, concepts and relationships between them, allowing you to describe some aspect of reality. A model should not be confused with a theory. The purpose of a model is to represent something. A theory is to explain a class of phenomena (Frigg, Hartmann, 2025; Nersessian, 2010). The role of logic in research is crucial because it allows to draw correct conclusions and avoid errors in reasoning.

Logic is a formal science (Copi et al., 2016). The basic concept of logic is the concept of truth and its opposite concept of falsehood (Quine, 1986). In the most general sense logic is concerned with the principles of valid (true) inference (Kneale, Kneale, 1962). Both formal and informal principles of logic can be applied to the analysis of a text in natural language

(Ngalande, 2011). The author of the article does not use formalisms. The goal is not to strictly reproduce the conceptual structure of the analyzed field but to capture the most central problems of the concept of hypothetico-deductive method in the aspect of its evolution. The term "logic" that appears here should not be identified with a priori science. It is rather a specific method of research used in the social sciences (Mahoney, 2021).

It is worth pointing out the difference between the terms "methodology" and scientific "methods". In the most general sense, "methods" mean the techniques used by scientists in their research practice (Bryman, 2008). Methodology is the study of research methods (Rajasekar, Verma, 2013). We distinguish general methodology of science, i.e. the theory of scientific methods used in all sciences, and detailed methodologies analyzing the methodological foundations of individual scientific disciplines.

3. Literature review

Science was born in ancient Greece in the 6th century BC. The first ancient Greek philosophers put forward the idea that the Universe is a certain structure and that its beginning was some primordial material, which they considered water, air, earth or fire. It was recognized that these elements can be transformed into each other and that natural phenomena are dependent on these transformations (Johansen, 2005). An inseparable part of this concept, which cut itself off from any reference to myths or religious beliefs, was the theory of the conservation of matter: nothing comes from nothing. Then Pythagorean philosophy, permeated with the science of numbers, introduced the idea of mathematization of the Universe (Barnes, 2002). Atomic philosophy proposed the structure of matter in the form of indivisible particles, or atoms, separated by a void (Pullman, 2001). Aristotle used empiricism to oppose Plato's theories on the geometrization of things in nature. As a keen observer of the form and habits of animals and the anatomy and functions of their organs, Aristotle is considered the first naturalist (Hähnel, 2020). He also gave us the basic principles of logic and is considered the discoverer of the empirical method.

There are four basic elements of ancient Greek science: the view of the whole, cause, analysis and composition (synthesis). Greek science was anthropocentric and developed the "physiocratic" (naturalistic) school of thought. On the other hand, however, it is easy to notice the humanistic motive, expressed in the belief that the basic goal of research is not practical application, but knowledge, which is an autotelic value (Charitos et al., 2022). Although in ancient Greece topics that are today classified as various scientific disciplines they were at that time called philosophy (literally 'love of wisdom').

The idea of science understood empirically appears already in the writings of Aristotle and in the late Middle Ages in the works of Roger Bacon. However, we owe the full understanding of the empirical nature of scientific knowledge to the thinkers of modern times. The first serious attempt in this area was made by Francis Bacon, who pointed to the so-called problem of induction (Bacon, 1878). Bacon distinguished two types of induction: enumerative and eliminative (Hintikka, 1968). Enumerative induction is performed by simply enumerating cases. It takes the form: if A_1 is B, A_2 is B, ..., A_n is B, then every A is B. This is simply naive reasoning. Eliminative induction is a method of finding truth by using evidence to eliminate false hypotheses and finding the true one (Hawthorne, 1993). Bacon's lasting contribution to the methodology of science is that in an attempt to explain the mechanism of eliminative induction he applied the idea of an experiment understood as a planned observation (Gooding, 2017). The essence of the problem of induction lies in the unreliable nature of the conclusions obtained through this method of reasoning.

David Hume noted that "inductive reasoning is an activity of the mind that takes us from the observed to the unobserved" (Sloman, Lagnado, 2005, p. 95). Hume, being an empiricist, pointed out the limitations of the inductive method (Howson, 2000). This was an important step in the development of the methodology of science because it forced subsequent scholars to undertake research, on the one hand, on the nature of scientific knowledge, and on the other hand, on the improvement of the research tools and techniques used.

Bacon was also the first scientist to point out the key role of hypotheses in scientific research. Although the concept of hypothesis already appeared in ancient thought (Forno, 2011), where it was often used by various thinkers, it was not until the modern era that this concept became an important element of methods used in science (McMullin, 2009; Brüssow, 2022; Karunarathna et al., 2024). In fact, the first scientific work to show the important role of hypotheses in the development of science were Euclid's *Elements*, written around 300 BC. (Heath, 1956). The importance of this work cannot be overestimated and is a separate issue that goes beyond the scope of this article. However, it indicates the continuity of the development of science also in terms of the used methods.

The actual beginning of the modern scientific method dates back to the seventeenth century involving: (1) a chain of research events from Copernicus to Newton, which resulted in (2) the gravitational model of the solar system, and (3) the theory of Newtonian physics to express the model (Betz, 2010). The methodological foundations of modern science, especially physics, were prepared by Galileo. The greatest emphasis in the method he developed was placed on reasoning (Finocchiaro, 2012). He was the author of the basic principles of conducting a scientific experiment, but he also developed and used a thought experiment. An important step was also the first philosophical work devoted exclusively to methodology, namely Descartes' *Discourse on Method* (Descartes, 1998). It seems to be no coincidence that the seventeenth century, in which methodology was the main subject of philosophical considerations, was also the beginning of modern science.

The first clear distinction between scientific and metaphysical knowledge was made, under the influence of the successes of Newtonian physics, by Immanuel Kant. According to him, science investigates objects of experience, while metaphysics analyzes the ideas of God, the cosmos, and the soul. Kant argued that the justification for the scientific method comes from metaphysics. Science is possible thanks to the a priori forms of sensibility, which are space and time, and the categories of pure understanding, an example of which is causality (Kant, 1787/1965). Kant's philosophy combined two great epistemological traditions: empiricism and rationalism.

Positivism, founded by the French philosopher and mathematician Auguste Comte, rejected metaphysics as a science. This resulted in a radical turn towards empiricism. A hundred years later the *Vienna Circle* revived a new version of Comte's position called neo-positivism or logical empiricism. The neopositivists introduced a demarcation criterion according to which only those statements that are experimentally verifiable are scientific (meaningful). It soon turned out that scientific statements are not able to meet this criterion (Stadler, Nielsen, 2001). Therefore, it was replaced by Rudolf Carnap's criterion of gradual confirmability.

Karl Popper addressed the above mentioned problem with a modification. He considered the theory of scientific method to be crucial to all epistemology (Popper, 2005). Popper proposed that the criterion of demarcation, or the principle enabling the distinction of scientific from pseudoscientific statements, should be the falsifiability of the first ones (Mahner, 2013). These statements should describe what is possible in reality and thus should be susceptible to refutation. In science, certain statements are accepted not because they are largely confirmed or highly probable. All scientific statements are in fact accepted on probation. The appearance of a state of affairs prohibited by a scientific hypothesis refutes that hypothesis. The scientific method in this approach does not consist in confirming hypotheses. Scientific statements are only more or less probable. One should not strive to confirm them, but the scientist's efforts should be directed at attempts to falsify, i.e. to demonstrate the inconsistency of the hypothesis with the results of the experiment. In short, Popper claimed that a scientific theory cannot be 'verifiable' but only 'falsifiable' (Mitra, 2020). The method presented above is called the HD method. The concept of deduction also requires a brief presentation.

Deduction, unlike induction, is characterized by reliability in the sense that only true conclusions result from true premises. This is of course provided that the premises are not false and no logical errors are made in the reasoning. Deduction does not refer to empirical facts, but is based on logical facts. It is a process of reasoning, the essence of which is to draw conclusions from the general to the specific (Kac, Ulam, 1992; Martin et al., 2001). The sciences based on deduction are mathematics and logic. However, the deductive method is also used in empirical sciences (Stadler, 2004). The relationship between mathematics and logic is a complicated matter (Cellucci, 2013; Morsanyi, Szűcs, 2014). The a priori status of these scientific disciplines is also sometimes questioned. This is an important issue from a methodological point of view, since the laws of logic are applied in all other sciences (May,

2018). Another important issue is the role of logic in scientific discovery. There are different possible positions here and the debate is more philosophical than scientific.

An example of a deductive reasoning scheme is a deductive argument form and rule of inference called *modus ponendo ponens*. It has the following logical form:

1. If p, then q
2. p
3. Therefore, q

The *modus ponens* rule may be written in sequent notation as:

- I. $P \rightarrow Q, P \vdash Q$

An example of an argument that fits the rule *modus ponendo ponens*:

1. If today is Monday, Mary will be happy
2. Today is Monday
3. Therefore, Mary will be happy

The general principle of deductive reasoning is expressed by the deduction theorem. According to it: If we can derive B from a set of premises Γ including A, then we can derive the implication $A \rightarrow B$ from the original premises alone. In other words, we can derive that A implies B. Formally, it can be expressed as:

- II. $\Gamma, A \vdash B \rightarrow \Gamma \vdash A \rightarrow B$

The deductive theorem allows us to transform a deduction that involves a hypothesis into a deduction without this hypothesis. It facilitates the simplification of complex arguments. This theorem is used in logic but also in mathematics, computer science and philosophy.

HD method in the face of the difficulties of induction presented above rejects this method and the possibility of verifying hypotheses. It accepts two basic assumptions: (1) that all statements occurring in science, including individual ones and those based on observation, are hypothetical and revocable; (2) that the aim of scientific procedure is to eliminate false hypotheses through falsification. These are the two basic methodological canons of this method.

In the HD method, the following three stages can be distinguished:

1. The stage of collecting information about individual phenomena or processes, identifying facts that require explanation (anomalies) and formulating a research problem.
2. The stage of constructing a theory, in which the formulation of hypotheses is of key importance. It is carried out on the basis of eliminating false hypotheses. This is what falsification is all about.
3. The stage of deciding on the value of the theory. It consists in testing the hypotheses. The value of the theory is confirmed not, as in the inductive method, by full or partial confirmation of the hypotheses, but by their falsification.

It is worth noting that the formulation of hypotheses also takes place in the inductive method. The difference is that the basis for determining hypotheses in the inductive method is a set of facts that create a basis for inference to confirm the degree of their credibility.

In the HD method, on the other hand, the basis for formulating hypotheses is an attempt to explain the discovered anomalies (Lisiński, 2016). In other words, the hypotheses formulated on the basis of the HD method are bold, creative, and original ideas.

From the hypotheses, empirical consequences are then deductively derived. These are predicted facts that should occur according to the hypotheses. This process is a logical inference. The process of deductive reasoning can be presented by the following diagrams:



Figure 1. Deductive Reasoning Scheme.

Source: own elaboration.

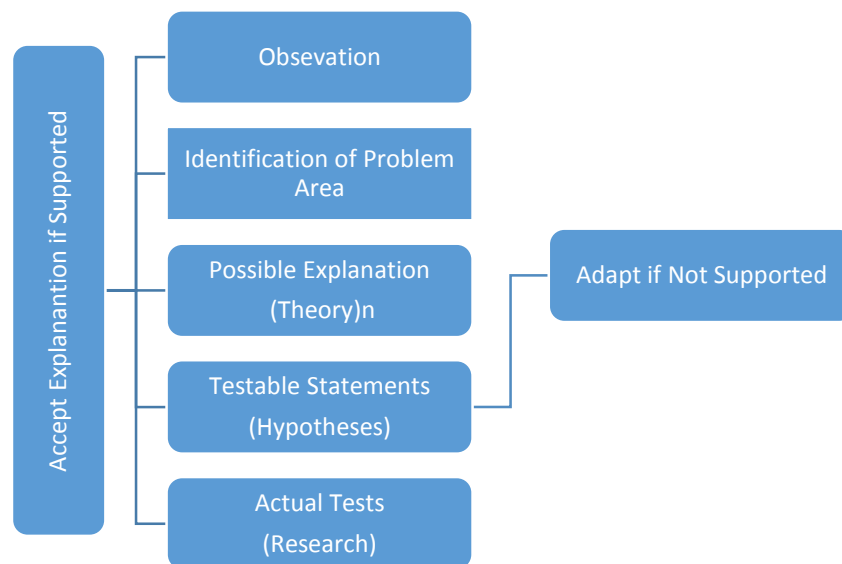


Figure 2. Model of the Hypothetico-Deductive Method.

Source: own elaboration.

Management science as we know it today did not suddenly appear fully formed. They emerged in a long process whose roots date back to antiquity. They belong to empirical sciences, or more precisely, economic ones (Dźwigoł, Dźwigoł-Barosz, 2018). It can be roughly assumed that the scientific approach to management appeared in the second half of the nineteenth century (Witzel, 2016). However, it should be remembered that scientific management is not the same as management science. From the point of view of the topic analyzed in this article, we are interested in the application of the HD method in these sciences. It should be stated that deductive method has been used in management sciences since its inception. Moreover, research on the history of economic methodology shows that the deductivist tradition is already present in classical and neoclassical economics (Klein, 1985).

If we accept the assumption that the methodology of management sciences should meet the criteria of rationality to the highest possible extent (Mantere, Ketokivi, 2013), then the use of the HD method seems to be indispensable. Due to space limitations, the importance of abductive reasoning is omitted in this study. However, it is worth being aware that it also plays an important role in management studies (Szydło, 2020). The concept of abduction comes from Charles Peirce's philosophy (Peirce, 1934). Broadly speaking, abductive reasoning involves formulating the most probable hypotheses to explain a given set of facts. Abduction is in fact the explanation of what is already known.

In the opinion of some scholars, one of the key problems of the relatively young management sciences are heterogeneous research methods. To increase the credibility of research, combining various research methods is proposed (Dźwigoł, 2022). The HD method is theory-based and allows for testing theories (Barkema et al., 2015; Walsh, 2015) which is particularly important in the development of management sciences. According to the HD method, hypotheses can contradict all existing theories and all literature on a given subject (Siponen, Kluavuniemi, 2020). This creates enormous opportunities for developing the theoretical framework of these sciences.

The HD method is used in quantitative management, which focuses on adapting mathematical models and processes to management situations (Pindur et al., 1995). Mathematical models support decision-making and problem-solving processes. In qualitative data analysis, a deductive approach is also used alongside inductive analysis, ensuring a greater degree of objectivity in the obtained results (Azungah, 2018; Kennedy, Thornberg, 2018). The deductive approach is also used in the commonly used content analysis (Pandey, 2019).

The general mechanism of applying the HD method in management sciences is aptly described by the following words: "Management is deductive: it states a goal and measures achievements, it is based on science. Science is inductive, using experiments and observations to draw conclusions and then deduces hypotheses for testing" (Davis, 1985, p. 588). The ability to reason deductively is obviously used at various stages of research. First and foremost, applying theory to practice requires a deductive approach (Lee, Lo, 2014).

Deductive reasoning in management sciences often involves using collected information and logical selection of a solution that appears most advantageous under the specific conditions of a given task (Konczak, Paslawski, 2013).

Research methods in management sciences are constantly modified and improved due to the fact that research conducted in these sciences concerns dynamic changes of a social, economic, scientific, technological and cultural nature (Rose et al., 2023). This, of course, forces scientists to use various research tools and techniques. There is a tendency to reject traditional thinking in favor of combinative thinking. This also applies to the methods used within these sciences (Dźwigoł, Dźwigoł, 2018). As already noted above, management sciences are empirical ones and therefore they use methods characteristic of these disciplines. The HD method is one of the most commonly used.

4. Results and Discussion

The term "methodology" comes from the Greek words "methodos" and "logos", which together mean "way" or "study". In the most general sense a method is always a method of a certain specific type of human activity. Each such activity, in turn, is a process. Each process is a certain whole, that is, a type of complex object. Each such complex object has its own structure that can be understood in a broader or narrower sense. In the broader sense, a structure is a system of relations between the components of a whole; in the narrower sense, it is a set of components of a whole and a system of relations between them (Kotarbiński, 1977). This is a general, even philosophical, approach to the concept of method.

The hypothetico-deductive (HD) method is a term for the scientific procedure of validating theories by formulating hypotheses (premises) and deriving and testing conclusions. J.S. Mill, a proponent of methodological empiricism, proposed that political economy should be studied first by postulating a series of general definitions and laws concerning the behavior of the objects studied, and then on their basis deriving conclusions concerning specific and observable facts. Interestingly, Mill also considered mathematics and logic to be empirical sciences.

HD method is based on two assumptions: (1) all statements made in science, including individual ones and those based on observation, are hypothetical and revocable; (2) the aim of scientific procedure is to eliminate false hypotheses through falsification. According to the above considerations, it can be stated that HD method consists of: (1) freely putting forward the most daring and risky theoretical hypotheses until they can be falsified, i.e. shown to be false; (2) deductively deriving observational conclusions; (3) carrying out the most rigorous attempts to refute them by pointing out inconsistencies between predictions and experimental results.

Some of the major problems associated with the HD method are the problem of alternative hypotheses and the Duhem-Quine problem, in light of which a number of alternatives to the HD method have been proposed, such as Carl G. Hempel's account of confirmation, probabilistic and Bayesian accounts of confirmation, and Milton Friedman's instrumentalism. One of the basic problems of the HD method, which we only mention, is the fact that scientific hypotheses, if they are to be useful in science, should be calibrated with the empirical world. However, the relationship between hypotheses and empirical data raises many difficulties (Sprenger, 2011; Casula et al., 2021). According to Hempel's (1967) interpretation of the HD method, which is widely accepted, the main purpose of the HD method is to determine whether the theory is (at least observationally) true or not.

The analysis of the current state of methodology in management sciences is of course a separate issue. One can find in the literature a view that this state is not satisfactory (Labarca, 2017; O'Leary, 2017; Quinton, Reynolds, 2018; Thomas, 2017). However, it seems that these

opinions are exaggerated. It should be remembered that management sciences are interdisciplinary in nature, which also influences the methodology used in them (Van Baalen, Karsten, 2012). This interdisciplinarity is the strength of these sciences and can bring new insights and support effective problem-driven research (Reinecke et al., 2024). However, this also brings new challenges, one of which is the clarification of the research tools and used techniques (Sieldok, Hibbert, 2014).

However, it should be borne in mind that the methods used in management sciences are not and cannot be of a universal nature (Dźwigoł, 2019). This is due to the dynamic nature of the environment analyzed by these sciences and the processes taking place in it. The HD method, sometimes called simply the scientific method, is often used in management sciences. Its use brings the methods of these sciences closer to a strict pattern of reasoning and allows for obtaining useful knowledge, which is particularly desirable.

Management research has a long and rich history of borrowing theoretical frameworks, methods and ideas from other disciplines. In terms of the influence of methodologies developed in other disciplines on the methods used in management sciences, one can point to fields such as machine learning (von Krogh et al., 2023), computational modeling, or qualitative comparative analysis (Bliesen et al., 2024). The methods used there can offer innovative ways of exploring new management problems or help to see existing problems in a new way. This also applies to the HD method. In its different versions.

The question of the role of deductive reasoning in knowledge creation arose already at the beginning of philosophy (Plato, 1962). It remains relevant even in the context of the considerations presented in this article. If management sciences are empirical disciplines, then the question arises: what is the contribution of deductive reasoning to the creation of knowledge acquired within these sciences? The concept of "learning by thinking" seems to be an interesting contribution to this issue (Lombrozo, 2024). Current progress in the field of artificial intelligence shows that such learning is possible not only in the case of human minds. It also opens up further possibilities for research into the nature and mechanisms of deductive reasoning. The use of the HD method in management sciences makes the obtained results more precise and these sciences themselves become methodologically similar to the exact sciences.

According to what has been found, there are not many studies devoted to the HD method in its historical development and significance for contemporary research conducted in management sciences. This article attempts to fill this gap. Its goal is to identify the origins of the HD method as a way to avoid the problems associated with the use of inductive reasoning, and to highlight its contribution and significance to achieving full methodological maturity in management sciences.

5. Summary

The history of the development of the scientific method began in ancient Greece. Greek philosophers are considered the founders of science precisely because they were the first who realized the need to study reality based on cognitive efforts rooted in rational reflection and experience. A brief outline of research on the methodology of science in the European tradition shows that science constitutes a certain whole and its development is largely determined by research methods that should be used in various types of cognition.

In the most general sense, it can be said that progress in scientific research is made through a dialectical dialogue between the formulation of hypotheses and their experimental testing. During the development of scientific knowledge, two basic research methods emerged: induction and deduction. The HD method has developed in a long process of evolution of research on methods of scientific cognition, particularly under the influence of difficulties related to induction.

The methodology of management sciences, as any scientific methodology in general, should meet the criteria of rationality to the greatest possible extent. Various types of research methods are used in management sciences. This is mainly due to the diversity of the issues addressed and the interdisciplinary nature of these sciences. Both quantitative and qualitative research methods are used. The problem of choosing a specific research method is dictated, on the one hand, by the aspect of creating new knowledge, and on the other, by the issue of its justification. The main research method, as in other empirical sciences, remains induction. Under the influence of Karl Popper's criticism of the inductive method, the HD method began to be used more and more frequently in economic sciences and then in management sciences.

HD method refers to empirical facts. The use of this method allows us to formulate statements that are only to a certain extent probable. They are hypothetical in nature, because they are only partially confirmed by the collected facts and events. The use of this method, which is particularly important in the case of management sciences, allows you to obtain useful knowledge.

It is worth paying attention to another rarely discussed theme: the HD method, due to the way in which hypotheses are formulated on its basis, most fully expresses the creative nature of scientific knowledge. Management sciences, on the other hand, analyze not only the objective facts and conditions accompanying management processes but also refer to actions undertaken by people who are free and autonomous moral entities.

References

1. Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data analysis. *Qualitative research journal*, 18(4), pp. 383-400.
2. Bacon, F. (1878). *Novum organum*. Clarendon press.
3. Barkema, H.G., Chen, X.P., George, G., Luo, Y., Tsui, A.S. (2015). West meets East: New concepts and theories. *Academy of Management Journal*, 58(2), pp. 460-479. <http://dx.doi.org/10.5465/amj.2015.4021>.
4. Barnes, J. (2002). *The presocratic philosophers*. Routledge.
5. Betz, F. (2011). Origin of Scientific Method. In: *Managing Science. Innovation, Technology, and Knowledge Management*. New York, NY: Springer, https://doi.org/10.1007/978-1-4419-7488-4_2
6. Bliese, P., Certo, T., Smith, A., Wang, M., Gruber, M. (2024). Strengthening theory–methods–data links. *Academy of Management Journal*, 67, pp. 893-902.
7. Brüssow, H. (2022). On the role of hypotheses in science. *Microbial Biotechnology*, 15(11), pp. 2687-2698. <https://doi.org/10.1111/1751-7915.14141>
8. Bryman, A. (2008). Of methods and methodology. Qualitative research in organizations and management. *An International Journal*, 3(2), pp. 159-168.
9. Casula, M., Rangarajan, N., Shields, P. (2021). The potential of working hypotheses for deductive exploratory research. *Quality & Quantity*, 55(5), pp. 1703-1725. <https://doi.org/10.1007/s11135-020-01072-9>.
10. Cellucci, C. (2013). *Rethinking logic: Logic in relation to mathematics, evolution, and method, Vol. 1*. Dordrecht: Springer, pp. 75-94. DOI 10.1007/978-94-007-6091-2
11. Charitos, I.A., Topi, S., Santacroce, L., Bottalico, L. (2022). From myth to philosophy, the cradle of evolving medical thought and ethics in the classical antiquity. *Ethics, Medicine and Public Health*, 22, 100764. <https://doi.org/10.1016/j.jemep.2022.100764>
12. Copi, I.M., Cohen, C., McMahon, K. (2016). *Introduction to logic*. Routledge.
13. Davis, D.E. (1985). Management is deductive. *Wildlife Society Bulletin (1973-2006)*, 13(4), pp. 588-591.
14. Descartes, R. (1637, 1998). *Discourse on Method*. Indianapolis: Hackett.
15. Dźwigoł, H. (2019). Research methods and techniques in new management trends: research results. *Virtual Economics*, 2(1), pp. 31-48.
16. Dzwigol, H. (2022). Research methodology in management science: Triangulation. *Virtual Economics*, 5(1), pp. 78-93. [https://doi.org/10.34021/ve.2022.05.01\(5\)](https://doi.org/10.34021/ve.2022.05.01(5))
17. Dźwigoł, H., Dźwigoł-Barosz, M. (2018). Scientific research methodology in management sciences. *Financial and credit activity problems of theory and practice*, 2(25), pp. 424-437.
18. Finocchiaro, M.A. (2012). *Galileo and the art of reasoning: Rhetorical foundation of logic and scientific method, Vol. 61*. Springer Science & Business Media.

19. Forno, D.D. (2011). *Argument from hypothesis in ancient philosophy*. A. Longo (Ed.). Naples: Bibliopolis.
20. Frigg, R., Hartmann, S. (2025). Models in Science. *The Stanford Encyclopedia of Philosophy* (Summer 2025 Edition). E.N. Zalta, U. Nodelman (eds.), <https://plato.stanford.edu/archives/sum2025/entries/models-science/>.
21. Gooding, D.C. (2017). *Experiment. A Companion to the Philosophy of Science*, pp. 117-126. <https://doi.org/10.1002/9781405164481.ch18>
22. Gower, B. (2012). *Scientific method: A historical and philosophical introduction*. Routledge.
23. Hadi, N.F., Afandi, N.K. (2021). Literature review is a part of research. *Sulawesi Tenggara Educational Journal*, 1(3), pp. 64-71.
24. Hähnel, M. (2020). *Aristotelian naturalism*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-37576-8>
25. Harrington, H.J., Voehl, F. (Eds.) (2016). *The Innovation Tools Handbook, Volume 1: Organizational and Operational Tools, Methods, and Techniques that Every Innovator Must Know*. Boca Raton, FL, USA: CRC Press.
26. Hawthorne, J. (1993). Bayesian induction is eliminative induction. *Philosophical Topics*, 21(1), pp. 99-138.
27. Heath, T.L. (Ed.) (1956). *The thirteen books of Euclid's Elements*. Courier Corporation.
28. Hempel, C.G. (1967). Philosophy of natural science. *British Journal for the Philosophy of Science*, 18(1).
29. Hintikka, J. (1968). Induction by enumeration and induction by elimination. In: *Studies in Logic and the Foundations of Mathematics* (pp. 191-231). Elsevier, [https://doi.org/10.1016/S0049-237X\(08\)71045-0](https://doi.org/10.1016/S0049-237X(08)71045-0)
30. Howson, C. (2000). *Hume's problem: Induction and the justification of belief*. Clarendon Press.
31. Hume, D. (2000). *A treatise of human nature*. Oxford University Press.
32. Johansen, K.F. (2005). *A history of ancient philosophy: from the beginning to Augustine*. Routledge.
33. Kac, M., Ulam, S.M. (1992). *Mathematics and logic*. Courier Corporation.
34. Kant, E. (1787, 1965). *The Critique of Pure Reason*. New York: St. Martin's Press.
35. Karunarathna, I., Gunasena, P., Hapuarachchi, T., Gunathilake, S. (2024). *The role of scientific hypotheses in shaping modern research and innovation. Uva clinical research / research methodology / scientific hypotheses*, 1-7. <http://dx.doi.org/10.13140/RG.2.2.35252.87680>
36. Kennedy, B.L., Thornberg, R. (2018). *Deduction, induction, and abduction*. The SAGE handbook of qualitative data collection, pp. 49-64.
37. Klein, D.B. (1985). Deductive economic methodology in the French Enlightenment: Condillac and Destutt de Tracy. *History of Political Economy*, 17(1), pp. 51-71.

38. Kneale, W.C., Kneale, M. (1962). *The development of logic*. Oxford University Press.
39. Knopf, J.W. (2006). Doing a literature review. *PS: Political Science & Politics*, 39(1), pp. 127-132.
40. Konczak, A., Paslawski, J. (2013). Abductive and deductive approach in learning from examples method for technological decisions making. *Procedia Engineering*, 57, pp. 583-588.
41. Kotarbiński, T. (1977). *Concepts and Problems in General Methodology and Methodology of the Practical Sciences*. In *Twenty-Five Years of Logical Methodology in Poland*. Dordrecht: Springer Netherlands, pp. 279-289.
42. Labarca, C. (2017). *Qualitative Research for beginners*. Maracaibo, Venezuela: University of Zulia.
43. Lee, V., Lo, A. (2014). From theory to practice: Teaching management using films through deductive and inductive processes. *The International Journal of Management Education*, 12(1), pp. 44-54.
44. Lisiński, M. (2016). Metody naukowe w metodologii nauk o zarządzaniu. *Przegląd Organizacji*, 4, pp. 11-19.
45. Lombrozo, T. (2024). Learning by thinking in natural and artificial minds. *Trends in Cognitive Sciences*, Vol. 28, Iss. 11, pp. 1011-1022. <https://doi.org/10.1016/j.tics.2024.07.007>
46. Mahner, M. (2013) Science and pseudoscience: how to demarcate after the (alleged) demise of the demarcation problem. In: M. Pigliucci, M. Boudry (Eds.), *Philosophy of pseudoscience: reconsidering the demarcation problem* (pp. 29-43). Chicago, IL: University of Chicago Press.
47. Mahoney, J. (2021). *The logic of social science*. Princeton University Press.
48. Mantere, S., Ketokivi, M. (2013). Reasoning in organization science. *Academy of management review*, 38(1), pp. 70-89.
49. Martin, E., Sharma, A., Stephan, F. (2001, November). *A general theory of deduction, induction, and learning*. International Conference on Discovery Science. Berlin/Heidelberg: Springer, pp. 228-242.
50. May, R. (2018). Logic as Science. In: A. Coliva, P. Leonardi, S. Moruzzi (eds.), *Eva Picardi on Language, Analysis and History*. Cham: Palgrave Macmillan. https://doi.org/10.1007/978-3-319-95777-7_6.
51. McMullin, E. (2009). Hypothesis in early modern science. In: M. Heidelberger, G. Schieman (eds.), *The significance of the hypothetical in the natural sciences* (pp. 7-38). De Gruyter.
52. Midgley, G., Nicholson, J.D., Brennan, R. (2017). Dealing with challenges to methodological pluralism: The paradigm problem, psychological resistance and cultural barriers. *Industrial Marketing Management*, 62, pp. 150-159. <https://doi.org/10.1016/j.indmarman.2016.08.008>

53. Mitra, S. (2020). An analysis of the falsification criterion of Karl Popper: A critical review. *Tattva Journal of Philosophy*, 12(1), 1-18. <https://doi.org/10.12726/tjp.23.1>
54. Moreira, C.H.V., Azevedo, L., Ferreira, A.M., Oliveira, A.C.G., de Souza, A.B., Haikal, D.S.A., ... Sabino, E.C. (2025). Bridging the gap in Chagas disease management: a mixed-methods study using an implementation science approach within the Brazilian primary health care system—‘Implementa-Chagas/SaMi-Trop project’. *The Lancet Regional Health–Americas*, 47. <https://doi.org/10.1016/j.ordal.2025.200472>
55. Morsanyi, K., Szűcs, D. (2014). The link between mathematics and logical reasoning: Implications for research and education. In: *The Routledge international handbook of dyscalculia and mathematical learning difficulties* (pp. 101-114). Routledge.
56. Nersessian, N.J. (2010). *Creating scientific concepts*. MIT Press.
57. Ngalande, S. (2011). A logical analysis of selected texts in Nyanja. *African Study Monographs*, 32(3), pp. 91-109.
58. Ngulube, P., Mathipa, E.R., Gumbo, M.T. (2015). Theoretical and conceptual frameworks in the social and management sciences. In: E.R. Mathipa, M.T. Gumbo (eds.), *Addressing Research Challenges: Making Headway for Developing Researchers* (pp. 43-66). Noordwyk, South Africa: Mosala-MASEDI.
59. O’Leary, Z. (2017). *The Essential Guide to Doing Your Research Project*. London: Sage.
60. Pandey, J. (2019). Deductive approach to content analysis. In: *Qualitative techniques for workplace data analysis* (pp. 145-169). IGI Global.
61. Peirce, C.S. (1934). *Collected papers of charles sanders peirce, Vol. 5*. Harvard University Press.
62. Peregrin, J., Svoboda, V. (2017). *Reflective equilibrium and the principles of logical analysis: Understanding the laws of logic*. Taylor & Francis.
63. Pindur, W., Rogers, S.E., Suk Kim, P. (1995). The history of management: a global perspective. *Journal of Management History*, 1(1), 59-77.
64. Plato, H.G. (1962). *The collected dialogues of Plato*. Princeton University Press.
65. Popper, K. (2005). *The logic of scientific discovery*. Routledge.
66. Pullman, B. (2001). *The atom in the history of human thought*. USA: Oxford University Press.
67. Quine, W.V.O. (1986). *Philosophy of logic*. Harvard University Press.
68. Quinton, S., Reynolds, N. (2018). *Understanding Research in the Digital Age*. London: Sage.
69. Rajasekar, D., Verma, R. (2013). *Research methodology*. Archers & Elevators Publishing House.
70. Reinecke, J., Little, L. M., Simons, T., Bliese, P., Dencker, J., Roberson, Q., ... Gruber, M. (2024). Advancing management theory through interdisciplinary research: Challenges and opportunities. *Academy of Management Journal*, 67(6), pp. 1421-1427. <https://doi.org/10.5465/amj.2024.4006>

71. Rose, S., Spinks, N., Canhoto, A.I. (2023). *Management research: applying the principles of business research methods*. Routledge.
72. Sielidok, F., Hibbert, P. (2014). The organization of interdisciplinary work: Modes, drivers, and barriers. *International Journal of Management Reviews*, 16, pp. 194-210.
73. Siponen, M., Klaavuniemi, T. (2020). Why is the hypothetico-deductive (HD) method in information systems not an HD method? *Information and Organization*, 30(1), 100287. <https://doi.org/10.1016/j.infoandorg.2020.100287>
74. Sloman, S.A., Lagnado, D. (2005). *The problem of induction*. The Cambridge handbook of thinking and reasoning, pp. 95-116.
75. Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, pp. 333-339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
76. Sprenger, J. (2011). Hypothetico-deductive confirmation. *Philosophy Compass*, 6(7), pp. 497-508. <https://doi.org/10.1111/j.1747-9991.2011.00409.x>
77. Stadler, F. (Ed.) (2004). *Induction and Deduction in the Sciences, Vol. 11*. Springer Science & Business Media, pp. 1-15.
78. Stadler, F., Nielsen, C.R. (2001). *The Vienna circle: Studies in the origins, development, and influence of logical empiricism*. Vienna: Springer, pp. 279-299.
79. Streicher, P., Broadbent, A., Hellewell, J. (2025). The need for methodological pluralism in epidemiological modelling. *Global Epidemiology*, 9, 100177. <https://doi.org/10.1016/j.gloepi.2024.100177>
80. Szydło, J. (2020). Scientific reasoning in management. The role of abduction in research process design. In: A. Michałkiewicz, W. Mierzejewska (eds.), *Contemporary organisation and management. Challenges and trends*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
81. Teplow, D.B. (2023). *The Philosophy and Practice of Science*. Cambridge University Press.
82. Thomas, G. (2017). *How to Do Your Research Project: A Guide for Students*. London: Sage.
83. Van Baalen, P., Karsten, L. (2012). The evolution of management as an interdisciplinary field. *Journal of Management History*, 18(2), pp. 219-237.
84. Vignais, P.V., Vignais, P.M. (2010). *The Roots of Experimental Science from Ancient Greece to the Renaissance*. In: *Discovering Life, Manufacturing Life*. Dordrecht: Springer. https://doi.org/10.1007/978-90-481-3767-1_2
85. Von Krogh, G., Roberson, Q., Gruber, M. (2023). Recognizing and utilizing novel research opportunities with artificial intelligence. *Academy of Management Journal*, 66, pp. 367-373.
86. Walsh, I. (2015). Using quantitative data in mixed-design grounded theory studies: An enhanced path to formal grounded theory in information systems. *European Journal of Information Systems*, 24(5), pp. 531-557. <https://doi.org/10.1057/ejis.2014.23>
87. Witzel, M. (2016). *A history of management thought*. Routledge. <https://doi.org/10.4324/9781315692517>

STRATEGIC INJUSTICE IN GOALS SETTING AFTER USE OF AI

Mikolaj PINDELSKI

Warsaw School of Economics; mikolaj.pindelski@sgh.waw.pl, ORCID: 0000-0001-7410-8645

Purpose: To indicate the effects of setting strategic sales targets and the effects of their development over time using simulations in the NetLogo system and to show how the effects of sales target decision-making using artificial intelligence may evolve, and to indicate the extent to which discriminating some targets against others may affect their formation in subsequent forecast periods.

Design/methodology/approach: The goal will be achieved on the basis of the results obtained from simulations using NetLogo in the “cake sharing” model. This model, after taking into account the necessary modifications to be made to it, seems reasonable. This is due to the assumption that it is not possible to continuously maximise all objectives simultaneously. The simulation involves the preparation of a model in the NetLogo environment and the development of appropriate analytical support in Python to investigate how the choice of different sales targets shapes business performance. The simulation assumes 500 iterations, during which four possible operating strategies will be explored: maximising sales volume, maximising the value of ROI (Return on Investment), minimising the volume of sales costs and maximising the value of social objectives (ESG). Four objectives will be set in the system. The first relates to improving a selected performance indicator in this case return on investment (ROI), the second to increasing the volume of revenue, the third to reducing sales costs and the fourth related to ensuring sales sustainability. Once the simplified input conditions for each of the objectives had been established, financial and nonfinancial reports of 2023 of a Warsaw Stock Exchange listed company was entered into the ChatGPT and the user asked to indicate the preferred objective in this situation. This was followed by a programme in Python entered into the NetLogo application allowing accelerated simulation of the development of measures over time. The use of ChatGPT with Netlogo has already been indicated in the literature as having good results (Martinez et al. 2024).

Findings: As a result, it was found that when using AI as a source for recommending strategic goals in the area of sales, there could be discrimination against the other goals. An intervention after one hundred iterations does not significantly change this situation, as AI does not suggest significant changes. Moreover, it may prove to be significantly late in this period. Particularly as the degradation of the value of the other targets appears significant. Hypothesis H1 is therefore confirmed. Regression analysis indicates that, although the other values are also increasing, they are increasing at a much lower rate than those associated with the overarching goal. Hypothesis H2 was similarly positively verified. The use of artificial intelligence, in this case the ChatGPT, can lead to decisions that discriminate between certain targets in the sales area. This was particularly evident, for example, with regard to the objective of increasing ROI

and, at the same time, the very low increases associated with the indicator related to social objectives.

Research limitations/implications: Limitations are related to the simplified model used that was based on four goals. It is also to be considered that 500 iterations were made in the stable environment what does not describe a real life company's surroundings.

Practical implications: It can therefore be concluded that, in the simulation environment used, a decision preferring one objective will have the effect of significantly detracting from the value of the other sales objectives over time, and that the use of generative artificial intelligence in the form of OpenAI ChatGPT can lead to decisions that discriminate against some objectives in the sales function area. Managers should be aware of it and to make decision should be familiar with algorithms and models that are used in decision making.

Social implications: It is to be aware that use of AI in strategic goal settings usually discriminate social values as the sales function is usually focused on sales results, ROI and cost more than social goals.

Originality/value: The use of simulation and AI in setting strategic goals in sales department and checking for strategic injustice in goals setting with use of AI.

Keywords: Goals discrimination, Artificial Intelligence, OpenAI.

Category of the paper: Research, Conceptual.

1. Introduction

The application of artificial intelligence in the areas of operation of both individual companies and the economy as a whole is making its mark very clearly. This is indicated by a number of studies raising the replacement of human labour by automated and algorithm- and AI-driven systems (Furman, 2016; Frey, Osborne, 2013, 2017), or the widespread use and impact of AI in the economy (Agrawal et al., 2019). The application of AI is also making its mark in the area of an organisation's sales function in the context of sales processes supported by artificial intelligence and advanced algorithms (Fisher et al., 2022), the creation of sales value (Paschen et al., 2021) or the use of a range of tools to support sales and customer communication (Hildebrand, Bergner, 2019). Artificial intelligence is also being used to forecast sales performance and support sales performance in this regard (Mehendale et al., 2019), or to predict demand (Bandara et al., 2019). This, while favouring revenue growth objectives (Trivedi, Patel, 2020), directs attention to the other objectives that the sales function could, and perhaps should, set and achieve. The research problem that arises, therefore, concerns the preference of the goal indicated by artificial intelligence among the possible choices.

The purpose of the study is to indicate the effects of setting sales targets and the effects of their development over time using simulations in the NetLogo system (Tisue, Wilensky, 2004).

Four objectives will be set in the system. The first relates to improving a selected performance indicator in this case return on investment (ROI), the second to increasing the volume of revenue, the third to reducing sales costs and the fourth related to ensuring sales

sustainability. Once the simplified input conditions for each of the objectives had been established, data was entered into the ChatGPT and the user asked to indicate the preferred objective in this situation. This was followed by a programme in Python entered into the NetLogo application allowing accelerated simulation of the development of measures over time. The use of ChatGPT with Netlogo has already been indicated in the literature as having good results (Martinez et al., 2024). Once the results were obtained, they were indicated again to ChatGPT with a request to verify them in the next round. The result obtained was again subjected to simulation using NetLogo.

2. Context and purpose of the research

Organisations are increasingly using artificial intelligence systems, algorithms or analytical tools in task performance, forecasting and decision-making. Whether assessing creditworthiness, selecting colleagues or determining directions. The algorithms used for this purpose, however, are not without bias and are also often not objective when making assessments. An “algorithmic injustice” is indicated, where even a system that is assumed to be objective may, after taking into account certain variables, have a significant tendency to discriminate against, for example, particular groups of people, issues or areas. Although such action may not be intended by the algorithm developers, it can happen under the influence of the data, especially those used when training the model. Model bias can therefore affect decisions made in various areas of an organisation's operations, including the management of the sales function. This is not only true for decision-making issues related to selling methods or determining target customer groups, but also for strategic issues such as shaping the sales target. This is especially true if the algorithm will dictate that it should aim to maximise the value of the target. This is also a concern of algorithmic fairness theory (AFT) where designing, evaluating, and regulating algorithms also AI should lead to equal treatment of groups or social sensitive issues (Zhou et al., 2021; Morse et al., 2021; Juin, 2023). Being aware that discrimination and bias may arise from data or model structure. AFT balancing accuracy and social values deals with trained models that may amplify inequalities while progressing. This paper also should lead to build more responsible AI systems.

The aim of the study is therefore to show how the effects of sales target decision-making using artificial intelligence may evolve, and to indicate the extent to which discriminating some targets against others may affect their formation in subsequent forecast periods.

Two research hypotheses were also posed:

H1: Preferring one target to another will have the effect of significantly detracting from other sales targets over time.

H2: The use of generative artificial intelligence in the form of OpenAI ChatGPT may lead to decisions that discriminate between some targets in the sales function area.

The verification of the hypotheses will be done on the basis of the results obtained from simulations using NetLogo in the “cake-sharing” model. This model, after taking into account the necessary modifications to be made to it, seems reasonable. This is due to the assumption that it is not possible to continuously maximise all objectives simultaneously. The Pareto equilibrium, for example, may apply here. Once this is achieved, it is not possible to increase the level of one objective without worsening the situation of the others. Maximising revenue growth may limit the maximisation of achievement levels of social, or even efficiency or cost-of-sales goals. So, if we perhaps simplistically assume that the total to be shared between the objectives is 100%, the research question is whether the algorithm will pursue a Pareto balance and seek to optimise the levels of the objectives in the long term, or whether it will prefer to maximise the one set to it by the AI.

3. Model of simulation

The simulation involves the preparation of a model in the NetLogo environment and the development of appropriate analytical support in Python to investigate how the choice of different sales targets shapes business performance. The simulation assumes 500 iterations, during which four possible operating strategies will be explored: maximising sales volume, maximising the value of ROI (Return on Investment), minimising the volume of sales costs and maximising the value of social objectives.

An agent simulation model will be created within NetLogo to reflect the dynamics of the sales process with changing market conditions, competition and available resources. Each agent representing a salesperson or sales department will make decisions based on the currently selected strategic objective. Python programming will be used both to prepare the input data (including processing of annual reports and non-financial data of the company) and to analyse the results of the simulation - including the construction of evaluation functions that will measure how well the set objectives are being met.

A key role in this process will be played by ChatGPT, which will automatically recommend a sales target for a given simulation cycle based on the analysis of financial and non-financial reports. The decision to select a target will be based on an analysis of prevailing trends, such as the priority of increasing revenue, improving financial efficiency (ROI), reducing sales costs or increasing social impact (ESG). In the context of the social objective, general indicators have

been selected to be introduced into the model, but which can influence the achievement of the others. These include donating a portion of turnover to social causes, removing provisions from contracts that are disadvantageous to customers but profitable for the organisation, and the organisation of free training by the company's sales staff for local communities. These objectives may limit the possibility of achieving the sought-after higher or lower values of the other objectives, respectively.

During the 500 iterations of the simulation, it will be observed how the preference for one objective affects other areas. For example, choosing to maximise sales may lead to higher costs and lower ROI, while an emphasis on maximising social value may reduce immediate sales volume but improve long-term customer loyalty rates. Python will be used to build result sets, visualise trends and benchmark analyses between alternative strategies, allowing the discrimination of other objectives to be accurately indicated when one objective is dominant.

The final result of the simulation will therefore be a full characterisation of the interrelationship between objectives in the sales process, enabling the most sustainable sales strategies to be recommended based on the specific market and organisational conditions of the company in question.

The cake-sharing model reflects a situation in which agents compete for predetermined and limited resources or outcomes. Decisions about their allocation consequently affect the targets achieved. In the simulation adopted in the study, the strategic objectives related to the sales function relate to an increase in sales volume, a reduction in sales costs, an increase in ROI and an increase in the social objectives index. These can be treated as a limited resource, or fragments of a whole (cake) to be shared with a resource constraint, and influenced by the chosen strategy of action. Certain assumptions are made here as to the validity of the choice of model.

The constraint associated with increasing sales volumes and reducing sales costs. It can be assumed that an increase in sales volume requires additional costs or investments. Similarly, an increase in sales volume may have a limiting effect on the increase in ROI. Also, social objectives can affect cost increases, ROI decreases and sales volume decreases. Although these objectives are not obviously disconnected, it can be assumed that the achievement of these objectives limits the achievement of the others. It was therefore assumed that in a cake-sharing model, agents would make decisions that account for what part of the cake (costs, sales, ROI, social benefits) would be achieved. This model seems to present well the conflict of interest between objectives and indicates the actual situations in which managers, executives and other sales staff seek a balance between sometimes conflicting demands such as increasing revenue and at the same time spending time on social responsibility tasks. The model thus presents a situation in which objectives compete with each other in a situation of choosing a strategic goal and direction under conditions of limited resources and conflicting interests between objectives.

4. Process of simulation of the strategic goal in the sales function

The simulation uses the Python language and the NetLogo application. It commences with starting the system and defining the environment in which it will operate (Figure 1). The next stage is the AI system's enlistment, or partial input of source data. This data includes the company's annual financial and non-financial activity report for 2023, available on the company's official website. In a further progression, ChatGPT analyses the reports in terms of market sales trends for the indicated industry. It does this according to its own algorithm after asking the prompt 'Base the selection of a target from the indicated ones on the data from the reports and the market analysis and forecasts for the industry in which the company operates'. The target is set as a percentage by ChatGPT and adopted for the simulation.

Once the objective has been set, the simulation is parameterised in the NetLogo environment in Python according to the AI's chosen objective. In the next step, it is tested in a single iteration of the simulation in which agents representing activities in the area of the sales function take actions according to the predetermined priority. In the next phase, there are 500 iterations during which key values are indicated for the adopted targets. These relate to sales volumes, sales costs, ROI values and the level of achievement of social objectives. As the desired direction for the sales costs value is downwards, while for the other measures it is upwards, it is assumed that these will be the percentages for the targets set. Everyone can therefore achieve at most 100% in one step as the value corresponding to the full realisation of the goal. This is also in line with the "divide the cake" model adopted. This is repeated a total of 500 times while the parameters remain unchanged. This is intended to enable the collection of a sufficiently large set of outcome data to be analysed and, consequently, to verify the hypotheses. The way in which the achievement of one dominant objective shapes the achievement of the other objectives will be assessed. This will make it possible to assess the discrimination of other objectives when the system is subordinated to the achievement of the overriding objective. The results are presented visually in the form of graphs.

The simulation model is shown in the diagram (Figure 1). It includes four stages, from initiation, through ChatGPT, entering codes into NetLogo and analysing the simulation results.

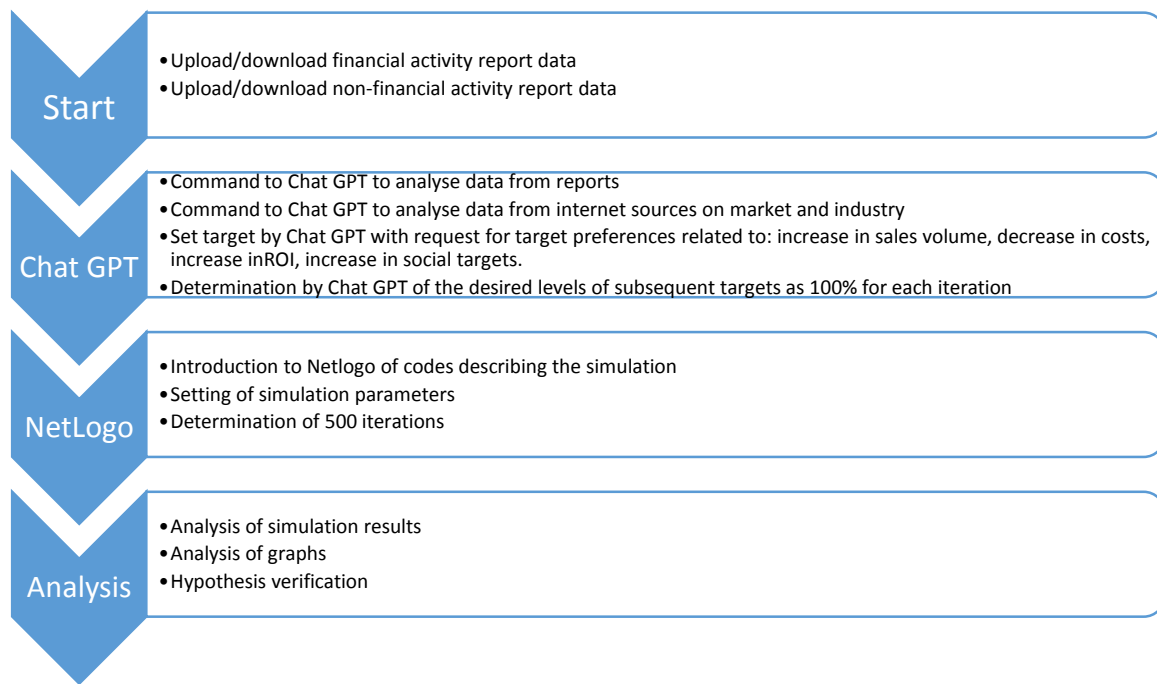


Figure 1. Diagram of the simulation model.

Source: author's own work.

5. Simulation

The simulations performed resulted in four situations. In each of them, the system's preference for individual targets is marked. In each situation, for individual target indications, the discrimination of the other targets is marked, but to varying degrees. Even stopping the simulation after 100 iterations and communicating the results obtained in it to ChatGPT does not change this situation. AI does not suggest significant changes here if the input conditions are still to be maintained.

The simulation for the sales growth target (Figure 2) clearly favours the objective set. This target is also followed by the ROI efficiency target and, to a lesser extent, the sales cost reduction target. However, the target related to social issues seems to be the most affected in this area. The intervention after 100 iterations in the ChatGPT does not change this situation and, under the same assumptions, suggests a continuation of the achievement of the previously set objective with a slight modification. However, regression analysis indicates that the development of the results of the other objectives in this simulation is strongly related to the development of the sales objective (Table 1).

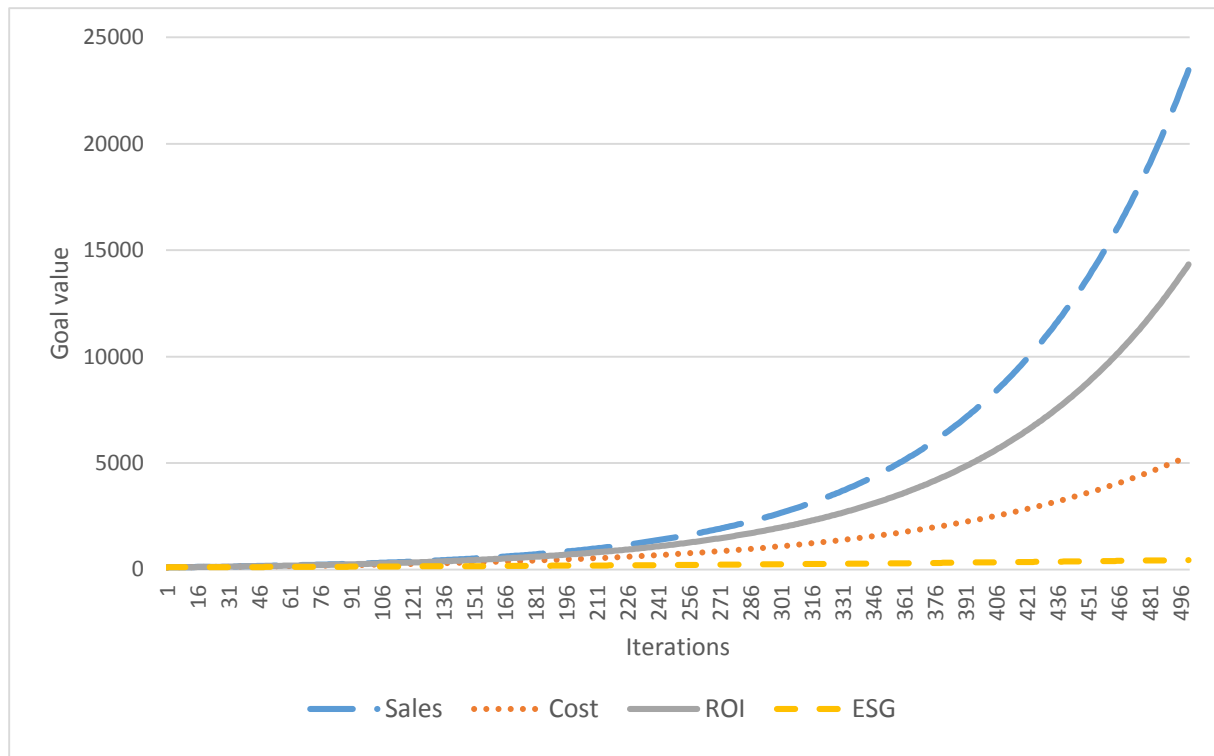


Figure 2. Simulation for the sales growth target.

Source: author's own work.

Table 1.

Linear regression for the independent variable sales growth

Variable	b0	b1 (sales)	SE (b1)	t	p	-/+95% confidence interval	Beta (standar.)	R ²
Cost	299.6	0.237	0.00138	171.7	<0.001	0.2343-0.2397	0.992	0.98
ROI	202.07	0.6218	0.00113	550.9	<0.001	0.6196-0.6241	0.999	0.998
ESG	163.06	0.0159	0.0003	53.39	<0.001	0.0153-0.0165	0.923	0.85

Source: author's own work.

A positive b1 value and relatively high t values indicate statistically significant results. The high R² indicates a significant explanation of the variation in the individual variables by the sales variable.

Similarly, the goal of reducing sales costs is achieved above all (Figure 3). Here, the other objectives are also achieved to a much lesser extent, but sustainability-related (ESG) objectives are particularly discriminated against.

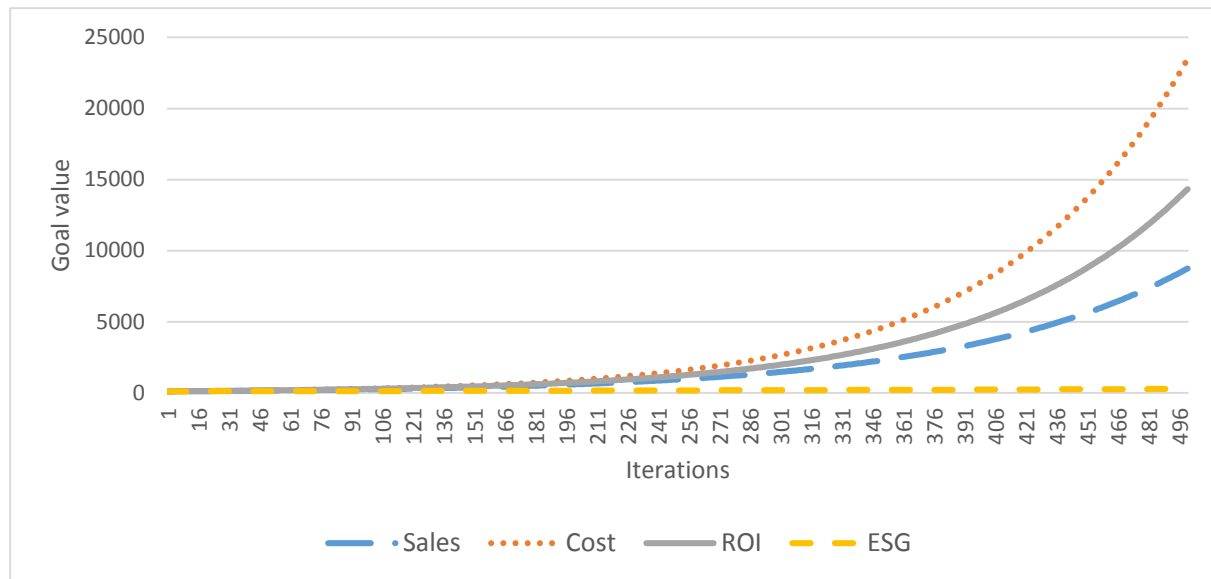


Figure 3. Simulation for the sales cost reduction objective.

Source: author's own work.

In the simple regression analysis for the simulation results (Table 2), positive b1 values and high t values indicate a significant statistical value of the results. In contrast, R2 indicates a significant explanation of the variation in results for ROI and sales cost results and an almost 20% gap in the explanation of the ESG objectives variable, indicating that it is explained by other variables.

Table 2.

Linear regression for the independent variable sales cost reduction

Variable	b0	b1 (cost)	SE (b1)	t	p	-/+95% confidence interval	Beta (standar.)	R ²
Sales	282.94	0.385	0.00144	266.5	<0.001	0.3822 – 0.3879	0.997	0.993
ROI	202.07	0.6218	0.00113	550.9	<0.001	0.6196 – 0.6241	0.999	0.998
ESG	138.31	0.0077	0.00017	45.6	<0.001	0.0074 – 0.0081	0.898	0.806

Source: author's own work.

In a situation in which priority is given to the objective related to increasing the value of ROI (Figure 4), the objective related to increasing the value of sales is achieved to a lesser extent, but the results for the objective related to reducing costs are particularly low, and to an even lesser extent for objectives related to the area of sustainability (ESG).

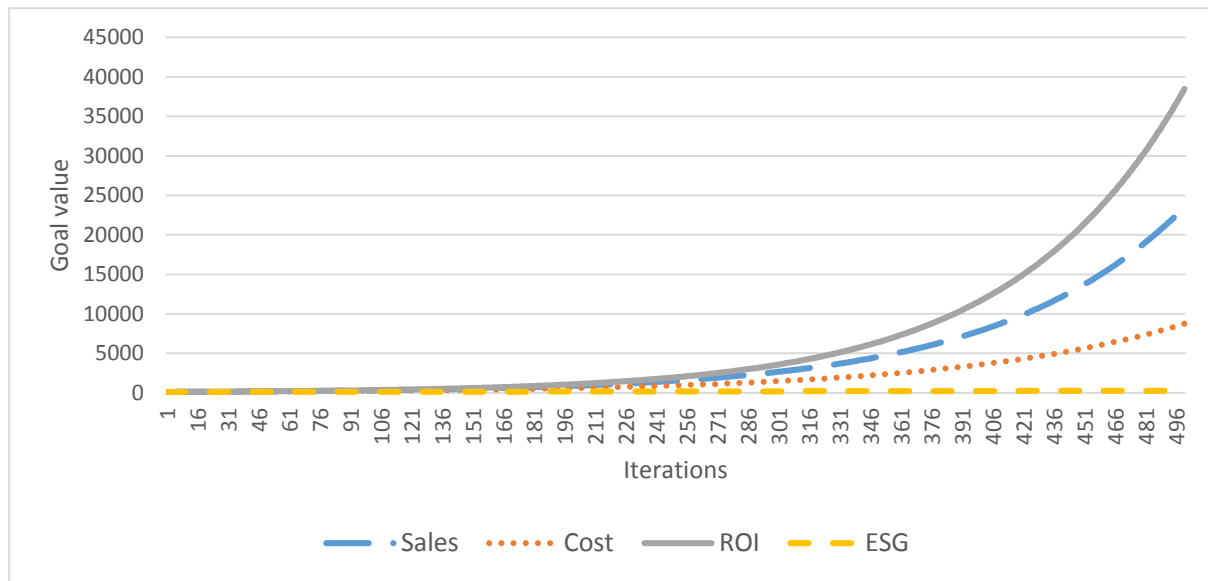


Figure 4. Simulation for the objective of raising ROI.

Source: author's own work.

For the grouping variable ROI (Table 3), b_1 is positive and t is high, but in the case of ESG relatively low in relation to the other two objectives. R^2 indicates that ROI explains costs and sales well and positively, but about 28% of ESG cases are not explained by ROI. In contrast, the narrow ranges indicate good estimation.

Table 3.

Linear regression for the independent variable increase of ROI

Variable	b0	b1 (ROI)	SE (b1)	t	p	-/+95% confidence interval	Beta (standar.)	R ²
Sales	268.742	0.6228	0.00106	586.33	< 0.001	0.6207 – 0.6249	0.9993	0.9986
Cost	391.331	0.2391	0.00131	182.86	< 0.001	0.2365 – 0.2416	0.9926	0.9853
ESG	140.925	0.0047	0.000113	41.82	< 0.001	0.0045 – 0.0050	0.8822	0.7783

Source: author's own work.

For the prioritisation of the social responsibility objective (Figure 5), all the other objectives are discriminated and their values in the subsequent iterations are very low compared to the priority objective. Here, as in the other cases analysed, the intervention in the ChatGPT regarding the indication after 100 iterations of the discrimination of the other three objectives does not significantly change the recommendation in this respect. However, if one wanted to look at the situation a little more positively, in the regression analysis, taking the achievement of ESG as the independent variable and the other goals as the dependent variables, it is indeed the case that a higher level of ESG is associated with a slightly higher increase in revenue than in costs. However, these are disproportionately low compared to the overarching objective (Table 4).

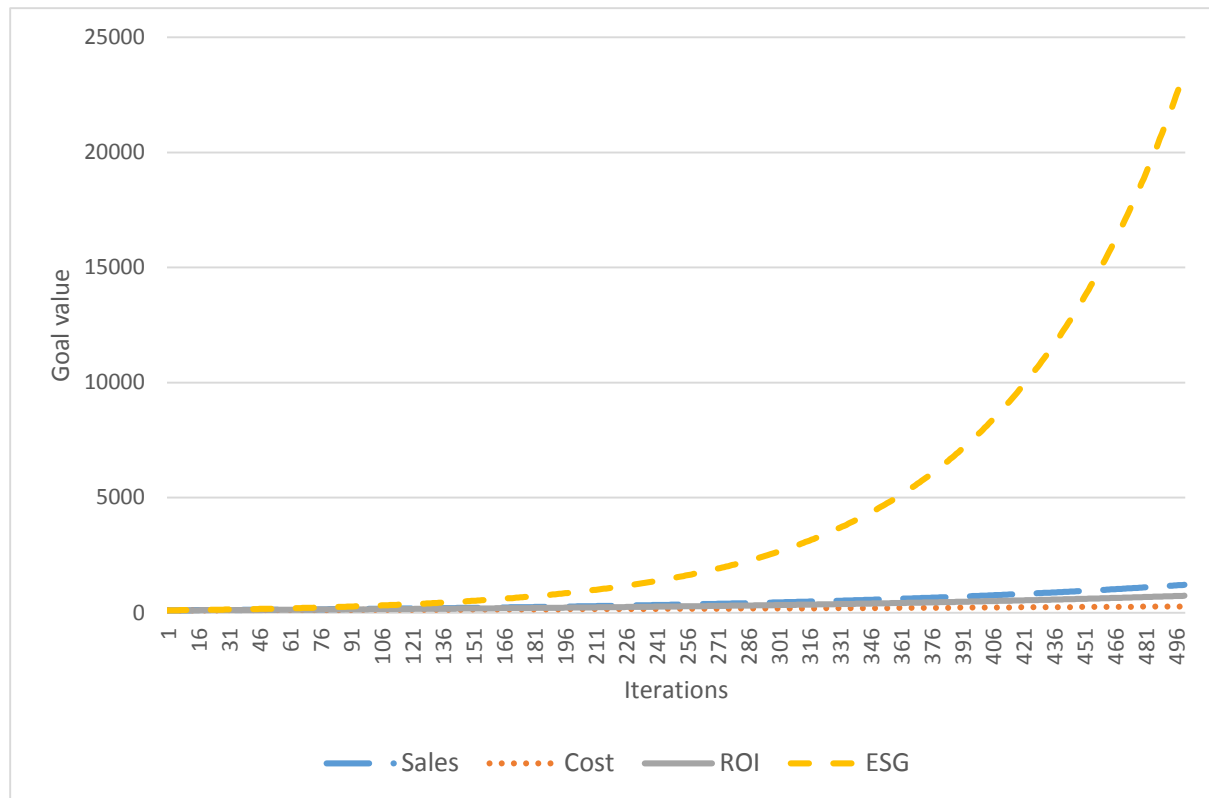


Figure 5. Simulation for the objective of increasing ESG engagement.

Source: author's own work.

Table 4.
Linear regression for the independent variable ESG

Variable	b0	b1 (ESG)	SE (b1)	t	p	-/+95% confidence interval	Beta (standar.)	R ²
Sales	224.44	0.0516	0.00067	76.9	<0.001	0.0503 – 0.0530	0.960	0.92
Cost	139.14	0.0078	0.00017	45.6	<0.001	0.0074 – 0.0081	0.898	0.81
ROI	192.03	0.0294	0.00046	63.4	<0.001	0.0285 – 0.0304	0.943	0.89

Source: author's own work.

For verification, a regression analysis was also performed for the explanatory variable ESG and considering the other variables as dependent. Positive b1 values and high t values were obtained. This indicates their significant statistical value. The relatively high coefficients of the standardised Beta value indicate a strong correlation of the ESG with the other objectives, while the high R² indicates that 81-92% of the variation in the variables can be explained by the ESG variable.

6. Summary

The study used ChatGPT as an artificial intelligence, whose decision recommendation area can be considered partly verifiable and partly difficult or impossible to determine. The official financial and non-financial reports of a company listed on the Warsaw Stock Exchange should be considered verifiable, while the basing of the recommended target value on market and industry data resulting from ChatGPT's own algorithms and methodologies should be considered difficult to verify. Using the NetLogo software and a divide the cake model, it was determined how such AI-recommended targets might evolve in subsequent iterations. Four options were considered. In the first, the priority was to increase sales volume, in the second to reduce sales costs, in the third to increase ROI values and in the fourth to maximise social objectives. As a result, it was found that when using AI as a source for recommending strategic goals in the area of sales, there could be discrimination against the other goals. An intervention after one hundred iterations does not significantly change this situation, as AI does not suggest significant changes. Moreover, it may prove to be significantly late in this period. Particularly as the degradation of the value of the other targets appears significant. Hypothesis H1 is therefore confirmed. Regression analysis indicates that, although the other values are also increasing, they are increasing at a much lower rate than those associated with the overarching goal. Hypothesis H2 was similarly positively verified. The use of artificial intelligence, in this case the ChatGPT, can lead to decisions that discriminate between certain targets in the sales area. This was particularly evident, for example, with regard to the objective of increasing ROI and, at the same time, the very low increases associated with the indicator related to social objectives. It can therefore be concluded that, in the simulation environment used, a decision preferring one objective will have the effect of significantly detracting from the value of the other sales objectives over time, and that the use of generative artificial intelligence in the form of OpenAI ChatGPT can lead to decisions that discriminate against some objectives in the sales function area. Managers should be aware of it and to make decision should be familiar with algorithms and models that are used in decision making.

It is then important to develop a decision framework for balancing competing objectives in particular when supporting the decision making by AI. There is a need for deeper research in that field to develop the framework that considers algorithmic fairness theory findings. Such a framework could help managers to navigate trade - offs between economic and social goals, short and long term results and other concerns. By leveraging AI driven insights in a structured way it could guide on how to align AI supported decisions with strategic priorities and organizational values, having in mind responsible technology adoption.

References

1. Agrawal, A., Gans, J., Goldfarb A. (2019). Economic policy for artificial intelligence. *Innovation policy and the economy*, Vol. 19, Iss. 1, pp. 139-159.
2. Bandara, K., Shi, P., Bergmeir, C., Hewamalage, H., Tran, Q., Seaman, B. (2019). Sales Demand Forecast in E-commerce Using a Long Short-Term Memory Neural Network Methodology. *Neural Information Processing*, pp.462-474.
3. Fischer, H., Seidenstricker, S., Berger, T., Holopainen, T. (2022). Artificial intelligence in B2B sales: Impact on the sales process. *Artificial Intelligence and Social Computing*, Vol. 28, Iss. 28, pp. 135-142.
4. Frey, C.B., Osborne, M.A. (2017). The Future of Employment: How Susceptible Are Jobs to Computerisation? *Technological Forecasting and Social Change*, vol. 114, pp. 254-280.
5. Frey, C.B., Osborne, M.A. (2013). The Future of Employment: How Susceptible Are Jobs To Computerisation. *Oxford Martin School Working Paper*, https://sep4u.gr/wp-content/uploads/The_Future_of_Employment_ox_2013.pdf
6. Furman, J. (2016). *Is This Time Different? The Opportunities and Challenges of Artificial Intelligence. Remarks at AI Now: The Social and Economic Implications of Artificial Intelligence Technologies in the Near Term*. New York University https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160707_cea_ai_furman.pdf
7. Heydari Fard, S. (2022). Strategic injustice, dynamic network formation, and social movements. *Synthese*, Vol. 200, Iss. 5, art. 392.
8. Hildebrand, C., Bergner, A. (2019). AI-driven sales automation: Using chatbots to boost sales. *NIM Marketing Intelligence Review*, Vol. 11, Iss. 2, pp. 36-41.
9. Juijn, G., Stoimenova, N., Reis, J., Nguyen, D. (2023). *Perceived algorithmic fairness using organizational justice theory: an empirical case study on algorithmic hiring*. Proceedings of the 2023 AAAI/ACM Conference on AI, Ethics, and Society, pp. 775-785. DOI: <https://doi.org/10.1145/3600211.3604677>
10. Martínez, J., Llinas, B., Botello, J.G., Padilla, J.J., Frydenlund, E. (2024). *Enhancing GPT-3.5's Proficiency in Netlogo Through Few-Shot Prompting and Retrieval-Augmented Generation*. 2024 Winter Simulation Conference, WSC, IEEE, pp. 666-677.
11. Mehendale, A., Nadheera Sherin, H.R. (2018). Application of Artificial Intelligence (AI) for Effective and Adaptive Sales Forecasting. *Journal of Contemporary Management Research*, Vol. 12, Iss. 2.
12. Morse, L., Teodorescu, M.H., Awwad, Y., Kane, G.C. (2021) Do the ends justify the means? variation in the distributive and procedural fairness of machine learning algorithms. *Journal of Business Ethics*, Vol. 181, Iss. 4, pp. 1083-1095, DOI: <https://doi.org/10.1007/s10551-021-04939-5>

13. Paschen, J., Paschen, U., Pala, E., Kietzmann, J. (2021). Artificial intelligence (AI) and value co-creation in B2B sales: Activities, actors and resources. *Australasian Marketing Journal*, Vol. 29, Iss. 3, pp. 243-251.
14. Tisue, S., Wilensky, U. (2004). Netlogo: A simple environment for modeling complexity. *International conference on complex systems*, May, Vol. 21, pp. 16-21.
15. Trivedi, S., Patel, N. (2020). *The Role of Automation and Artificial Intelligence in Increasing the Sales Volume: Evidence from M, S, and, MM Regressions*, June 20, 2020. DOI: <http://dx.doi.org/10.2139/ssrn.4180379>
16. Zhou, J., Verma, S., Mittal, M., Chen, F. (2021). *Understanding relations between perception of fairness and trust in algorithmic decision making*. DOI: <https://doi.org/10.48550/arxiv.2109.14345>

Appendix

Netlogo Code

```

globals [ chosen-goal ;; wybrany cel (np. maximize-sales, maximize-roi, minimize-costs, maximize-social)]
turtles-own [
  sales
  costs
  roi
  social-impact]
to setup
  clear-all
  setup-agents
  setup-environment
  set chosen-goal import-goal-from-chatgpt
  reset-ticks
end
to setup-agents
  create-turtles 50 [
    setxy random-xcor random-ycor
    set sales 0
    set costs 0
    set roi 0
    set social-impact 0
    set shape "person"
    set color blue
  ]
end
to setup-environment
  ;; Opcjonalnie można dodać klientów lub inne elementy środowiska
end
to-report import-goal-from-chatgpt
  let goals ["maximize-sales" "maximize-roi" "minimize-costs" "maximize-social"]
  report one-of goals
end
to go
  if ticks >= 500 [
    export-results
    stop
  ]
  ask turtles [
    perform-sales-activity
    update-indicators
  ]
  tick
end
to perform-sales-activity
  if chosen-goal = "maximize-sales" [
    set sales sales + random-float 10
    set costs costs + random-float 7
  ]
  if chosen-goal = "maximize-roi" [
    let effort random-float 5
    set sales sales + (effort * 2)
    set costs costs + effort
  ]
]

```

```
if chosen-goal = "minimize-costs" [  
  let saving random-float 2  
  set costs costs - saving  
  if costs < 0 [ set costs 0 ]  
  set sales sales + random-float 2  
]  
if chosen-goal = "maximize-social" [  
  set social-impact social-impact + random-float 5  
  set sales sales + random-float 3  
  set costs costs + random-float 2  
]  
end  
to update-indicators  
  if costs + 1 != 0 [  
    set roi (sales - costs) / (costs + 1)  
  ]  
end  
to export-results  
  ; Eksport danych do pliku CSV  
  let file-name (word "results-" chosen-goal ".csv")  
  file-open file-name  
  file-print "sales, costs, roi, social-impact"  
  
  ask turtles [  
    file-print (word sales ", " costs ", " roi ", " social-impact)  
  ]  
  file-close  
  show (word "Wyniki zapisano do pliku: " file-name)  
end
```


INSTITUTIONAL LOGIC IN MARKETING – A STRATEGIC PERSPECTIVE ON RELATIONSHIP BUILDING AND MARKET SEGMENTATION

Jarosław PLICHTA

Krakow University of Economics; plichtaj@uek.krakow.pl, ORCID: 0000-0001-9969-9832

Purpose: The study investigates the influence of institutional logics such as market, bureaucratic, communal, mission, professional, and entrepreneurial logics, on B2C market segmentation and customer- relationship management (CRM). Its objectives are to (a) develop a transparent, reproducible framework for aligning marketing strategies with these logics and (b) demonstrate that such alignment enhances consumer trust, engagement, and repeat – purchase behaviour.

Design/methodology/approach: A comprehensive search was conducted on the Web of Science, Scopus, ABI/Inform, and JSTOR for peer- reviewed articles published between 1990 and 2024. Keywords combined “institutional logic*” with “market segmentation”, “CRM”, and “brand strategy”. After title and abstract screening against inclusion criteria (explicit discussion of at least one institutional logic and direct relevance to segmentation or CRM), 72 articles remained.

Findings: (1) Proposal of logic-based segmentation. Firms with a dominant market logic use price-value and functional criteria; communal-logic firms emphasize community events and peer reputation; bureaucratic-logic firms highlight certifications and clear procedures; entrepreneurial-logic firms spotlight innovation and risk-taking; mission-logic firms foreground ethical commitments; professional-logic firms leverage expert endorsements. (2) CRM alignment. When firms’ CRM tools (e.g., loyalty programs, personalized communications, certification displays) resonate with customers’ institutional logics, brand trust and engagement increase. (3) Value co-creation development. Institutional congruence fosters deeper co-creation as consumers perceive brands as legitimate partners within their normative frameworks.

Research limitations/implications: As a theoretical paper, it lacks empirical validation. Future studies should develop both qualitative and quantitative measures of consumer and firm logic profiles, then test their effects on trust, purchase intention, and loyalty through field surveys or experiments. Future research is advised to develop quantitative surveys measuring consumer and firm logic profiles and to conduct field experiments manipulating CRM communications to establish causal links.

Practical implications: Managers can enhance segmentation accuracy and CRM effectiveness by: (1) Diagnosing both corporate and customer logic profiles, (2) Tailoring product positioning, messaging, and loyalty mechanisms to these profiles, (3) Embedding institutional alignment into brand strategy to boost trust and retention.

Originality/value: This is the first paper to integrate the institutional logics meta-theory with market segmentation and relationship marketing, offering a novel lens for both scholars and practitioners to design consumer-centric strategies.

Keywords: Institutional logics; Market segmentation; Relationship marketing; Customer trust; Value co-creation, Logic-align marketing.

Category of paper: Conceptual paper, Viewpoint.

1. Introduction

Dynamic changes in the global economy in recent decades have forced the search for an explanation of the logic of contemporary market processes, which resulted in the emergence of various concepts, including the SDL concept (Services Dominant Logic), which is an attempt to search for universal premises for the actions of contemporary entities, or directly for consumers themselves within the concept (CDL - Consumer Dominant Logic) (Bruhn et al., 2024; Vargo, Akaka, 2009). Creating value based on the dominance of intangible elements in contemporary products perceived as bundles of values has found wide application in marketing (Grönroos, Voima, 2013; Nabhan et al., 2024; Shaner et al., 2024; Vargo, Lusch, 2004). The evolution of the marketing concept is heading in the same direction, emphasizing the importance of values and social relations. This trend is consistent with the institutional approach to contemporary transaction processes, which emphasizes the importance of behavioral factors and structures based on interpersonal relationships (Kotler, 2020; Plichta, 2019a; Shaner et al., 2024). Due to the role played by customers in the stakeholder structure of enterprises and the importance of relationships in contemporary markets, this article addresses the issue of the importance of institutional logic in marketing. The hypothesis adopted as the basis for considerations is that the institutional logic according to which a given organization operates is a key element of segmentation and the basis for building effective relationships with buyers. Despite the emergence of hypermedia space and modern technologies, market segmentation and the selection of the target group remain a key stage in the marketing management process.

2. Premises for the development of the concept of institutional logics

Since the 1980s, there has been a growing interest in institutional economics and its applications in management (Anam et al., 2024; Ferreira et al., 2014; Martins et al., 2010). This applies not only to the New Institutional Economics and the transaction cost theory developed, e.g., by O.E Williamson, but also to a return to the achievements of the so-called old-stream institutionalists, who emphasized behavioral aspects in their concepts (Simon, 1990;

Veblen, 2017) and the role of individuals in creating relationships and structures of production and exchange (Coase, 1937; North, 1990b; Ostrom, 1998; OE Williamson, 1993). The demands made among scientists regarding a departure from the so-called The changes in the so-called scientific imperialism manifested by a silo and exclusionary approach to the development of scientific disciplines in favor of inclusiveness and a more holistic approach have found good justification for the development of various, often eclectic concepts in institutional economics (Brzeziński et al., 2008; Fiedor, Hockuba, 2009; Gorynia, 1998; Richter, 2001; Stone, 1986). The departure from neoclassical assumptions regarding the determinants of entities' behaviors occurred gradually, often outside the mainstream, e.g. in marketing or in behavioral finance, which drew on the achievements of psychology and sociology, combining quantitative and qualitative methods in research (Kahneman, Tversky, 1984; Foxall, 1997; Jonassen, 1959; Lee et al., 2007). In the area of management sciences, for example, the school of organizational behavior currently draws many elements from institutional achievements (Ponte, Pesci, 2022). This also resulted in the development of research and publications in the field of the efficiency of exchange processes, referring mainly to the theory of transaction costs, agency theory or property rights theory, addressing the broad issue of explaining the existence and functioning of various forms of organizing economic activity (Carroll, Teece, 1999; Jensen, Meckling, 1979; Menard, Shirley, 2005), cooperative phenomena or corporate governance and relations between stakeholders (Bundy et al., 2018; Chung, Luo, 2008; Messiah, 2006; North, 1990a). To this day, however, the institutional approach does not often appear in the issues of mainstream management, which is certainly one of the reasons for which is the problem with the research methodology and measurement of, for example, transaction costs, agency costs and transfer of property rights resulting from the behavior of entities that are often hidden in nature and with the separation of physical costs and transaction costs (Hodgson, 2010; Plichta, 2019b). Another reservation is the focus on the cost side and the assumption of reducing transaction costs, which are the main reasons for inefficiency at the level of organizational units and the entire economy, and to a lesser extent on value creation (Plichta, 2019a). This certainly makes management and measurement of effectiveness and efficiency, which plays a fundamental role in management, difficult.

Globalization and the development of transnational corporations, new business models and integrated logistics chains or network organizations have shed light on the causes of the formation of market structures at the micro-, meso- and macro-levels and the relations between the public and private spheres (Menard, Shirley, 2005; Ostrom, 2010). The dynamism of changes explained mainly by technological progress, global mobility and threats resulting from the expansionary economy of natural resources has directed the attention of some researchers to the social consequences and the impact on changes in the institutional environment, emphasizing cultural conditions and the role of informal institutions in the behavior of market entities (Dobler, 2011; Li, 2024; Williamson, 2009). The need to describe contemporary phenomena characterized by information noise and uncertainty resulting from information

asymmetry on the one hand and the growing capabilities of information and communication technologies on the other hand imposes a search for regularities and a specific logic of these processes. This is certainly a big challenge for organizations looking for tools to facilitate management in the digital era. It is also a challenge to create a new research perspective for dynamic and complex social relations, including economic ones (Wu et al., 2023).

The fact that organizations are embedded in complex institutional relations was noticed by DiMaggio and Powell, who pointed out that organizations compete not only for resources and customers, but also for political power and institutional legitimacy. This causes organizations to become similar (isomorphism) to each other in the process of imitation and conformism dictated by the implementation of goals and the uncertainty of their achievement (DiMaggio, Powell, 1983). Therefore, the actions of organizations are not only the result of their strategies of action, but above all the result of institutional ties between participants in value creation processes (stakeholders) within different institutional logics. This means that different participants in exchange processes, regardless of their role and place in value creation processes, can act according to the same or different institutional logics, which, according to many authors, is, for example, the reason for entering cooperative relations or is the reason for competitive behavior. For example, the presence of strong institutional norms or state policies can reduce resistance to competitiveness and encourage market actors to form alliances and partnerships (Thornton et al., 2012a)

3. Areas of application of the concept of institutional logics

The concept of institutional logic has evolved over the years - from a macro-social perspective to an organizational and micro-social level. Today, it is used in economics, management, marketing, and entrepreneurship. It is also discussed in other disciplines, such as sociology and psychology or political science (Cervi, Christopoulos, 2024). The concept and creation of the foundations of institutional logic dates to the early 1990s, when the first classifications and research programs were created. Already in 1949, Selznick expressed the view that institutions have their values and identities that influence their decisions, contesting the neoclassical rationality of economic decision-making (Selznick, 1949). In 1977, Meyer and Rowan drew attention to the fact that organizations adopt structured norms and myths to maintain their legitimacy and are not guided only by efficiency considerations. They also pointed to the role of the legitimization factor in the convergence of organizational structures and behaviors (Meyer, Rowan, 1977). A breakthrough in this respect was the publication by DiMaggio and Powell in 1983, analyzing the causes and process of organizations becoming like each other. They specified three types of institutional isomorphism (coercive, mimetic, and normative) (DiMaggio, Powell, 1983). In 1991, Friedland and Alford defined institutional

logic as a set of cultural beliefs and rules that determine decision-making processes at the macro-social level (e.g. state, market, family, religion). Institutional logic was considered to be competing belief systems that shape the way individuals and organizations act. (Friedland, 1991). Thornton and Ocasio made a major contribution to the operationalization of the concept, developing the concept of institutional logic for many years in many areas, such as leadership and corporate governance (Thornton, Ocasio, 1999) or the determinants of companies' strategic decisions (Thornton, 2004; Thornton et al., 2012a). In the following years, the concept of institutional logic was formalized and research on complexity, how organizations navigate and cope in the face of conflict between different logics and how to combine different logics within the framework of their activities was deepened (Greenwood et al., 2011; Lounsbury et al., 2021; Thornton et al., 2012b). The concept of institutional logics has been used and studied in many disciplines (Cervi, Christopoulos, 2024; Lounsbury, Wang, 2023; Wu et al., 2023). However, a detailed understanding of how the different elements associated with logic combine or group together to form a coherent and recognizable pattern and how this pattern evolves is still lacking. That is, how the elementary components of logic become collectively shaped to become coherently identifiable and maintained in each social domain.

4. The essence and classification of institutional logic

Various classifications of institutional logics aim to comprehensively capture the mechanisms of the organization's relations with the environment. Research conducted for many years is most often based on several classifications of institutional logics, the most popular of which are:

- Friedland and Alford's concept referring to the main foundations of social order, such as the state (power and administration), family (social ties) and religion (spiritual values) (DiMaggio et al., 1991, p. 259).
- Scott's concept is based on three pillars that are the basis of legitimization, namely: regulatory (imposition of norms), normative (social pressure) and cultural-cognitive (internal beliefs and values) helps to understand why organizations follow certain logics and how they are implemented and legitimized in organizations (Scott, 1995, 2000).

The concept of Thornton, Ocasio and Lounsbury, which distinguished 7 institutional logics: market, state, professional, community, family, religious, and corporation (Thornton et al., 2012). The most frequently discussed and used concept in research and publications is the last concept of 7 institutional logics, in which several dimensions can be distinguished:

- cultural-cognitive (beliefs and values in the organization),
- normative (standards and professional ethics),
- structural (formal structures, policies, corporate governance, division of power),

- symbolic (symbols and rituals, brand management and marketing communication),
- material (allocation of resources, artefacts and devices used in the organization).

The fundamental element that distinguishes institutional logic from organizational culture is that institutional logic is the rules and norms that regulate the way of acting in each environment. Organizational culture, on the other hand, is the rules, norms and practices that primarily shape the identity and internal behavior of an organization. Organizational culture can be a combination of various institutional logics, which it interprets in a sense. For example, the organizational culture of a university can be a combination of state, market and professional logic. In private universities, market logic prevails, while in public universities, state logic prevails. However, in both situations, there are tensions between these main logics, reinforced on the one hand by legitimization and subordination to norms and on the other hand by a clear signal from the legislator about the need for change and adaptation to international competition in accordance with market logic. The new paradigm of university management initiated by the 2018 higher education reform promotes strong organizations based on strong leadership, hierarchical structures, efficiency, standardization and accountability. However, it leaves the decisive voice to the regulator and state authorities, which causes numerous tensions in both types of universities. (Urbanek, 2020, p. 105). In turn, family businesses have been dominated for many years by family logic, which is based on family ties, loyalty and personal relationships, which increasingly often come into conflict with market logic focused on efficiency, competition and profit maximization. The effect of this is, among others, the search for formal solutions for ensuring succession and protecting material and social resources related to the activities of such entities.

The relations of an organization with its environment may have a different nature. For many years, the traditional approach in strategic management, where the so-called environmental factors were pointed out, has been evolving towards an institutional and more subjective approach. The effect of this is the division of the environment into institutions in the form of organized entities and units with specific resources, e.g. intellectual or technological, and institutions in the sense of formal and informal norms and rules of action. An example of combining various research and conceptual approaches is the stakeholder theory developing towards stakeholder relationship management, referring to relationship marketing, resource theory and transaction cost theory (Bourne, 2016; Freeman et al., 2004; Plichta ed., 2022). Stakeholder theory allows for enriching the concept of institutional logic with research on the relationships between various logics and building relationships with stakeholders. Therefore, it can be hypothesized that institutional logic, or rather their combination, affects stakeholder relations. Most importantly, each market entity, not only the organized one, should operate according to a specific combination of institutional logics.

The concept of institutional logic can be identified with the concept of an organizational field, which is defined as a group of organizations that interact and function within a common institutional environment, including regulators, competitors, customers, suppliers,

and professional associations. While the organizational field is shaped by external influences, such as legal regulations, professional norms or economic pressures, institutional logic defines the "rules of the game" in the organizational field (Wooten, Hoffman, 2017). An example is banking institutions, which for many years were guided by state logic based on legal regulations, government policy, and public interest, which were characterized primarily by transparency, responsibility, and compliance with the law. With globalization, they began to apply on an increasingly large-scale market and corporate logic focused on profit, efficiency and expansion strategy. In turn, the entry of new entities representing new business models based on new communication and information technologies into the education sector, offering e.g. remote learning, introduced market logic, changing the image of the education sector. In each organizational field, different institutional logics can compete, co-exist, and combine. In the health care system, professional logic (medical ethics) can clash with market logic (hospital profitability). In universities, state logic (public financing) coexists with market logic (tuition fees, rankings).

Institutional logics are dynamic and may change over time, for example, due to regulatory pressure resulting from the implementation of sustainable development policies, technological progress, or social movements that force producers to adopt a pro-ecological orientation. Tensions between logic within an organization, e.g. in the form of protests and strikes or in stakeholder relations, can cause conflicts and change the organization itself and the structure of the organizational field. Managers play an important role in solving them and adapting various institutional logics. In 2019, research conducted among 1000 managers of public sector organizations in the United States on the adaptation of organizations to climate change indicates that the effectiveness of this adaptation depends on the interaction between institutional logics at the macro level (government authority, professionalism and the market) and the meso level (risk-based logic and capability-based logic). The presence of distinct organizational configurations suggests that not all organizations respond to climate threats to the same extent. Only the group of pioneers (adapted to climate change) demonstrates effective adaptation. The study results highlight the crucial role of top managers in integrating competing logics to improve climate resilience (Zhang, Welch, 2023).

5. Institutional logic of customer relationship management

The fundamental element of shaping stakeholder relations in the organizational field is marketing. Despite the existence of a well-known canon of marketing instruments, each organization can shape it within the framework of various action strategies, which, according to the considerations presented so far, should be consistent with a specific institutional logic or their combination. This assumption indicates the role of institutional logic

in fulfilling expectations and methods of interaction with stakeholder groups to achieve their own strategic and operational goals. For example, companies guided by market logic focus on relations with investors and maximizing profits, while organizations operating according to community logic focus on social involvement and relations with local communities. Patients expect relationships based on expert knowledge and ethics from entities operating according to professional logic, e.g. doctors, which means building trust and complying with ethical norms. It can be hypothesized that, to build relationships within a given institutional logic, both parties to the relationship should act in the same logic, or it should be dominant. Within a given organization and thus in relations with various stakeholders, hybrid logic may exist, e.g., doctors are guided by professional logic (professional ethics, expert knowledge), but at the same time, hospitals may be managed in a market-oriented manner (cost-effectiveness, competition).

Customer relationship management is a marketing concept and practice that has been developed over many years, the idea of which is based on creating and co-creating values that lead to building trust and credibility between the parties to the relationship. It has been adapted to the field of cooperative relations between stakeholders, using instruments developed by marketing. However, it is currently most widely used in the B2B and B2C markets in customer relationship management. To implement the above values, CRM systems should, within their properties and purpose, implement many functions and tasks that affect the value delivered to customers, such as customer data management, marketing and sales process automation, task planning and coordination, reporting, data security, customer service, or personalization. Nevertheless, trust, credibility, and reputation are key values that build long-term relationships (Sztompka, 2007).

In relationships, we deal with a whole bundle of values. The most famous are the concepts of Schwarz, Rokeach, Mitchel (VALS) and Kahl (LOV) (Payne, Holt, 2001; Sagan, 2011). By synthesizing the basic functions of CRM systems and value structures, we can indicate several groups of values that shape effective relationships with customers (AB Carroll, 1991; Cropanzano, Mitchell, 2005; Hofstede, 2001):

- relational (social) values – based on trust, loyalty and emotional commitment,
- economic values based on material benefits and reciprocity and fairness of exchange,
- normative values – based on honesty, transparency, and corporate social responsibility,
- Cognitive values – based on knowledge and competences, increasing shared experience and learning, as well as innovation and adaptation to the client,
- Cultural values – aimed at adapting to client values and intercultural sensitivity.

Based on the analysis of the values delivered to customers in the customer relationship management process and the general characteristics of various institutional logics, it is easy to see that they are closely interconnected (Table 1).

Table 1.*Human values as a link between institutional logic and systems of CRM*

Institutional logic	Value Group	Example of a relationship with CRM systems
Market	Economical	Customer segmentation is based on economic value, enabling the delivery of personalised offers, discounts, and promotions.
Professional	Cognitive	CRM system adapted to manage expert knowledge, e.g., in hospitals and law firms.
Community	Relational	CRM supports loyalty programs and activities based on building a community around the brand.
Corporate	Economic and normative	CRM that optimizes sales processes, monitors employee performance, and automates KPI analyses.
State/Bureaucratic	Normative	CRM that ensures regulatory compliance, e.g. customer data protection in line with GDPR.
Enterprising	Cognitive, Economic	CRM supports the analysis of market trends and personalization of services for dynamic start-ups.
Missionary/Community	Normative, Relational	CRM focused on social engagement and building relationships with donors and volunteers.

Source: own study.

It should be emphasized that the building of relationships with customers may differ significantly depending on their preferences and value structures. This also applies to differences resulting from B2B and B2C relationships. Similarly, just as the existence of transaction costs is not limited to inter- and intraorganizational relationships, institutional logics are not the domain of organizations, but also of individual market entities. Therefore, the effectiveness and efficiency of relationships with customers depend on the recognition and operationalization of institutional logics both within a given organization and among customers. This means that it is necessary to introduce criteria into segmentation variables that allow for the identification of attitudes and behaviors toward individual logics. Community logic will probably be more a feature of customers who value long-term relationships and brand loyalty, and those who buy ecological products and support local communities, while professional logic will be more characteristic of customers who value specialist knowledge, expert recommendations, and individual service. A consequence of the segmentation process is the need to develop marketing strategies that consider the adopted segmentation criteria that refer to the basic institutional logics.

6. Proposal for methodology

Both in marketing literature and institutional research, there is a growing shift from functional understandings of market segmentation toward approaches that incorporate deeper motivations and the cultural frameworks within which consumers operate. In response to this trend and the triangulation of the research process, this study proposes a methodology that integrates the perspective of institutional logics with operational tools of market segmentation

and customer relationship management (CRM). It is assumed that consumers differ not only in terms of demographic characteristics or lifestyle but also function within distinct institutional logics, that is, normative and symbolic structures that influence how they understand values, evaluate brands, and form expectations toward relationships with organizations.

The starting point for designing the research model is the recognition that institutional logic is present both on the side of the consumer and the organization (brand). The consumer's logic constitutes an independent variable that shapes their expectations toward the company, while the logic represented by the brand, manifested through marketing communication, CRM activities, and organizational identity, serves as the second independent variable. A key element of the model is the mediating variable, such as logic congruence, understood as the perceived alignment between the organization's values and actions and the consumer's internal beliefs. This congruence influences the consumer's level of engagement with the brand, which in turn leads to increased trust and both declaration and actual loyalty. The model also includes moderating variables, such as the consumer's involvement with the product category and the broader cultural and demographic context.

The proposed methodology follows a sequential combination of qualitative and quantitative research. The initial phase involves content analysis and conceptual mapping based on a systematic literature review. Relevant publications from the fields of relationship marketing, institutional management, and research on consumer values and segmentation are analyzed. Based on this analysis and using appropriate software tools, researchers can code institutional logics (market, bureaucratic, communal, mission, professional, entrepreneurial), associate them with segmentation variables (e.g., price/value, community, ethics, professional quality), and identify corresponding CRM tools (e.g., loyalty programs, co-creation platforms, expert recommendations). In the next step, conceptual maps are created based on the content analysis of academic articles, marketing strategies, customer communication, etc., to visualize connections between logics, segments, and relationship tools. These maps allow for the identification of recurring configurations and relationships, which are then formulated into a theoretical model.

The qualitative phase also includes in-depth interviews (IDIs) with marketing experts, company representatives, and consumers. These interviews aim to validate the identified logics, explore their interpretation in the context of everyday consumer choices, and collect language and examples useful for constructing research instruments. Based on the gathered data, survey questionnaires for the quantitative phase are developed. These should include measurement scales for all model variables, including consumer logic, logic congruence, brand trust, loyalty, and moderating factors. The study should be conducted among respondents from the B2C sector. After exploratory factor analysis (EFA), the data should undergo confirmatory factor analysis (CFA), followed by testing of structural relationships using structural equation modelling (SEM). This methodology allows not only empirical testing of theoretical assumptions concerning the role of institutional logics in marketing but also for practical application, particularly in developing CRM systems and market segmentation strategies that

reflect the cultural-normative conditions of target audiences. As a result, organizations can not only tailor their offers and communications better but also build stronger customer relationships based on shared values, leading to greater trust, engagement, and long-term loyalty.

7. Conclusions and future research

The concept of institutional logic has been developed in many areas for over 30 years. However, both its basic assumptions and its possibility of application in management sciences require further conceptual and research work. The advantage of this concept is its universal nature, reaching the essence of exchange processes, which allows for a holistic approach to this problem. Based on the analysis of selected publications and own research on institutional processes in the field of marketing, the hypotheses put forward in the text about the possibility and need to apply this concept in this area can be positively verified. The evolution of the marketing concept toward value marketing and social and relational marketing is in line with the direction of research on various institutional logics. As shown, the original concept of institutional logic referring to organizations should take into account the broader context of value creation processes in the vertical (value creation chains) and horizontal (management of relationships with stakeholders) systems, and in particular with customers. They also act, like other participants in value creation processes, according to specific institutional logics. Therefore, it is possible to indicate the connections between institutional logic and activities in the field of customer relationship management and with the characteristics of segments and target groups. This means that it is necessary to introduce criteria into the segmentation variables that allow for the identification of attitudes and behaviours towards individual logics.

Table 2 presents hypothetical examples of market segments developed based on the characteristics of individual institutional logics in connection with selected market strategies (Table 2).

Table 2.

Institutional logic as a link between market segmentation and market strategies

Market segment	Institutional logic	Compatibility with traditional market strategies
Economic rationalists	Market	Cost advantage strategy (Porter) - minimize costs and increase efficiency.
Experts and professional users	Professional	Qualitative differentiation strategy (Porter) - emphasize unique features and high quality.
Socially engaged	Missionary and community	Social marketing (Kotler) - communication of social and ethical values.
Innovation leaders	Entrepreneurial	Innovation leadership strategy (Kotler) – creating new trends, unique offers.
Loyal relational customers	Community/Missionary	Relationship marketing (Grönroos) – building long-term relationships with customers.
Transactional	Market/Corporate	Market penetration strategy (Ansoff) – mass advertising and aggressive expansion.

Source: own study.

This indicates a great opportunity to enrich the current market segmentation methodology and to better link it with the marketing strategy and the strategy of the entire organization. Analysis of the institutional logic according to which a given organization operates in relations with other entities increases the possibility of greater compliance between the image, identity, and reputation of the organization, which can ensure its more sustainable development.

Research on the application of the concept of institutional logic in marketing is in its early stages. The hypotheses presented in the text require empirical verification. The research program should cover both the sphere of external relations and internal relations of the organization, as various institutional logics connects both areas. This also opens a new area of research on factors that shape the relationships between stakeholders and in network systems. Several main directions for further research in this area are indicated, namely greater exposure of values, the importance and practical application of this concept, and the possibilities of managing logic and institutional order (Lounsbury et al., 2021, p. 267).

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References

1. Anam, M.S. et al. (2024). New Institutional Economics: Bibliometric analysis and future research directions. *Indonesian Journal of Economics, Social, and Humanities*, 6(2), 177-192.
2. Blau, P.M. (1964). *Exchange and Power in Social Life*. Wiley.
3. Bourne, L. (2016). *Stakeholder relationship management: A maturity model for organizational implementation*. Routledge.
4. Bruhn, M., Saleschus, M., Hadwich, K. (2024). Theoretical Foundation of Customer-Dominant Logic. In: M. Bruhn, M. Saleschus, K. Hadwich (Eds.), *Customer-Dominant Logic: Customer-Dominant Management as a New Target in Relationship Marketing* (pp. 51-72). Springer Fachmedien. https://doi.org/10.1007/978-3-658-45352-7_3
5. Brzeziński, M., Gorynia, M., Hockuba, Z. (2008). Economics and other social sciences at the beginning of the 21st century. Between imperialism and cooperation. *Ekonomist*, 2, 201-232.

6. Bundy, J., Vogel, R.M., Zachary, M.A. (2018). Organization–stakeholder fit: A dynamic theory of cooperation, compromise, and conflict between an organization and its stakeholders. *Strategic Management Journal*, 39(2), 476-501. <https://doi.org/10.1002/smj.2736>
7. Carroll, A.B. (1991). The Pyramid of Corporate Social Responsibility: Toward the Morai Management of Organizational Stakeholders. *Business Horizons*, 34(4), 39-48.
8. Carroll, G.R., Teece, D.J. (1999). *Firms, Markets and Hierarchies: The Transaction Cost Economics Perspective*. Oxford University Press.
9. Cervi, F., Christopoulos, T.P. (2024). Dynamics of institutional sustainability logics in organizations: A systematic literature review. *Cadernos EBAPE.BR*, 22(2), e2023-0086. <https://doi.org/10.1590/1679-395120230086x>
10. Chung, C.-N., Luo, X. (2008). Institutional Logics or Agency Costs: The Influence of Corporate Governance Models on Business Group Restructuring in Emerging Economies. *Organization Science*, 19(5), 766-784.
11. Coase, R.H. (1937). The Nature of the Firm. *Economica*, 4(16), 386-405.
12. Cropanzano, R., Mitchell, M.S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*, 31(6), 874-900.
13. DiMaggio, P.J., Powell, W.W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 48(2), 147-160. <https://doi.org/10.2307/2095101>
14. DiMaggio, P.J., Powell, W.W. et al. (1991). *The new institutionalism in organizational analysis (Vol. 17)*. University of Chicago Press Chicago, IL.
15. Dobler, C. (2011). Institutions – an empirical approach. In: *The Impact of Formal and Informal Institutions on Economic Growth* (pp. 61-122). NED-New edition. Peter Lang AG. <https://www.jstor.org/stable/j.ctv9hj8zr.8>
16. Ferreira, M.P., Pinto, C.F., Serra, F.R. (2014). The transaction costs theory in international business research: A bibliometric study over three decades. *Scientometrics*, 98, 1899-1922.
17. Fiedor, B., Hockuba, Z. (Eds.) (2009). *Economic sciences in the face of contemporary challenges*. Polish Society Economical.
18. Foxall, G. (1997). *Marketing psychology: The paradigm in the wings*. Springer.
19. Freeman, R.E., Wicks, A.C., Parmar, B. (2004). Stakeholder Theory and “The Corporate Objective Revisited”. *Organization Science*, 15(3), 364-369. <https://doi.org/10.1287/orsc.1040.0066>
20. Friedland, R. (1991). *Bringing society back in: Symbols, practices, and institutional contradictions. The New Institutionalism in Organizational Analysis*, 232-263.
21. Gorynia, M. (1998). *Behavior of enterprises in the transformation period. Microeconomics of transition*. Poznań University of Economics.

22. Greenwood, R., Raynard, M., Kodeih, F., Micelotta, E.R., Lounsbury, M. (2011). Institutional complexity and organizational responses. *Academy of Management Annals*, 5(1), 317-371.
23. Grönroos, C., Voima, P. (2013). Critical service logic: Making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, 41(2), 133-150.
24. Hodgson, G.M. (2010). Limits of transaction cost analysis. *The Elgar Companion to Transaction Cost Economics*. Cheltenham, UK/Northampton, MA: Edward Elgar, 297-306.
25. Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. Sage publications.
26. Jensen, M.C., Meckling, W.H. (1979). Theory of the firm: Managerial behavior, agency costs, and ownership structure. In: *Economics social institutions* (pp. 163-231). Springer.
27. Jonassen, C.T. (1959). Contributions of Sociology to Marketing. *Journal of Marketing*, 24(2), 29-35. <https://doi.org/10.2307/1248844>
28. Kahneman, D., Tversky, A. (1984). Choices, values, and frames. *American Psychologist*, 39(4), 341.
29. Kotler, P. (2020). Marketing and value creation. *Journal of Creating Value*, 6(1), 10-11.
30. Lee, N., Broderick, A.J., Chamberlain, L. (2007). What is 'neuromarketing'? A discussion and agenda for future research. *International Journal of Psychophysiology*, 63(2), 199-204. <https://doi.org/10.1016/j.ijpsycho.2006.03.007>
31. Li, T. (2024). The joint effects of formal and informal institutions on entrepreneurial startups: A global perspective. *International Studies of Management & Organization*, 1-23. <https://doi.org/10.1080/00208825.2024.2354667>
32. Lounsbury, M., Steele, C.W.J., Wang, M.S., Toubiana, M. (2021). New Directions in the Study of Institutional Logics: From Tools to Phenomena. *Annual Review of Sociology*, 47(1), 261-280. <https://doi.org/10.1146/annurev-soc-090320-111734>
33. Lounsbury, M., Wang, M.S. (2023). Expanding the Scope of Institutional Logics Research. *Management and Organization Review*, 19(6), 1185-1188. <https://doi.org/10.1017/mor.2023.24>
34. Martins, R., Serra, F., Leite, A., Ferreira, M.P., Li, D. (2010). *Transactions Cost Theory influence in strategy research: A review through a bibliometric study in leading journals*. globADVANTAGE - Center of Research in International Business & Strategy.
35. Menard, C., Shirley, M.M. (Eds.) (2005). *Handbook of New Institutional Economics*. Springer Nature. <http://dx.doi.org/10.1007/b106770>
36. Messiah, C. (2006). Review of theoretical concepts of corporate governance. *Scientific Papers*, 700. Cracow University of Economics, 47-62.
37. Meyer, J.W., Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, 83(2), 340-363.
38. Nabhan, F., Waluyo, A., Ferdinand, A.T. (2024). *The Important Role of Network Value Alignment (Nva) in Improving Marketing Performance: Perspective of Service-Dominant*

- Logic Theory* (SSRN Scholarly Paper 5072839). Social Science Research Network. <https://doi.org/10.2139/ssrn.5072839>
39. North, D.C. (1990a). Cooperation: The theoretical problem. In: *Institutions, Institutional Change and Economic Performance* (pp. 11-16). Cambridge University Press (CUP). <http://dx.doi.org/10.1017/cbo9780511808678.004>
40. North, D.C. (1990b). *Institutions, institutional change, and economic performance*. Cambridge University Press.
41. Ostrom, E. (1998). A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address. *American Political Science Review*, 92(01). American Political Science Association, 1-22.
42. Ostrom, E. (2010). Beyond markets and states: Polycentric governance of complex economic systems. *Transnational Corporations Review*, 2(2), 1-12.
43. Payne, A., Holt, S. (2001). Diagnosing Customer Value: Integrating the Value Process and Relationship Marketing. *British Journal of Management*, 12(2), 159-182. <https://doi.org/10.1111/1467-8551.00192>
44. Plichta J. (ed.) (2022). *Key tools and elements of the co-management concept in building cooperative relationships with stakeholders*. <http://www.attyka.net.pl/pl/p/Kluczowe-narzedzia-i-elementy-koncepcji-co-management-w-budowaniu-relacji-kooperacyjnych-z-interesariuszami/125>
45. Plichta, J. (2019a). Transaction costs in the processes of co-creation of value by consumers. *Scientific Papers. Special Series, Monographs*, 264. Cracow University of Economics.
46. Plichta, J. (2019b). Measurement of transaction costs-different approaches and research perspective. *Ekonomista*, 3, 291-320.
47. Ponte, D., Pesci, C. (2022). Institutional logics and organizational change: The role of place and time. *Journal of Management and Governance*, 26(3), 891-924.
48. Richter, R. (2001). New economic sociology and new institutional economics. In: *Essays on New Institutional Economics* (pp. 51-75). Springer.
49. Sagan, A. (Ed.). (2011). *Customer Value in Market Systems*. Krakow University of Economics Publishing House.
50. Scott, W.R. (1995). *Institutions and Organizations*. Thousands Oaks, CA: Sage Publications.
51. Scott, W.R. (2000). *Institutional Change and Healthcare Organizations: From Professional Dominance to Managed Care*. University of Chicago Press. <https://books.google.pl/books?id=vomaHpFVcOAC>
52. Selznick, P. (1949). *TVA and the Grass Roots (Vol. 3)*.
53. Shaner, M.B., Bush, V., Parajuli, J. (2024). Marketing under pressure: Improvisation as an instrumental process for change. *Journal of Marketing Theory and Practice*, 1-23. <https://doi.org/10.1080/10696679.2024.2446154>

54. Simon, H.A. (1990). Bounded Rationality. In: J. Eatwell, M. Milgate, P. Newman (Eds.), *Utility and Probability* (pp. 15-18). Palgrave Macmillan UK.
55. Stone, A. (1986). The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. By Williamson Oliver E. New York: Free Press, p. 450, \textdollar27.95. *Am. Polit. Sci. Rev.*, 80(04), 1424-1425. <https://doi.org/10.1017/s000305540018596x>
56. Sztompka, P. (2007). *Trust. The Foundation of Society*. Sign.
57. Thornton, P.H. (2004). *Markets from culture: Institutional logics and organizational decisions in higher education publishing*. Stanford University Press.
58. Thornton, P.H., Ocasio, W. (1999). Institutional Logics and the Historical Contingency of Power in Organizations: Executive Succession in the Higher Education Publishing Industry, 1958-1990. *American Journal of Sociology*, 105(3), 801-843. <https://doi.org/10.1086/210361>
59. Thornton, P.H., Ocasio, W., Lounsbury, M. (2012). *The institutional logics perspective: A new approach to culture, structure, and process*. Oxford University Press.
60. Urbanek, P. (2020). The evolution of institutional logic in the reformed higher education system in Poland. Economy National. *The Polish Journal of Economics*, 302(2), 95-122.
61. Vargas-Hernandez, J.G., Vargas-González, O.C., Vargas-Hernandez, J.G., Vargas-González, O.C. (1 CE, January 1). *Socio-Organizational Structure and Institutional Logics* [Chapter]. <https://Services.Igi-Global.Com/Resolvedoi/Resolve.aspx?Doi=10.4018/979-8-3693-1155-4.Ch004>. IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-1155-4.ch004>
62. Vargo, S.L., Akaka, M.A. (2009). Service-Dominant Logic as a Foundation for Service Science: Clarifications. *Service Science*, 1(1), 32-41.
63. Vargo, S.L., Lusch, R.F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing*, 68(1), 1-17.
64. Veblen, T. (2017). *The theory of the leisure class*. Routledge.
65. Williamson, C.R. (2009). Informal Institutions Rule: Institutional Arrangements and Economic Performance. *Public Choice*, 139(3/4), 371-387.
66. Williamson, O.E. (1985). *The economic institutions of capitalism*. Simon and Schuster.
67. Williamson, O.E. (1993). Calculativeness, Trust, and Economic Organization. *The Journal of Law & Economics*, 36(1), 453-486.
68. Wooten, M., Hoffman, A.J. (2017). *Organizational fields: Past, present and future*. The Sage Handbook of Organizational Institutionalism, 55-74.
69. Wu, X., Tan, X., Wang, X. (2023). The institutional logics perspective in management and organizational studies. *Journal of Business Research*, 167, 114183.
70. Zhang, F., Welch, E.W. (2023). Explaining Public Organization Adaptation to Climate Change: Configurations of Macro- and Meso-Level Institutional Logics. *Journal of Public Administration Research and Theory*, 33(2), 357-374. <https://doi.org/10.1093/jopart/muac027>

ARTIFICIAL INTELLIGENCE AND THE EVOLUTION OF JOB MARKET IN CHINA

Bogdan PLISZKA

Silesian University of Technology; bogdan.pliszka@polsl.pl, ORCID: 0000-0002-3021-905X

Purpose: China is a country where artificial intelligence is being used on a mass scale. Demographic processes taking place in China have made production automation a requirement for Chinese industry. Artificial intelligence is increasingly replacing human resources in decision-making about production methods and techniques used in Chinese factories.

Design/methodology/approach: Conducting a bibliometric review in online resources. Both in scientific publications and journalistic articles concerning the phenomena analyzed in the article. Due to the specific nature of the phenomenon analyzed, the bibliography is based on relatively recent publications.

Research limitation/implications: This analysis is merely a contribution to broader research that seems necessary to understand the technological processes and related social implications currently taking place in China. This article serves as an introduction to further analyses that seem necessary to properly assess the use of artificial intelligence in the Chinese labor market.

Practical implications: Artificial Intelligence should become one of many tools used in the labor market. The Chinese experience should be thoroughly analyzed in other countries, including Poland.

Social implications: Artificial intelligence will be, or rather, already is, a revolution in the labor market. Like previous new technologies, it will lead to, at least temporarily, technological unemployment. Many professions will not withstand the competition from AI. Observing this process taking place in China may allow us to avoid the pitfalls inherent in the mass use of this new technology.

Originality/value: Drawing on a wealth of sources, this article presents a phenomenon being studied on a large scale worldwide. China's experience, in particular, appears pioneering and original in its methods of implementing new technology.

Keywords: China, job market, Artificial Intelligence, evolution, experiences.

Category of the paper: Literature review.

1. Introduction

Artificial intelligence has gone beyond a specialized technological field and become a force that is changing industries, economies, and societies at an exponential pace. This change is more obvious and imperative in China than other countries due to the large population size, speedy industrial upgrade, and the highest degree of digitalization. The advancement of AI technologies has created unprecedented challenges and opportunities in the job market of China, resulting in a drastic change that requires critical and systematic exploration. Thus, the research question will be: How is the introduction of artificial intelligence reshaping the job market in China, and what are the implications for technological unemployment, new professions, educational reform, economic development, and ethical and social issues?

The study of the relationship between artificial intelligence and the labor market in China is not only an important aspect to consider for the country's internal economic health, but also a key factor for the overall global competitive arena. Emerging technologies such as machine learning, big data, robotics, and natural language processing are all changing the structure of the labor market through automation, leading to higher productivity gains. However, Chinese trends, such as demographic transition, urban-rural disparities, constantly changing policies, and strong government initiatives to develop AI, add more complexity to the picture of this relationship.

This paper aims to analyze the impact of artificial intelligence on the labor market in China. It also aims to explore the consequences that AI has had on the development of the Chinese economy, education, employment, and moral issues. This paper will answer the main research question and other related questions, addressing the opportunities and challenges of incorporating AI. In addition, it can contribute to the formulation of appropriate measures that are related to policy making, education and training, employment security, economic restructuring, and the development of AI technologies, as well as the promotion of the stability and development of the Chinese economy and society.

This paper is intended to use a multidisciplinary approach. Data and arguments are extracted from various disciplines in the social science. This paper adopts literature reviews, policy analysis, case studies, official data reports, comparative research methods, historical analysis, and critical reflection. Literature reviews are undertaken from academic perspectives to find relevant findings in academia. Policy analysis will provide some insights into Chinese policies and government interventions. Official data is used to assess AI-based economic changes, labor employment structure, educational inputs, etc. Case studies provide us with anecdotal data to support the key points that this paper addresses. Furthermore, historical analysis is incorporated into this paper in order to explore how AI has evolved to dominate the economy. To address ethical and social concerns raised by the intrusion of AI into the job market, this paper will

adopt critical reflection. All in all, this study attempts to bring different research methods to answer the main research question.

To provide some preliminary evidence of how AI has been changing the landscape of the job market in China, several recent studies provide a comprehensive overview.

First of all, research on China's employment structure demonstrates the displacement of jobs through automation. As shown by a survey of American experts by Frey and Osborne, there is a 51% probability that all activities in some occupation are replaceable by AI technology (Frey, Osborne, 2017).

In addition to the displacement of the original employees, the emergence of artificial intelligence has generated new professions and occupations. One of the most noticeable jobs is AI trainer/expert and algorithm engineers. Some researchers have stated that the internet of things (IOT) and algorithm-driven technology are becoming the leading industries (Duan et al., 2017). The development of the IOT has given rise to many AI-related jobs.

There is inequality regarding the development of AI at the rural and urban levels in China. While AI in urban areas shows significant advancements, in rural areas AI seems to still be at the experimental stage.

Moreover, Chinese government policies play an important role in the construction and development of AI technology. Policies that are proposed at the national and local level are considered an important factor for achieving the goals of AI transformation. The government-based AI transformation may act as a role model and accelerate this change, allowing companies and businesses in China to undergo this transformation in a more systematic and orderly manner.

Moreover, Chinese AI-related policies are also aimed to boost employment and innovation, with most of the regulations relating to talent recruitment, training programs, educational intervention, and technological innovation.

Due to the quick pace of technological upgrade, not all workers in the Chinese workforce are capable of dealing with new techniques and methods. A large number of manual workers are left behind and will struggle to find suitable new occupations.

This paper is divided into five chapters. Chapter two introduces the status quo and prospect of China's AI development, AI market size, and AI-related Chinese government policies. Chapter three analyzes the influences of AI on the job market in China, especially on job market transformation and the emergence of new professions. Chapter four describes the challenges of incorporating AI into the job market. In chapter five, a brief summary of the implications for the future job market and the conclusion of this paper are presented.

2. Methods

This article uses a research method called desk research to collect, analyze, and synthesize relevant information from a wide range of scientific and other professional literature. Desk research is a complete research method. A well-conducted desk research can provide an insight into the current state of knowledge in a given field and provide reliable answers to research questions (Snyder, 2019). It is an excellent analysis method in interdisciplinary research. It also allows for the synthesis of research results and the discovery of areas where further research is needed. The literature review was conducted in Google Scholar and Science Direct. The databases were searched using the following keywords: human resources, artificial intelligence, management, new technologies, labor market, China.

3. China's AI Development Strategy

A China's national strategy in artificial intelligence, characterized by government-led initiatives, significant investments, and an innovative ethos, sets the stage for the country's ascension as a leader in AI. Understanding these policies is critical to grasping China's rapid developments in technology, industry integration, and talent recruitment, all of which form an integral part of analyzing the impact of AI on China's economy and society.

3.1. Current State and Market Size

China's AI sector is one of the fastest-growing in the world. By company number, it comes in second to the United States as home to the most AI companies. The government has encouraged the development of over 4300 AI firms by providing state support, investment, subsidies, grants, and relaxed regulatory structures (Greeven, Liu, 2025). State investments and favorable government policies have fostered rapid growth of new AI enterprises (Greeven, Liu, 2025). China has also become the global leader in research publications and citations on AI (Yu, Liang, Xue, 2021; Li, Tong, Xiao, 2021). 17% of US-trained AI doctorates returned to China, and 40% of them entered industry jobs (Yu, Liang, Xue, 2021). Over half of all highly cited AI papers in China involve international collaborations (Yu, Liang, Xue, 2021). The country has the largest number of AI-related patents and peer-reviewed journal citations, signifying its impact on shaping industry standards (Pitukhina, Gurtov, Belykh, 2024; Slotta, 2025). High-speed information and communication technologies, vast internet usage, and low labor cost all provide the impetus and scale required for AI developments to become fully functional in commercial and industrial settings (Yu, Liang, Xue, 2021). Government support provides favorable computing capacity and low barriers to entry (Greeven, Liu, 2025), making

China an environment for innovation and competitiveness for AI. The goal for China's artificial intelligence firms is to have 50% of AI systems be domestically made by 2030 (Olotu, Famiyesin, 2024). The government predicts the artificial intelligence sector's value will double from \$70 billion to \$140 billion by 2030 (Greeven, Liu, 2025).

State policy has helped expedite the growth of many AI companies. An example of this is government investment in supporting compute resources, which can be critical for startups (Greeven, Liu, 2025). In March 2023, the government also stated it would spend an estimated 364 billion yuan in AI, with an additional 750 billion yuan in funding during a 5-year period (Pitukhina, Gurtov and Belykh, 2024). It incentivizes risk-taking by investing billions of dollars and lowering the barrier of entry by supporting startup subsidies, grants, and government subsidies. This environment fosters innovation and commercialization. (Greeven, Liu, 2025) By designing its AI talent, funding, and education programs, China continues to adapt to a global technological shift in competitiveness (Olotu, Famiyesin, 2024). Capital inflow is the greatest asset for AI growth; it enables companies to swiftly and readily prototype and test AI in areas like autonomous driving and healthcare. In fact, it takes China's AI companies only five years to become unicorns (a billion-dollar-value-creating company), in contrast to the US and the EU's average of eight to ten years. This shows the close relationship between startup financing, venture capital, and government regulations (Pitukhina, Gurtov, Belykh, 2024).

State funding allows the rapid scaling of prototypes into pilots and finally the commercialization of AI products (Pitukhina, Gurtov, Belykh, 2024). State support for compute power provides a lower barrier to enter the market and therefore encourages more AI companies to emerge (Greeven, Liu, 2025). Therefore, capital has been paramount for AI companies in China, and has spurred growth in emerging AI fields, such as urban AI, especially in top metropolitan areas such as Beijing and Shenzhen.

There is a growing AI trend within multiple sectors in China. In terms of transportation, state AI policies incentivize rapid experimentation, allowing AI-operated traffic optimization technologies to reduce congestion in cities such as Hangzhou. For example, the government teamed up with the technological and e-commerce company Alibaba to install 128 cameras across 420 streets that used machine learning algorithms to predict optimal traffic flow (Barton et al., 2017). For automobiles, artificial intelligence has allowed for advancements in autonomous vehicles, route optimization, and battery enhancements for electric vehicles. This allows China to establish global leadership in the car sector with smart EVs, thus improving transportation sustainability (Greeven, Liu, 2025). AI provides improvements to healthcare such as better clinical diagnosis accuracy, new ways of drug discovery, and greater coverage for people living in rural areas through the use of digital healthcare and telemedicine (Greeven, Liu, 2025). Artificial intelligence will also advance industrial processes by incorporating robot-based processes like machine control, automatic detection, and predictive maintenance (Pitukhina, Gurtov, Belykh, 2024). In the state sector, experimental applications

of AI are advancing smart cities through the creation of digital administrative assistance and automated urban planning (Zeng, 2020).

China has positioned itself as the leader in AI research, accounting for the largest AI-related patents in the world (Slotta, 2025), and more than 73.4% of the total number of published AI papers (Yu, Liang, Xue, 2021). Also, China is listed as the leading country on citations in peer-reviewed journals (Pitukhina, Gurtov, Belykh, 2024). AI-related publications in China are rapidly increasing, having grown from 7276 in 2016 to around 42,556 papers in 2021 (Pitukhina, Gurtov, Belykh, 2024). China uses foreign partnerships to foster innovation and improve AI technology. For example, the amount of research output from the foreign partnerships China made, 51.1%, is more cited than its domestic counterparts (Yu, Liang, Xue, 2021). One of China's primary concerns regarding AI is securing national and intellectual property, so China dominates the number of AI-related patents (Slotta, 2025).

Political ideology in China is an impetus for the country's AI sector because the central government views AI policy as a way to demonstrate and expand the country's capabilities and governance style. For example, China adopts a light, regulatory approach to AI, which allows companies to experiment with technologies freely (Zeng, 2020). In 2017, the AI Development Plan stated, "AI is the new focus for the global competition on technologies, and AI constitutes the latest frontier for economic development" (Olotu, Famiyesin, 2024). This initiative highlights the political legitimacy that AI policy gives for future technology control in China. State policies align AI across the provincial levels to coordinate efforts (Olotu, Famiyesin, 2024). Many AI academic programs have been launched in over 30 universities throughout China (Olotu, Famiyesin, 2024). Overall, China legitimizes its expansion in AI by incorporating it into political and economic narratives.

3.2. Policy Framework

China's AI policy framework is characterized by an overt centralism with robust public sector investments into research, infrastructure, and industrial transformation over five years and has committed an additional 364 billion yuan in 2023 to sectoral growth and transformation (Pitukhina, Gurtov, Belykh, 2024). Such investments have fostered technological advancements by building over 250 advanced AI data centers and high-performance processors (Shao, 2025). They are also designed to serve the military and space industries to further achieve China's strategic ambitions (Shao, 2025). China's national policy plan further emphasizes the need to rapidly deploy physical infrastructure to support the burgeoning AI economy in all major industrial and administrative sectors to make the nation a global AI industry power (Greeven, Liu, 2025). However, such a highly centralized strategy may entail inherent risks of entrepreneurial and innovative constraints for an overreliance on state support. to become the global leader in artificial intelligence by 2030. To this end, the nation is investing 750 billion yuan (USD 105 billion).

Beyond infrastructure and investment, China's AI policies foster innovation and growth via flexible regulations by promoting public and private AI development. With 4300 AI companies in 2023 (Pitukhina, Gurtov, Belykh, 2024; Greeven, Liu, 2025), China's AI industry expansion is not solely dependent on government-funded entities. Regulatory and financial flexibility coupled with significant central funding has fostered the development of numerous companies that can operate within their own unique experimental spaces and develop AI-enhanced products and services to enhance all sectors. Furthermore, local governments are increasingly using AI to improve traffic, healthcare, and other critical public services (Shao, 2025), signaling a commitment to optimizing public services with intelligent technologies.

In line with AI development, China's national policies proactively address human capital deficiencies and ensure access to hardware resources by subsidizing the cost of high-performance computing (Greeven, Liu, 2025). To attract domestic and foreign AI researchers and engineers in a competitive field, China's national policies have strategically developed educational programs and incentives to mitigate the acute shortage of skilled AI professionals (Shao, 2025; Greeven, Liu, 2025). Through subsidized high-performance computing and talent development, AI adoption barriers are low for new startups as well as existing companies in China (Greeven, Liu, 2025), thus making the sector attractive for growth and experimentation.

Although the United States has imposed export controls on China's purchases of advanced semiconductors and manufacturing equipment, China's AI policy framework has successfully enabled the AI sector to adapt to this pressure. For example, the government has incentivized firms to optimize software efficiency and use less powerful and older hardware as a stop-gap strategy (Shao, 2025; Kilic, 2025). Furthermore, it has actively promoted the use of indigenous semiconductor manufacturers, thus increasing the resilience and autonomy of the nation's AI sector. Overall, China's flexible policy approaches have been successful in counteracting international pressure and keeping AI development competitive despite the semiconductor shortages.

With goals beyond sectoral development and economic benefits, China's AI policies are clearly aligned with an ideological framework. By prioritizing strategic AI advancement in areas such as health, transportation, and national defense, China hopes to increase and optimize the power of the state (Triolo, Schaefer, 2024; Shao, 2025). In addition, through policies designed to foster growth in autonomous vehicles and smart cities, China aims to promote public safety and welfare (Triolo, Schaefer, 2024). To increase national administrative competence, AI tools are being adopted across the country to modernize government administration and state control through smart cities, AI-based education, and a social credit system (Triolo, Schaefer, 2024; Shao, 2025). These approaches increase the competence of the state to govern efficiently.

To further optimize resources, China's national policies support the growth of the platform economy, particularly with gig work (Li, Moa, Zhou, 2022). However, in the context of growing gig work, regulatory frameworks for employment protection and compensation for workers are

lagging. Specifically, lack of insurance portability and flexible healthcare plans for contract workers lead to significant economic vulnerability for them and necessitate the need for policy innovation (Li, Moa, Zhou, 2022). As such, China's national policies should also adopt measures to strengthen social security and welfare for gig workers such as the introduction of flexible benefit accounts.

Studies on policies related to AI in BRICS countries have found that they lead to improvements in economic growth rates, higher employment rates, and more productive economic output (Abir et al., 2024). In addition to this positive effect, results suggest that the interplay between governance quality and the integration of AI into policies has a positive association with economic outcomes (Saba, Ngepah, 2024). As such, economic success brought about by the integration of AI into national policies will become significantly greater if there is also a commensurate improvement in the quality of governance (Saba, Ngepah, 2024). This result reinforces the point of view that well-structured regulatory practices in AI sector policies can significantly enhance a country's ability to adapt to economic shocks and to improve national resilience to labor and technology disruptions.

In sum, the national policies around AI and platform economies that support their growth in China demonstrate a strong centralized structure and approach to regulation to foster sectoral growth and expansion.

4. Impact on Employment Structure

The transformation that artificial intelligence has brought on China's job market has caused different changes concerning job availability, as well as within certain industries and regions. However, these changes have also opened new job opportunities in certain regions or industries. It is crucial to examine how AI is affecting the job market in China to learn about China's future economic and societal success.

4.1. Job Market Transformation

The effect on China's job market, due to AI, is characterized by job loss combined with job creation. According to predictions, 26% of employment will likely be automated or displaced by AI in the next two decades, while net employment will increase by 12%, creating around 90 million new jobs (Chang et al., 2017).

The effect of AI on China's sectoral labor changes, in the next two decades, predicts a rise of 29% for employment in the service sector, 23% for construction, and 39% for industry. However, agriculture will see a net loss of 10% (Chang et al., 2017). This shift will have a particularly adverse effect on the job market in areas that rely heavily on agriculture, where the ability for employees to find jobs elsewhere is limited due to a lack of connectivity

and technology. The anticipated rise in manufacturing and services, though, is coherent with the goals of China's development strategy in areas such as urbanization, etc.

The substitution of repetitive, low-skill jobs by AI and robots initially means a loss of jobs, but this will lead to an improvement in the overall quality of jobs. This is observed in China's manufacturing sector, where the U-shaped curve exhibits a significant and positive effect (Huo, Ruan, Cui, 2024). Furthermore, AI is expected to reduce the income gap by generating job opportunities in areas with lower rates of employment. However, employment quality will ultimately depend on the ability of governments and organizations to implement policies that mitigate the initial unemployment effect in certain areas.

Employment polarization is heightened by the adoption of AI and digital technologies as demand for low-skilled employees falls and for medium- and high-skilled jobs grows. This describes a 'hollowing out of the middle' (Karippacheril, Alassani, Pela, 2024), which can lead to skill-based inequality. The accelerated introduction of AI could further contribute to the skills mismatch already prevalent in China's job market, threatening the progress of inclusive economic development. AI could impact almost 40% of the workforce and employment in many countries, adding to the likelihood that this phenomenon will worsen, leading to increased societal inequality.

One effect of AI adoption in China is that labor structure and the level of skill exhibited are better in coastal provinces, which have relatively advanced digital infrastructure, high labor costs, and an aging population (Hua et al., 2024; Wang, Chen, Chen, 2024). On the other hand, there are higher employment rates in regions with poor digital infrastructure and low labor costs. Therefore, it is essential to consider regional disparities to improve overall job quality.

With the growth of AI and digital technologies, new business models have emerged that provide more flexible employment options. Such AI-driven trends have made working as a platform or gig worker possible. Though these opportunities facilitate greater job flexibility and a wider range of employment choices, such benefits do not come without drawbacks, such as a lack of benefits, limited job security, and regulatory measures to manage new job types. Thus, governments and organizations should consider such effects when considering and implementing AI and digital technologies in China to ensure job security and social welfare.

The current upgrading and optimization of the labor force are due to industrial restructuring prompted by the adoption of AI and digitalization. AI and digitalization are helping China advance up the industrial chain and optimize its sectoral production (Wang, Chen, Chen, 2024). With greater technical expertise required to operate and maintain AI-driven facilities, traditional manual labor is replaced. However, the new industrial trends lead to various labor challenges.

Interregional labor flows have increased because of regional integration within the Chinese labor market. Furthermore, spatial heterogeneity models provide evidence that the effect of AI adoption is positively correlated to other provinces in close proximity (Wang, Chen, Chen, 2024). As such, it is essential to consider the interconnection of labor trends between

different provinces to facilitate the smooth integration and optimization of the labor force across all regions.

Displacement of employees in unskilled and routine-intensive jobs as a result of AI adoption has worsened in China. However, structural transformation in this area also implies an upgrading of the skills of the workforce. Regions and provinces with high labor market protection and relatively strong digital infrastructure show a more positive influence on employment structure (Hua et al., 2024). This suggests that the lack of such resources and infrastructure leads to a negative effect, resulting in poorer integration of resources in AI and technological advancements, thus widening the disparity in employment structures between regions.

The introduction of AI in the Chinese manufacturing sector has brought upon adverse effects on employment and skill mismatches and heightened the income gap. This reflects the unequal growth effects between skill groups and, to some extent, an increasing skills mismatch as a consequence of AI. However, large-sized organizations and firms show relatively less negative impacts, thus supporting evidence of heterogeneity (Ren, Ishak, Hamzah, 2024).

China's unemployment rates are up due to the loss of low- to medium-skilled jobs. Additionally, due to skills-job mismatches, higher education graduates often struggle to find jobs. According to Ren, Ishak and Hamzah (2024), "The AI implementation increases the unemployment rate in provinces with a higher proportion of the population with a higher education degree". This demonstrates the growing challenge facing educated workers in the Chinese labor market, which has not yet optimized a suitable ecosystem of education or upskilling opportunities.

The increasing demand for AI-related jobs also poses challenges for the government due to the large skills gap between job requirements and current capabilities of employees and job-seekers. With China now the country with the greatest employment in AI-related jobs, the need for digital talent and digital upskilling has also increased (Liu Yukun, 2024). In China, AI programmers receive an 81.3% higher premium for technology roles and a 39.4% higher premium for non-technical roles compared to non-AI programmers (Liu J. et al., 2025). As such, more AI programmers will fill those in-demand roles, highlighting the importance of China filling in its skills gap in the technological areas. The national talent shortage is also estimated to be around 25 to 30 million, indicating an increasing need for investment in upskilling, education, and training programs to promote digital talents that can meet the increasing demand.

The forecasts of total employment will depend on a variety of other factors, such as economic conditions, external factors, policies, investments, and technologies (Chang et al., 2017; Wang, Chen, Chen, 2024). This can lead to greater risks of job losses despite the overall benefits that AI adoption brings to economic activity.

China's labor market is undergoing transformation and optimization. AI is used in China's labor market to improve its efficiency. As a result, there are new challenges arising that need to be considered to provide stable and positive economic results.

4.2. Emerging Professions

The emergence of new professions is inseparable from the rapid development of artificial intelligence and the growth of digital economy and platform economy. In the four years from 2021 to 2024, over 50 new types of occupations emerged. Whether it's e-commerce, entertainment, logistics, or smart manufacturing, artificial intelligence has injected new vitality into almost all fields (Liu, 2024). The jobs like livestreaming anchor, AI trainer, drone pilot, and medical escort reflect both the transformation and the new requirements for work. The content of the work and the requirement for personnel are changing drastically as artificial intelligence is being more widely used in various areas (Rashid, Kausik, 2024). Moreover, the most-developed platform economy in the urban areas promotes the development of new professions. However, different progress of digitalization in different areas leads to the problem of inequality. More opportunities for new professions will be generated in the eastern China compared to the western China.

The shortage of AI-related professionals can be well supported by the data on job posting. According to statistics, the posting of AI trainer-related roles increased by 62% and the posting of drone pilot jobs soared by 177% (Liu, 2024). Besides logistics, agriculture, and disaster relief, AI has also been widely used to improve service experience, efficiency, and reliability. The shortage of talent and the high demand for such professions are in line with the fact that many high-tech professions command decent salaries. AI engineer tops the chart with the highest average monthly salary in China (RMB 24,127) (GT staff reporters, 2024). Moreover, the recruitment demand for drone assembly and testing positions increased by 82.7%, which is a reflection of high growth. In addition to the fact that these kinds of jobs usually have higher salaries, the supply of professionals is far lower than demand, resulting in a large gap. These professions will encounter problems recruiting talent from the job market, as a sufficient supply will be extremely hard. Hence, China still needs to optimize the current educational system and workforce training so as to reduce the talent shortage and catch up with the trend (GT staff reporters, 2024).

The application of artificial intelligence to the fields of manufacturing, medical care, and climate also created some new professions such as AI algorithm engineer, chip designer, and developer of multimodal AI system (GT staff reporters, 2024). Many emerging professions are specialist jobs that require a high degree of expertise in some of these industries. For instance, the positions in medical area such as responsible AI ethicist and AI interpreter are created to combine professional knowledge in the medical area with technical capabilities of artificial intelligence. The positions in medical areas require individuals that have experience and a good understanding of the industry, along with knowledge of how to properly apply

artificial intelligence to that particular field to enhance service quality and reliability. Similar things have happened in finance-related fields. In addition, roles that facilitate the transformation from fossil fuel to sustainable energy are also emerging, with the help of AI. China is the country that employs the most workers in renewable energy, accounting for 46% globally (Li, Shine, 2025). Moreover, jobs related to AI-enabled devices and other technologies applied in climate change mitigation and adaptation are growing fast (GT staff reporters, 2024). This has proved that AI-related jobs are more diversified than general digital jobs, and future success will be dependent on the development of multidisciplinary talent.

China is still facing a severe shortage of digital talent at both national and city levels. According to estimations, the shortage of digital professionals is about 25 to 30 million nationwide (Liu, 2024). With the shrinking of the working-age population, the digital economy can suffer further from talent shortage unless more professionals are hired, promoted, and retained (GT staff reporters, 2024). Although professional skills and knowledge are being continuously enriched due to the rapid technological evolution, educational institutions have failed to catch up and thus there are few graduates prepared for emerging jobs (GT staff reporters, 2024). Policymakers and organizations have responded to the shortage of digital workers by improving digital talent training and reskilling programs, but these policies remain inadequate. Moreover, there is also the issue of digital imbalance at the city level. Cities with higher digital penetration have attracted a large percentage of digital professionals, while regions with lower digital penetration have lost considerable digital talent.

With the development of AI, roles for domestic service jobs, such as babysitter or companion of the elderly, are becoming more popular. According to recent data, recruitment demand in the elderly care sector increased by 21%, and the recruitment need for baby or toddler care increased by 34% (Liu, 2024). Most elderly individuals are able to understand and accept new services and experiences introduced to them, supported by new technologies. Moreover, 83% of the elderly users of elderly-care services are very satisfied with what artificial intelligence offers them (Zhao, Li, 2024).

To reflect the labor market's current needs, the Chinese government has updated the national occupation classification system and released a list of 97 new digital occupations (Liu, 2024). New job titles such as fintech professional, e-sports job, and digital engineering professional are included to reflect the market's current conditions (GT staff reporters, 2024). As more new occupations are emerging, these changes highlight the necessity of improving the national education system and talent training to meet the market's demand.

The emergence of AI has brought new requirements to many conventional occupations. The core skills such as problem-solving, constant learning, and ability to interact with automated systems are now of crucial importance to be qualified for AI-based professions (Chowdhury, 2021). Also, the changes in labor markets lead to changes in the roles of AI talents. All of these things together are redefining professional identity.

5. Discussions

The challenges and future implications of artificial intelligence for China's labor market highlight skill mismatches, regional disparities, technological unemployment, and the ethical implications of AI that require immediate and decisive actions.

Persistent skill mismatches and high regional disparities hamper China's pursuit of equitable AI-driven economic growth. High-tech sectors like advanced manufacturing and technology demand a workforce with proficient STEM capabilities, an issue exacerbated by lagging vocational training and education in underdeveloped rural economies (Shi, 2024). Urban metropolises like Beijing and Shanghai outperform their rural counterparts in productivity, intensifying regional imbalances (Zhang, 2024). To counteract skill mismatches, training and re-skilling in areas like digital technologies and green-technology infrastructure should be strengthened at a regional level (Li, Shine, 2025). Expanding educational and technological infrastructure outside urban centers to include rural areas will be necessary for inclusive growth and the narrowing of regional divides.

With growing automation and AI, up to 51% of China's jobs are estimated to be under threat by the potential for replacement, especially repetitive and routine work (Pinar, 2024). Recent research indicates that, on average, 1.6 workers are displaced by the integration of a new robot into industrial tasks (Pinar, 2024; Liu et al., 2021). Industries characterized by labor-intensive, routine work, such as the production of electrical appliances, electronics, and machinery, are among those most significantly affected (Liu et al., 2021). While AI creates new jobs, it also results in increased unemployment, social instability, and underemployment, as a major portion of workers may not have the necessary skills to re-enter the workplace (Sun, 2024). Moreover, the decreasing labor force puts additional pressure on institutions and employers to engage in mass upskilling and training schemes. Therefore, addressing China's technological unemployment challenges will require extensive government-funded reskilling initiatives and the mobilization of businesses to ensure that their workforce receives training for emerging, in-demand AI-related skills.

AI-driven advances in industries such as renewables and big data have given rise to the rapid growth of new sectors and corresponding professions. Renewable energy industries, for example, employ 47% of the global workforce in the field of renewable energy (Li, Shine, 2025). Furthermore, AI trainers and drone pilots are among several emerging professions that are witnessing significant increases in demand. However, this dramatic growth has not yet been met with corresponding talent supply. By 2021, an estimated 50,000 individuals in China were trained in AI-related fields. This disparity fuels intense competition for jobs in strategic industries such as intelligent manufacturing, green industries, and climate technology, potentially lowering overall productivity and hindering industry advancement (Zhang, 2024). Policies promoting extensive, effective training programs will be instrumental in ensuring that

the growing skills gap is addressed and talent supply catches up with demand. Moreover, curriculum reform and the prioritization of lifelong learning in academic institutions should be undertaken to ensure students have the knowledge required to thrive in AI-driven fields.

Algorithmic management has led to increased labor extraction from individual workers, which is largely associated with lower job stability, lower employee satisfaction, and diminished autonomy (Sun, 2024). With algorithmic management, companies and employers achieve greater levels of control and data gathering, which leads to decreased bargaining power among workers. The increasing prevalence of algorithmic surveillance also hinders workers' ability to negotiate or bargain for fairer wages or better labor conditions, therefore lowering job quality. Policymakers must protect workers by regulating algorithms, enforcing fairer labor practices, and minimizing surveillance in workplaces.

Because AI has different impacts on the regional and national level across varying job titles and sectors, making generalizations about future employment in China is difficult. Previous studies on technological unemployment have shown that AI has a mixed impact on China's regions and sectors, causing increases and decreases in total employment (Filippi, Bannò, Trento, 2023; Shi, 2024). Thus, policymakers should approach this challenge by taking a regional approach. The regions or sectors with the most prevalent job disruption should be targeted through a social safety net that is specifically designed to address local economic, cultural, and employment factors.

The incorporation of AI into processes and tasks has greatly increased the productivity and energy efficiency of the electronics, robotics, and IT industries, which further advances China's goals of reducing national energy intensity and realizing national industrial modernization (Liu et al., 2021; Zhang, 2024). Yet, China's manufacturing industry accounts for over 70% of the country's total energy consumption. Thus, the large cloud computing and data-center industries are very high-energy sectors, as are heavy industries that utilize AI technology (Liu et al., 2021). This calls for policymakers to promote sustainable growth by incorporating green technology training and practices into industrial reskilling schemes.

Artificial intelligence will inevitably impact China's labor market, which requires extensive, coordinated actions to ensure a fair and more even transition to a post-AI labor market.

6. Conclusion

The purpose of this paper is to critically analyze the impact of AI on China's labor market in terms of opportunities and risks. This objective has been achieved through the analysis of the influence of technology advancement, governmental policies, restructuring of the labor market, and social impact. This paper seeks to answer the research question of how AI influences

China's employment. Through quantitative and qualitative analysis, it examines job creation and destruction as well as its impact on the country's economy and society.

Based on the analysis in the body of the paper, the entrance of AI into China's labor market is characterized by strong governmental intervention, industrial integration, the displacement of routine jobs, and the growth of new skills and occupations. This paper argues that China's AI policy has brought about the rapid rise of AI technology, which is characterized by strong governmental promotion and investment as well as the mobilization of technological innovation, as a result of which many non-skill-required jobs were terminated. However, the paper also argues that China's AI policy enables rapid growth in technology and leads to the rapid creation of new skills and occupations. The rapid growth leads to employment growth and offsets some of the job losses caused by AI technology. The paper also argues that AI policy tends to benefit urban areas and coastal provinces because of their advanced infrastructure and other resources, whereas rural and undeveloped areas cannot benefit from these policies as easily as urban areas.

This analysis also confirms that the global trend of the development of AI is converging with China's AI policy. However, China differs from other countries in the sense that the country's AI policy is driven by strong government interventions, compared to the policy or market forces in other countries. In addition, evidence of this analysis reveals the persistent trend of skill mismatches and skill gaps, particularly regarding digital talent, in the job market, thus highlighting the importance of multiple skills.

The main contribution of this research is that it provides a comprehensive review and analysis of empirical data and previous studies and adds China's AI phenomenon to the debate on the impact of new technology on labor and society. It also provides implications to policymakers on how to prevent widening gaps between the developed and less-developed economies in order to embrace technology without suffering its undesirable effects.

The limitations of this paper are that, first, the main source of data is secondary data, for example, government and industry reports, which may vary regarding reliability, precision, comprehensiveness, and so on. In addition, as a developing, relatively unexplored market, the lack of research on this market poses a challenge for drawing meaningful inferences. This limitation hinders the ability of the research to identify causality, as the primary method used is review and synthesis and does not engage empirical analysis. Lastly, the research suffers from a lack of dynamism, as the data are only recent and do not reflect future trends, which makes it difficult to foresee the long-term implications of the integration of AI technology.

Future research should further examine the ethical and social dimensions of technology-related career and organizational development. This includes, for example, the creation of an ethical work environment or the impact of automation on the future of work. Empirical research should explore the consequences and effectiveness of various policy interventions on the impact of technology and technology management on the workforce, such as education reform, vocational training, and the promotion of social equality. Further research should also

investigate the influence of social and political ideology on the process of technological change in a nation or economy. Lastly, the longitudinal analysis of the effects of artificial intelligence technology on human resource management, technology-related workforce development, and the development of jobs and careers is another potential area for further investigation.

Through this research, I learned about the growing gap and the complicated relationships between technology advancement and the job market. This research project motivates me to dive into the topics that combine society, economics, technology, and human resources and careers.

References

1. Abir, S.I. et al. (2024). Accelerating BRICS Economic Growth: AI-Driven Data Analytics for Informed Policy and Decision Making. *Journal of Economics, Finance and Accounting Studies*, 6(6), pp. 102-115. DOI: 10.32996/jefas.2024.6.6.8
2. Barton, D., Woetzel, J., Seong, J., Tian, Q. (2017). *Artificial Intelligence: Implications for China*. <https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/China/Artificial%20intelligence%20Implications%20for%20China/MGI-Artificial-intelligence-implications-for-China.pdf>
3. Chang, J., Atkinson, J., Wood, M., Likens, S. (2017). *The net impact of AI and related technologies on jobs in China*. China: PwC.
4. Chowdhury, M. (2021). *The Evolution of Artificial Intelligence: Past, Present & Future, Analytics Insight*, pp. 1-4. <https://www.analyticsinsight.net/artificial-intelligence/the-evolution-of-artificial-intelligence-past-present-future>
5. Filippi, E., Bannò, M., Trento, S. (2023). Automation technologies and their impact on employment: A review, synthesis and future research agenda. *Technological Forecasting and Social Change*, 191, p. 122448. DOI: <https://doi.org/10.1016/j.techfore.2023.122448>
6. Greeven, M.J., Liu, S. (2025). *China's technology sector: AI innovation drives market leadership as domestic powerhouses diversify, Asian hub*, pp. 1-4. <https://www.imd.org/ibyimd/asian-hub/chinas-technology-sector-ai-innovation-drives-market-leadership-as-domestic-powerhouses-diversify/>
7. GT staff reporters (2024). China's job market sees high demand for AI, big data talent: minister. *Global Times*, pp. 1-5. <https://www.globaltimes.cn/page/202403/1308559.shtml>
8. Hua, S. et al. (2024). Does robotization improve the skill structure? The role of job displacement and structural transformation. *Applied Economics*, 56(28), pp. 3415-3430. DOI: <https://doi.org/10.1080/00036846.2023.2206623>

9. Huo, Q., Ruan, J., Cui, Y. (2024). 'Machine replacement' or 'job creation': How does artificial intelligence impact employment patterns in China's manufacturing industry? *Front Artif Intell*, 7, 1337264. DOI: <https://doi.org/10.3389/frai.2024.1337264>
10. Karippacheril, T.G., Alassani, A., Pela, K. (2024). The Age of AI, Jobs, and Inequality. *Knowledge4Jobs Newsletter*, April, pp. 1-7. <https://www.jobsanddevelopment.org/wp-content/uploads/2024/04/K4J-march-2024.pdf>
11. Kilic, B. (2025). AI, Innovation and the Public Good: A New Policy Playbook. *CIGI Papers*, No. 318, pp. 1-23. https://www.cigionline.org/documents/3280/no._318Kilic_gH6nWFl.pdf
12. Li, D., Tong, T.W., Xiao, Y. (2021). Is China Emerging as the Global Leader in AI? *Harvard Business Review*, pp. 1-2. <https://hbr.org/2021/02/is-china-emerging-as-the-global-leader-in-ai>
13. Li, H. (2023). AI in Education: Bridging the Divide or Widening the Gap? Exploring Equity, Opportunities, and Challenges in the Digital Age. *Advances in Education, Humanities and Social Science Research*, 8, pp. 355-360. <https://madison-proceedings.com/index.php/aehtsr/article/download/1924/1915>
14. Li, L., Moa, Y., Zhou, G. (2022). Platform economy and China's labor market: structural transformation and policy challenges. *China Economic Journal*, 15(2), pp. 139-152. DOI: <https://doi.org/10.1080/17538963.2022.2067685>
15. Li, R., Shine, I. (2025). *The future of jobs in China: the rise of robotics and demographic decline are opening up skills gaps*. Forum Stories. World Economic Forum. <https://www.weforum.org/stories/2025/04/the-future-of-jobs-in-china-the-rise-of-robotics-and-demographic-decline-are-opening-up-skills-gaps/>
16. Liu, J. et al. (2025). Generate the Future of Work through AI: Empirical Evidence from Online Labor Markets. *Information Systems Research*, pp. 1-42. <https://arxiv.org/pdf/2308.05201>
17. Liu, L., Yang, K., Fujii, H., Liu, J. (2021). Artificial Intelligence and Energy Intensity in China's Industrial Sector: Effect and Transmission Channel. *Munich Personal RePEc Archive*, 106333, pp. 1-37. https://mpra.ub.uni-muenchen.de/106333/1/MPRA_paper_106333.pdf
18. Liu, Y. (2024). Aps rise sparks new professions, reshapes employment landscape. *China Daily*. <https://www.chinadaily.com.cn/a/202406/05/WS665fa1d6a31082fc043cae8b.html>
19. Olotu, G., Famiyesin, M.O. (2024). Artificial Intelligence and Global Power Dynamics: China's Economic Ascendancy. *Hyuku International Journal of Politics and Development Studies (HIJPDS)*, no. 1, pp. 1-12. [https://hijpdsjournal.org.ng/wp-content/themes/uploads/Artificial%20Intelligence%20and%20Global%20Power%20Dynamics-China's%20Economic%20Ascendancy\(1\).pdf](https://hijpdsjournal.org.ng/wp-content/themes/uploads/Artificial%20Intelligence%20and%20Global%20Power%20Dynamics-China's%20Economic%20Ascendancy(1).pdf)
20. Pinar, A. (2024). Technological Unemployment and the AI Revolution: An Investigation on Macroeconomic Consequences. *Econharran Harran Üniversitesi İktisadi ve İdari*

- Bilimler Fakültesi Dergisi*, 8(2), pp. 15-26. <https://dergipark.org.tr/tr/download/article-file/4081404>
21. Pitukhina, M.A., Gurtov, V.A., Belykh, A.D. (2024). The Review of Chinese Artificial Intelligence Labor Market: Both in Figures and Skills. *Journal of Siberian Federal University. Humanities & Social Sciences*, 17(3), pp. 580-591. https://elib.sfu-kras.ru/bitstream/handle/2311/152712/14_Pitukhina.pdf?sequence=1&isAllowed=y
 22. Rashid, A.B., Kausik, A.K. (2024). AI revolutionizing industries worldwide: A comprehensive overview of its diverse applications. *Hybrid Advances*, 7, p. 100277. DOI: <https://doi.org/10.1016/j.hybadv.2024.100277>
 23. Ren, J., Ishak, S., Hamzah, H.Z. (2024). AI and the Future of Work: Investigating the Transformation of the Labor Market in China's Secondary Sector with a Focus on Income Distribution, Skill Gaps, and Unemployment Rates. *Cuadernos de Economía*, 47(134), pp. 38-52. DOI: <https://doi.org/10.32826/cude.v47i134.1405>
 24. Saba, C.S., Ngepah, N. (2024). The impact of artificial intelligence (AI) on employment and economic growth in BRICS: Does the moderating role of governance matter? *Research in Globalization*, 8, pp. 1-2. DOI: <https://doi.org/10.1016/j.resglo.2024.100213>
 25. Shao, G. (2025). China's AI Breakthrough Signals a New Era of Tech Innovation. *The Diplomat*. <https://thediplomat.com/2025/02/chinas-ai-breakthrough-signals-a-new-era-of-tech-innovation/>
 26. Shi, T. (2024). The Economic Implications of Skill Mismatch in China's Labor Market: A Focus on Higher Education Graduates. *Law and Economy*, 3(10), pp. 30-38. DOI: 10.56397/LE.2024.10.05
 27. Slotta, D. (2025). *Artificial intelligence in China - statistics & facts*. <https://www.statista.com/topics/8383/artificial-intelligence-in-china/>
 28. Sun, N. (2024). *Workplace AI in China*. London: The Royal Institute of International Affairs. DOI: 10.55317/9781784136154
 29. Triolo, P., Schaefer, K. (2024). *China's Generative AI Ecosystem in 2024*. The National Bureau of Asian Research. <https://www.nbr.org/publication/chinas-generative-ai-ecosystem-in-2024-rising-investment-and-expectations/>
 30. Wang, X., Chen, M., Chen, N. (2024). How artificial intelligence affects the labour force employment structure from the perspective of industrial structure optimization. *Heliyon*, 10(5). DOI: <https://doi.org/10.1016/j.heliyon.2024.e26686>
 31. Yu, Z., Liang, Z., Xue, L. (2021). *A data-driven global innovation system approach and the rise of China's artificial intelligence industry*. *Regional Studies*. DOI: 10.1080/00343404.2021.1954610
 32. Zeng, J. (2020). Artificial intelligence and China's authoritarian governance. *International Affairs*, 96(2), pp. 419-438. DOI: <https://doi.org/10.1093/IA/IIAA172>

33. Zhang, Y. (2024). Artificial Intelligence and the Transformation of China's Industrial Structure. *SHS Web of Conferences*, 208, 01017. DOI: <https://doi.org/10.1051/shsconf/202420801017>
34. Zhao, Y., Li, J. (2024). Opportunities and challenges of integrating artificial intelligence in China's elderly care services. *Scientific Reports*, 14(1), pp. 1-17. DOI: <https://doi.org/10.1038/s41598-024-60067-w>

ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCES MANAGEMENT: A MOMENTARY TREND OR NECESSITY?

Bogdan PLISZKA

Silesian University of Technology; bogdan.pliszka@polsl.pl, ORCID: 0000-0002-3021-905X

Purpose: The reason for writing this article is to answer the question about using artificial intelligence as a tool in human resources management. Is this a temporary trend caused by the fashion for using this new, not fully tested tool, or maybe a necessity in a world of increasingly complex social processes in which artificial intelligence plays an increasingly important role.

Project/methodology/approach: The purpose of this analysis is to try to understand what the tasks of artificial intelligence in human resources management are. How do different authors see the role of these tasks. The methodology used is the analysis of distributed sources, in which the authors try to answer not only the question about the current role of artificial intelligence in human resources management, but also about its role in the future. The article tries to analyze different sources and related approaches to the topic.

Practical implications: Artificial intelligence is a relatively new tool in the hands of managers. The article, based on the analyzed sources, tries to answer the questions; whether and to what extent it will be a helpful tool in human resources management. As well as to what extent the experience gained in previous work will be helpful and to what extent they will hinder the implementation of tasks using artificial intelligence.

Social implications: The article may be a signal to management regarding a completely new tool in their work. It may also signal the existence of traps in thoughtless use of artificial intelligence.

Originality/value: The integration of Artificial Intelligence into Human Resources Management is no longer a speculative trend but a transformative necessity. From automating repetitive tasks and enhancing decision-making to personalizing employee experiences and forecasting workforce trends, AI is fundamentally reshaping the HR landscape.

Keywords: human resources, Artificial Intelligence, management, new technologies.

Category of the paper: Research paper.

1. Introduction

In the 21st century, technological advances have redefined traditional practices in almost all industries, including human resource management (HRM). Once a science fiction topic, artificial intelligence (AI) has now permeated organizational practices and led to a paradigm

shift in the way organizations handle their most valuable assets: their employees (Rothmann, Mahomed, 2019). The debate on whether AI in HRM is a passing trend or an emerging necessity has become of considerable importance in the scientific, practical, and political spheres. The purpose of this paper is to examine the convergence of AI technologies with HRM practices, assess the benefits and challenges of such implementation, and evaluate whether the introduction of AI in HRM is a passing innovation or an indispensable advancement. By analyzing current applications, case studies, and future projections, this study aims to provide a comprehensive understanding of the transformative impact of AI on the HR function. The scope of this paper includes detailed theoretical background, practical applications, advantages, challenges, ethical considerations, and future prospects related to AI in HRM. The study is based on a wide range of sources, including academic articles, industry reports, and case studies.

2. Theoretical background

2.1. Definition of artificial intelligence

Artificial intelligence (AI) refers to the simulation of human intelligence processes by machines, especially computer systems (Russell, Norvig, 2020). These processes include learning, logical thinking, problem solving, perception, and language understanding. AI systems are designed for tasks that usually require human cognition and are continuously improved through data-driven learning algorithms (Goodfellow, Bengio, Courville, 2016). In the broader field of artificial intelligence, subfields such as machine learning (ML), natural language processing (NLP), and robotic process automation (RPA) play an important role in improving human resource functions (Jordan, Mitchell, 2015). AI has the potential to analyze large amounts of data, identify patterns, and provide predictive recommendations, which makes it a powerful tool in modern organizational environments.

2.2. The development of human resource management

Human resource management has evolved from administrative personnel management to a strategic function that is critical to the success of a business (Ulrich, 1997). Traditionally, HR processes are labor-intensive and rely heavily on human judgment, resulting in inefficiency and bias (Storey, 2007). The integration of digital technologies has gradually transformed HRM, culminating in the introduction of AI-driven systems to achieve greater accuracy, efficiency, and strategic alignment (Cascio, Montalegre, 2016).

The digital transformation of HRM can be divided into three waves: HRM 1.0 (administrative focus, 1950s to 1980s), HRM 2.0 (strategic HRM, 1990s to 2010s), and HRM 3.0 (digital and AI-enabled HRM, 2010s to present) (Bondarouk, Brewster, 2016).

3. Application of AI in Human Resource Management

3.1. Recruitment and Candidate Selection

AI has revolutionized the recruitment and selection process, making hiring decisions more efficient, fair, and data-driven. Traditional methods, which often require time-consuming manual review of resumes, are now being supplemented or replaced by AI tools that can analyze thousands of applications in seconds (Upadhyay, Khandelwal, 2018). These tools use algorithms to identify keywords, match qualifications to job descriptions, and evaluate candidates based on predefined metrics (Black, van Esch, 2020).

AI platforms such as HireVue and Pymetrics use machine learning and natural language processing to conduct preliminary interviews, analyze tone, facial expressions, and word choice, and predict whether a candidate is a good fit for the position (Chamorro-Premuzic et al., 2017). This not only speeds up the recruitment process, but also improves objectivity by minimizing the human bias inherent in traditional assessments (Raghavan et al., 2020).

Additionally, AI chatbots improve the candidate experience by providing 24/7 support, answering common questions, and automatically scheduling interviews (Langer, König, 2018). Companies such as Unilever have reported significant improvements in recruitment outcomes through AI, including increased diversity, reduced costs, and improved retention (Deloitte, 2020).

3.2. Talent Management and Employee Development

AI is revolutionizing talent management through a personalized and dynamic approach to employee development. By analyzing performance data, learning patterns, and career trajectories, AI systems can develop customized training plans that meet organizational goals and individual needs (Sivathanu, Pillai, 2018).

AI-powered learning management systems (LMS) recommend specific learning modules, courses, and certifications based on an employee's role, skills gaps, and performance metrics (Sharma, Sharma, 2020). These platforms also monitor engagement and adjust content delivery in real time to optimize learning outcomes (Wang, Siau, 2019).

AI coaching platforms like BetterUp use behavioral analytics and goal-setting frameworks to provide virtual coaching and performance feedback. This ensures continuous, personalized, and data-driven development and promotes long-term career development and loyalty to the company (Jarrahi, 2018).

3.3. Performance Evaluation and Employee Engagement

Performance evaluations in the past have been characterized by subjectivity, timeliness bias, and inconsistent metrics. AI addresses these challenges through real-time performance tracking, pattern recognition, and predictive analytics (Meijerink et al., 2020). Advanced platforms analyze project contributions, collaborative behaviors, and results to create holistic performance reports (Storey, 2007). AI-powered continuous feedback systems allow managers to gain actionable insights without waiting for annual reviews. This promotes transparency, encourages regular dialogue, and supports agile performance management practices (Cascio, Montalegre, 2016).

To improve employee engagement, sentiment analysis tools use communication channels such as emails and surveys to capture emotions, stress levels, and overall satisfaction (Zhang et al., 2020). These findings help take proactive interventions to improve work atmosphere and reduce the risk of turnover (Tursunbayeva et al., 2018).

3.4. HR Data Analysis and Trend Forecasting

HR analytics (often referred to as people analytics) has been significantly improved through AI capabilities. These tools collect and analyze large data sets from a variety of sources (such as employee records, surveys, and performance indicators) to discover patterns and predict future outcomes (Bondarouk, Brewster, 2016).

AI enables workforce planning models that predict talent shortages, succession risks, and hiring needs based on internal mobility trends and external labor market data (Ulrich, 1997). These predictions are critical for proactive strategic planning and risk mitigation.

Moreover, scenario modeling powered by AI supports decision-makers in simulating the impact of policy changes, restructuring, or training initiatives on workforce dynamics (Russell, Norvig, 2020). This elevates HR's role from a support function to a strategic business partner.

4. Benefits of AI Integration in Human Resources Management

The integration of Artificial Intelligence (AI) into Human Resources Management (HRM) has brought about substantial transformation, redefining how organizations manage people and develop strategic value from their workforce. The use of AI technologies not only improves operational efficiency but also enhances the strategic capabilities of HR departments by

enabling data-driven decision-making, personalizing employee experiences, and optimizing resource allocation (Jarrahi, 2018). This section provides an in-depth analysis of the key benefits of AI implementation in HRM, including increased efficiency, better decision-making, cost reductions, enhanced employee engagement, and improvements in diversity and inclusion practices.

4.1. Increased Efficiency and Automation of Repetitive Tasks

One of the most immediate and tangible benefits of AI in HRM is the automation of repetitive and administrative tasks. AI technologies such as Robotic Process Automation (RPA) can handle routine operations including employee onboarding, payroll processing, benefits administration, and document management at a much faster pace and with fewer errors than human workers (Upadhyay, Khandelwal, 2018). For instance, AI-powered systems can automatically verify documentation, populate employee records, and generate compliance reports without manual input (Deloitte, 2020).

This automation frees HR professionals from mundane tasks and allows them to focus on more strategic roles such as organizational development, talent strategy, and workforce planning. As a result, companies report notable improvements in HR response times, reduced paperwork, and more streamlined processes (Meijerink et al., 2020).

4.2. Improved Decision-Making with Predictive Analytics

Another significant advantage of AI in HRM lies in its capacity for advanced data analysis. AI tools enable predictive analytics that help HR leaders make informed decisions based on historical data, behavioral trends, and real-time inputs (Cascio, Montealegre, 2016). For example, predictive models can identify employees who are at risk of leaving, suggest optimal times for hiring or training, and recommend promotion candidates based on performance data (IBM, 2019).

By using predictive analytics, HR departments can move from reactive to proactive management. Such tools provide insights that are otherwise hidden in large datasets, helping organizations to act early and prevent workforce disruptions. Furthermore, AI systems reduce human bias in decision-making by basing recommendations on objective criteria and algorithmic models rather than subjective intuition (Raghavan et al., 2020).

4.3. Cost Reduction and Resource Optimization

AI adoption in HRM also contributes to significant cost savings. Automating high-volume tasks reduces the need for large administrative teams, minimizing labor costs without compromising productivity. According to a McKinsey Global Institute report, AI technologies can reduce operational expenses in HR departments by as much as 30% when deployed effectively (McKinsey, 2017).

AI also optimizes resource utilization through smarter workforce planning. Tools equipped with AI can analyze workloads, employee competencies, and future business needs to allocate human resources more effectively (Ulrich, 1997). This not only ensures optimal performance but also reduces overtime costs and burnout by balancing workloads across teams.

4.4. Enhanced Employee Experience and Engagement

Employee experience has emerged as a critical factor in attracting and retaining talent. AI contributes to improving this experience through personalization and continuous engagement. Chatbots and virtual assistants provide employees with immediate support for HR-related inquiries, improving response times and accessibility (Tursunbayeva et al., 2018).

Furthermore, AI-enabled platforms track individual employee behaviors and preferences to customize learning, development, and wellness programs (Sharma, Sharma, 2020). These systems can suggest training courses, career paths, and even wellness initiatives based on an employee's engagement history and career objectives (Sivathanu, Pillai, 2018).

Sentiment analysis tools, which scan emails, feedback forms, and social media, help HR teams gauge morale and respond to concerns before they escalate. This fosters a culture of inclusivity and responsiveness, contributing to higher levels of satisfaction and loyalty among employees.

4.5. Enhancing Diversity and Inclusion Initiatives

Diversity and inclusion (D&I) remain central goals for modern organizations. AI can serve as a powerful tool in supporting D&I efforts by identifying and reducing unconscious bias in hiring and promotion decisions. AI tools anonymize candidate data during screening, ensuring that decisions are made based on qualifications and competencies rather than demographics (Raghavan et al., 2020).

In addition, AI-driven dashboards allow HR teams to monitor diversity metrics across departments and adjust recruitment strategies accordingly. Such real-time tracking provides transparency and accountability in D&I initiatives. However, organizations must remain vigilant about the data used to train AI systems, as biased datasets can perpetuate existing inequalities (Binns, 2018).

4.6. Strategic Workforce Planning and Agility

AI enhances an organization's strategic agility by enabling real-time workforce analytics and scenario modeling. HR departments can simulate the impact of business decisions—such as mergers, reorganizations, or layoffs—on workforce composition and performance (Bondarouk, Brewster, 2016). These simulations help prepare contingency plans and facilitate smoother transitions during organizational changes.

AI tools also support continuous alignment between workforce capabilities and strategic business goals. Through skills gap analysis and talent forecasting, AI helps leaders plan for future needs and ensure readiness in an ever-evolving business environment.

5. Challenges and Ethical Considerations in Implementing AI in HRM

While Artificial Intelligence (AI) offers numerous benefits to Human Resources Management (HRM), its implementation is not without significant challenges. As organizations increasingly integrate AI technologies into their HR functions, they must navigate a complex landscape of ethical dilemmas, technical limitations, legal constraints, and organizational resistance. This section provides a comprehensive exploration of the key challenges and ethical considerations related to AI in HRM, focusing on algorithmic bias, data privacy, transparency, accountability, and change management (Binns, 2018).

5.1. Algorithmic Bias and Discrimination

One of the most widely discussed ethical concerns in AI-based HRM is algorithmic bias. Although AI is often perceived as objective, it can reflect and even exacerbate existing human biases if trained on skewed or incomplete datasets (Raghavan et al., 2020). For example, Amazon famously scrapped an AI recruiting tool that favored male candidates for technical roles because the training data reflected historical hiring patterns biased against women (Dastin, 2018).

Bias can be introduced at multiple stages, including data collection, model selection, and algorithm design. If unchecked, these biases can result in discriminatory practices in hiring, promotions, and evaluations, undermining diversity and inclusion efforts (Mehrabi et al., 2021). Therefore, HR professionals must work closely with data scientists to audit and validate AI systems, ensuring that they promote fairness and equity.

5.2. Data Privacy and Confidentiality

AI systems in HRM rely heavily on data—often personal, sensitive, and confidential. From tracking employee performance and behavior to processing biometric data and communication patterns, AI can gather and analyze vast quantities of information (Tursunbayeva et al., 2018). While this enables powerful insights, it also raises serious privacy concerns.

Employees may feel that their autonomy and personal space are being violated, particularly when AI systems operate without transparency. The General Data Protection Regulation (GDPR) in the European Union, along with other privacy laws, mandates strict controls over how employee data can be collected, stored, and used (Voigt, von dem Bussche, 2017).

Organizations must implement robust data governance frameworks and ensure that AI systems comply with legal requirements, including the right to explanation and consent.

5.3. Lack of Transparency and Explainability

Another major challenge in AI-driven HRM is the lack of transparency in algorithmic decision-making. Many AI models—especially those based on deep learning—function as 'black boxes,' offering limited insight into how specific decisions are made (Burrell, 2016). This can be particularly problematic in HR contexts where decisions about hiring, promotions, or performance reviews must be clearly justified to maintain trust and legal defensibility.

Explainable AI (XAI) has emerged as a field focused on making algorithms more interpretable. However, the balance between accuracy and interpretability remains difficult to achieve. HR professionals must advocate for transparency in AI systems and collaborate with vendors who prioritize model explainability.

5.4. Accountability and Liability Issues

As AI systems become more autonomous, questions about responsibility and accountability become increasingly complex. When an AI system makes a decision that adversely affects an employee—such as rejecting a qualified applicant or issuing an incorrect performance rating—who is to blame? The software developer, the HR department, or the executive leadership? (Eubanks, 2018).

These grey areas present significant legal risks. Organizations must clearly define roles and responsibilities for AI oversight, ensuring that human review mechanisms are in place to catch and correct erroneous or unjust outcomes. This includes regular audits, ethical review boards, and the designation of responsible AI officers or teams.

5.5. Resistance to Change and Organizational Culture

Implementing AI in HRM also faces internal resistance from employees and HR practitioners who fear job displacement, loss of control, or skill obsolescence (Susskind, Susskind, 2015). Resistance is especially prevalent in organizations with hierarchical cultures or limited technological maturity.

Overcoming resistance requires transparent communication, inclusive implementation strategies, and continuous upskilling. Change management initiatives should emphasize the collaborative nature of AI—augmenting rather than replacing human roles—and involve stakeholders at every stage of deployment (Kotter, 2012).

5.6. Reliability, Security, and System Failures

AI systems are not immune to technical issues. Bugs, system outages, and cyberattacks can compromise the reliability of HR functions and erode employee trust. For instance, an error in an AI scheduling system could result in misassigned shifts or unprocessed payroll, leading to operational disruptions and dissatisfaction.

Furthermore, because AI systems often operate on cloud infrastructure and interface with multiple data sources, they become attractive targets for cyber threats. Organizations must invest in cybersecurity protocols, redundancy systems, and continuous monitoring to safeguard AI functionality (Brynjolfsson, McAfee, 2014).

5.7. Ethical Governance and Policy Development

In light of these challenges, establishing ethical frameworks for AI use in HR is crucial. Ethical governance involves setting clear policies on data use, bias mitigation, accountability, and employee rights. These frameworks should be developed collaboratively by HR leaders, legal teams, ethicists, and technical experts (Jobin, Ienca, Vayena, 2019).

Additionally, organizations should adhere to international ethical standards such as the OECD Principles on Artificial Intelligence and the AI Ethics Guidelines by the European Commission. Embedding these principles into HR strategy can promote responsible AI use and build stakeholder trust.

6. Case Studies: AI Implementation in HRM Practice

The practical application of Artificial Intelligence (AI) in Human Resources Management (HRM) can be best illustrated through real-world case studies. Analyzing how different organizations implement AI offers valuable insights into the benefits, challenges, and strategic considerations associated with digital HR transformation. This section presents a detailed examination of AI adoption in HRM across several leading organizations, highlighting their objectives, tools, outcomes, and lessons learned.

6.1. Unilever: AI in Recruitment and Candidate Screening

Unilever, one of the world's largest consumer goods companies, has successfully leveraged AI to transform its recruitment process. The company implemented a multi-stage AI-powered hiring pipeline, including gamified assessments, video interviews analyzed by machine learning, and AI chatbots to guide candidates through the process (Black, van Esch, 2020).

The AI system evaluates candidates based on verbal and non-verbal cues, comparing them against a profile of successful employees. According to Unilever, the integration of AI reduced hiring time by 75% and improved candidate satisfaction by offering a smoother, more transparent process (Deloitte, 2020). It also led to increased diversity among new hires by minimizing unconscious bias.

6.2. IBM: Predictive Analytics for Retention and Talent Management

IBM has been a pioneer in using AI for workforce analytics. The company's AI system, powered by IBM Watson, predicts employee attrition with up to 95% accuracy by analyzing a variety of factors including job satisfaction, performance trends, and external labor market conditions (IBM, 2019).

Managers receive early warnings and suggested interventions, allowing them to proactively retain top talent. IBM reports that these AI-driven insights have saved the company millions in rehiring and retraining costs. Furthermore, the system supports career pathing by recommending learning modules and lateral opportunities.

6.3. Hilton: Chatbots and AI Assistants for Candidate Engagement

Hilton, the global hospitality chain, implemented an AI chatbot named 'Connie' to assist with recruitment inquiries and candidate screening. Connie answers frequently asked questions, schedules interviews, and provides status updates. This innovation significantly improved response time and reduced the workload on HR personnel (Tursunbayeva et al., 2018).

The use of conversational AI led to a measurable increase in candidate engagement and a decrease in application abandonment rates. Hilton's example demonstrates how AI can enhance user experience while maintaining HR efficiency.

6.4. Amazon: Lessons from a Failed AI System

Not all implementations of AI in HRM have been successful. Amazon developed an AI tool to automate resume screening but ultimately abandoned the system after discovering that it favored male applicants for technical positions due to biased training data (Dastin, 2018).

This case highlights the importance of dataset quality and bias monitoring in AI development. It serves as a cautionary tale about the unintended consequences of poorly governed AI systems in sensitive HR functions.

6.5. Infosys: AI in Learning and Development

Infosys, a global leader in consulting and IT services, utilizes AI to customize learning experiences for its employees. The company's Lex platform uses machine learning to recommend personalized learning paths based on skill gaps, job roles, and employee interests (Sharma, Sharma, 2020).

The adoption of AI in training has improved engagement rates and accelerated upskilling, helping Infosys stay competitive in the rapidly evolving tech landscape. The case demonstrates how AI can support large-scale workforce development efficiently.

7. Future Outlook: The Evolving Role of AI in Human Resources Management

As the adoption of Artificial Intelligence (AI) in Human Resources Management (HRM) continues to expand, the future promises a more integrated, strategic, and employee-centered approach to workforce management. While AI technologies are currently focused on improving efficiency and streamlining administrative tasks, future developments are expected to deepen AI's role in talent strategy, organizational design, and workforce well-being (Jarrahi, 2018). This section explores key trends and future directions for AI in HRM, including hyper-personalization, augmented intelligence, ethical AI frameworks, and the evolving role of HR leaders.

7.1. Hyper-Personalization and the Employee Experience

AI will drive the next wave of hyper-personalized employee experiences. Using deep learning, AI will tailor every interaction—from onboarding and career planning to wellness programs and recognition—based on individual profiles, preferences, and behaviors (Sharma, Sharma, 2020). This personalization will go beyond generic benefits packages or training programs and instead deliver real-time, context-aware support for each employee.

For example, virtual assistants could suggest mental health resources during periods of stress or recommend career pivots when employee engagement declines. Such enhancements will contribute to increased satisfaction, loyalty, and performance.

7.2. Augmented Decision-Making and Strategic Alignment

Future AI tools will not replace HR leaders but augment their capabilities by synthesizing vast datasets into actionable insights. HR professionals will increasingly rely on AI to identify skills gaps, optimize succession planning, and forecast workforce needs in real time (Bondarouk, Brewster, 2016).

In strategic meetings, HR leaders will bring dashboards powered by predictive analytics, helping executive teams make data-driven decisions about mergers, diversity initiatives, or remote work strategies. This will elevate HR's role as a strategic partner rather than an administrative function (Ulrich, 1997).

7.3. Rise of Responsible and Ethical AI Governance

As AI becomes more central to HR practices, the need for robust ethical governance will intensify. Organizations will be expected to implement explainable AI models, bias audits, and privacy-preserving technologies to ensure fairness and accountability (Binns, 2018).

Global bodies like the European Commission and the OECD are already developing regulatory frameworks, and these are likely to become mandatory in the near future. HR departments will need dedicated resources and expertise to manage ethical compliance, ensuring that AI enhances rather than erodes employee trust (Jobin, Ienca, Vayena, 2019).

7.4 Lifelong Learning and AI Literacy for HR Professionals

To effectively manage AI tools, HR professionals will need to acquire new competencies, including data interpretation, digital fluency, and AI ethics. Training programs and certifications focused on HR analytics and technology management will become standard (Brynjolfsson, McAfee, 2014).

This evolution will redefine the HR career path, blending human-centric skills such as empathy and negotiation with technical proficiencies. Forward-looking organizations will invest in upskilling their HR teams to lead in a data-driven environment.

7.5. Integration with Emerging Technologies

AI will increasingly converge with other technologies such as blockchain, virtual reality (VR), and the Internet of Things (IoT) to redefine HR functions. Blockchain could secure employee records and contract verification, while VR could simulate onboarding or soft skills training environments (Wang, Siau, 2019). AI-powered wearables may also monitor employee health metrics to optimize wellness initiatives.

This integration will demand cross-functional collaboration between HR, IT, and compliance teams, fostering a more holistic approach to human capital management.

8. Conclusion

The integration of Artificial Intelligence into Human Resources Management is no longer a speculative trend but a transformative necessity. From automating repetitive tasks and enhancing decision-making to personalizing employee experiences and forecasting workforce trends, AI is fundamentally reshaping the HR landscape. As organizations strive for agility and resilience in a rapidly changing environment, AI serves as a catalyst for smarter, faster, and more inclusive HR practices.

However, the journey toward AI-enhanced HRM is not without significant challenges. Concerns around bias, privacy, transparency, and accountability demand responsible implementation and robust ethical governance. Case studies demonstrate that while the benefits of AI are substantial, they are fully realized only when supported by clear policies, cultural readiness, and continuous learning.

Looking forward, the role of AI in HRM will continue to evolve, driven by advances in technology and shifts in organizational expectations. HR leaders must not only embrace AI tools but also guide their ethical use, ensuring that technology serves human needs and fosters fairness, engagement, and innovation. As this report demonstrates, AI in HRM is not a fleeting trend but a strategic imperative shaping the future of work.

References

1. Binns, R. (2018). *Fairness in Machine Learning: Lessons from Political Philosophy*. Proceedings of the 2018 Conference on Fairness, Accountability and Transparency.
2. Black, J.S., van Esch, P. (2020). AI-enabled recruiting: What is it and how should a manager use it? *Business Horizons*, 63(2), 215-226.
3. Bondarouk, T., Brewster, C. (2016). Conceptualising the future of HRM and technology research. *The International Journal of Human Resource Management*, 27(21), 2652-2671.
4. Brynjolfsson, E., McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W.W. Norton & Company.
5. Burrell, J. (2016). How the machine 'thinks': Understanding opacity in machine learning algorithms. *Big Data & Society*, 3(1).
6. Cascio, W.F., Montealegre, R. (2016). How technology is changing work and organizations. *Annual Review of Organizational Psychology and Organizational Behavior*, 3, 349-375.
7. Chamorro-Premuzic, T., Akhtar, R., Winsborough, D., Sherman, R. (2017). *The Talent Delusion: Why Data, Not Intuition, Is the Key to Unlocking Human Potential*. Piatkus.
8. Dastin, J. (2018). *Amazon scraps secret AI recruiting tool that showed bias against women*. Reuters.
9. Deloitte (2020). *The Future of Work in Human Resources*.
10. Eubanks, V. (2018). *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor*. St. Martin's Press.
11. IBM (2019). *How IBM uses AI to predict employee flight risk*.
12. Jarrahi, M.H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, 61(4), 577-586.
13. Jobin, A., Ienca, M., Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature Machine Intelligence*, 1(9), 389-399.

14. Kotter, J.P. (2012). *Leading Change*. Harvard Business Review Press.
15. Langer, M., König, C.J. (2018). Effects of a structured web-based procedure on applicants' reactions. *International Journal of Selection and Assessment*, 26(1), 36-48.
16. McKinsey & Company (2017). *A future that works: Automation, employment, and productivity*.
17. Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., Galstyan, A. (2021). A survey on bias and fairness in machine learning. *ACM Computing Surveys*, 54(6), 1-35.
18. Meijerink, J., Bondarouk, T., Lepak, D.P. (2020). When HRM meets the digital workplace: A systematic review. *Human Resource Management Review*, 30(4).
19. Raghavan, M., Barocas, S., Kleinberg, J., Levy, K. (2020). *Mitigating bias in algorithmic hiring: Evaluating claims and practices*. Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency.
20. Russell, S., Norvig, P. (2020). *Artificial Intelligence: A Modern Approach (4th Edition)*. Pearson.
21. Sharma, A., Sharma, T. (2020). HR analytics and performance appraisal system: A case study of Indian IT company. *Journal of Critical Reviews*, 7(9), 2630-2635.
22. Sivathanu, B., Pillai, R. (2018). Smart HR 4.0 – how industry 4.0 is disrupting HR. *Human Resource Management International Digest*, 26(4), 7-11.
23. Storey, J. (2007). *Human Resource Management: A Critical Text*. Cengage Learning.
24. Susskind, R., Susskind, D. (2015). *The Future of the Professions: How Technology Will Transform the Work of Human Experts*. Oxford University Press.
25. Tursunbayeva, A., Bunduchi, R., Franco, M., Pagliari, C. (2018). Human resource information systems in health care: A systematic evidence review. *Journal of the American Medical Informatics Association*, 24(3), 633-654.
26. Ulrich, D. (1997). *Human Resource Champions*. Harvard Business School Press.
27. Voigt, P., von dem Bussche, A. (2017). *The EU General Data Protection Regulation (GDPR)*. Springer.
28. Wang, W.Y.C., Siau, K. (2019). Artificial intelligence, machine learning, automation, robotics, future of work and future of humanity: A review and research agenda. *Journal of Database Management*, 30(1), 61-79.
29. Zhang, A., Lipton, Z.C., Li, M., Smola, A.J. (2020). *Dive into Deep Learning*. Creative Commons.

STRUCTURAL GRID LIMITATIONS AND SOLAR OVERSUPPLY: LESSONS FROM POLAND

Małgorzata RATAJ

University of Information Technology and Management in Rzeszow; mrataj@wsiz.edu.pl,
ORCID: 0000-0002-0469-2687

Purpose: The author aims to highlight a significant global issue: the difficulty of integrating photovoltaic (PV) electricity sources into power line systems (grid). In Poland, 30,357 applications for the connection of photovoltaic systems to the electricity grid were rejected between 2022 and the first quarter of 2023.

Design/methodology/approach: The author analyzed available reports and articles on the topic of blocking access of energy transmission produced by photovoltaics to national power grids. While the article focuses on Poland, it also provides examples of other countries facing similar challenges.

Findings: It appears that the European continent has not yet recognized the erroneous sequence in which investment in electricity is being conducted. This situation can be attributed to the fact that the existing grid infrastructure is outdated and does not have the necessary capacity to accommodate the increased electricity generation from photovoltaic systems. It is unreasonable to expect the grid to adapt without modification. In the absence of such modifications, the grid will be incapable of facilitating the transition to green energy, which will have a damaging effect on the country's energy security.

Social implications: Operators encounter difficulties in maintaining energy balance, which results in an increase in the number of shutdowns. In such cases, the deactivated installation is unable to generate electricity, thereby preventing prosumers from self-consuming the energy produced or benefiting from the support system designed for this purpose. Such a situation is the broader social and economic discouragement of renewable investments.

Value: The paper is addressed to the academic community, which can not only publicize the problem but also, due to its scientific potential and research facilities, provide scenarios for solving the discussed problem.

Keywords: renewable energy sources (RES); grid infrastructure; energy policy; grid capacity limitation; climate crisis.

Category of the paper: Viewpoint.

1. Introduction

According to the Institute of Renewable Energy Solar energy is widely recognized in the European Union as being crucial for the creation of a safe and sustainable energy system in the future. All future energy scenarios developed in the European Union to meet the 2050 climate goals provide a key role for solar energy. The Solar Europe Now campaign has been initiated by over 90 companies and research institutions from 15 EU countries, who have also signed its declaration. As posited by the signatories, solar energy is regarded as instrumental in achieving the objective of climate neutrality by the year 2050 (Gręda, 2021).

The EU has been increasing its Renewable Energy Sources targets not only because of the need to create a safe and sustainable energy system.

Other motivational factors include the limitation of the world's traditional energy resources (Kakaras et al., 2012), climate protection (Ge et al., 2020), rising electricity prices (Ember, 2021), and increasing demand for electricity.

And finally, as we read in Communication on REPowerEU: "EU leaders agreed in the European Council to phase out Europe's dependency on Russian energy imports as soon as possible" (REPowerEU, 2022). Russia's aggression against Ukraine has contributed to the decision that the 2030 Renewable Energy Sources target for the EU was raised from 27% set in 2014 to 45% in 2022 (Renewable Energy Directive, 2024). Succeeding in this goal will achieve energy stability in EU countries.

Photovoltaics is one of the green technologies that can be deployed most quickly as compared to wind sources windmills, heat pumps, and biogas installations (Martinopoulos, 2020). For this reason, the European Commission has set a REPowerEU target of installing new photovoltaic panels with more than double the current capacity by 2025 (European Green Deal, 2019).

Another factor in favor of investing in the photovoltaic market is climate change. An example of weather changes in Poland from 1961 to 2020 is given in Figure 1. As stated in the report European State of The Climate, prepared by Copernicus, "Globally, the last eight years have been the warmest on record, and 2022 was the fifth warmest year on record. In Europe, summer was the warmest on record, at 1.4°C above average, and 0.3-0.4°C above the previous warmest summer, in 2021. Most of western Europe saw heatwave conditions and temperatures in the United Kingdom reached above 40°C for the first time (European State of Climate, 2022). This situation was accurately summarized in The Washington Post: „Scientists said that could drive more renewable energy generation in countries not traditionally considered awash in solar resources" (Dance, 2024).

In Europe, not only do we have serious reasons to invest in photovoltaics, but we also have favorable climate conditions and attractive grant programs for these investments (Figure 1).

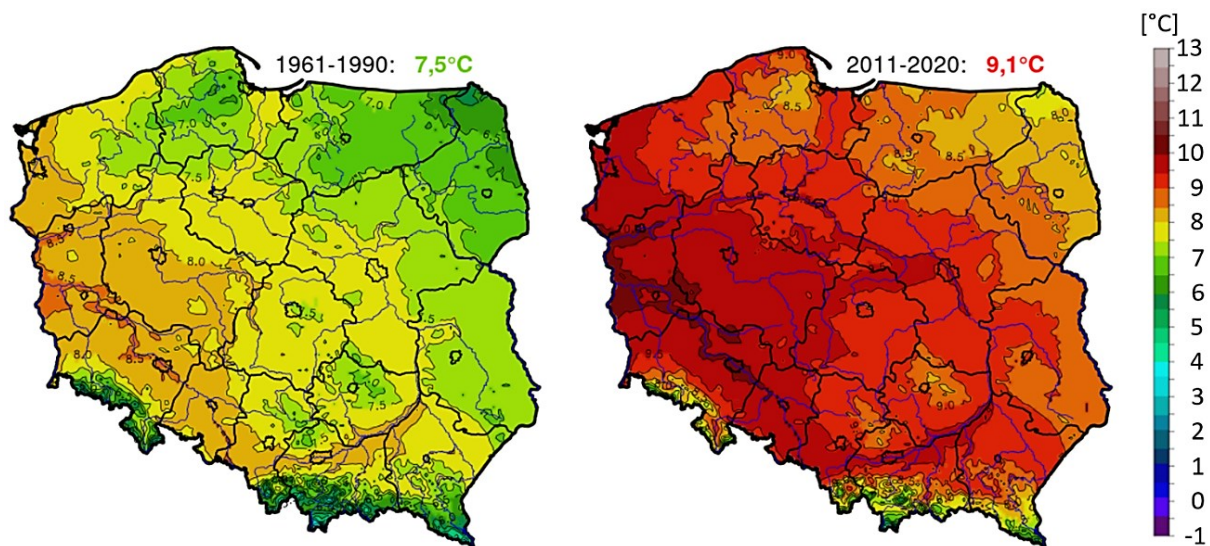


Figure 1. Average annual temperature in Poland in years 1961-1990 and 2011-2020.

Source: Nauka o Klimacie, 2023, 02.2025.

In recent years, Europe has experienced several major blackouts, highlighting vulnerabilities in its energy infrastructure and prompting serious concerns about the continent's capacity to handle such crises. As the transition to sustainable energy intensifies, solar power has become a vital part of this change, due to its environmental advantages and its current cost-effectiveness as a method of generating electricity (Rataj, 2025).

Despite the growing body of literature on renewable energy expansion and climate policy, there is a noticeable lack of focused research on the grid connection barriers—particularly refusals to connect renewable energy installations to the power grid—as a systemic challenge to energy transition (Castronuovo, Canavero, 2009; Gajdzik et al., 2023). Much of the existing academic discourse emphasizes financial, technological, or regulatory support for renewable generation, while insufficient attention is given to the technical and administrative limitations of grid infrastructure and the resulting bottlenecks in deployment (Del Río, Mir-Artigues, 2014; Johnstone, Newell, 2018). This gap is especially pronounced in the context of Poland and Central-Eastern Europe, where detailed empirical data and cross-country comparisons are scarce (CEENERGYNEWS, 2024).

The primary purpose of our study is to demonstrate how aging and inadequately scaled transmission, and distribution infrastructure have become a structural barrier to distributed solar deployment, undermining both national and EU- wide decarbonization targets. By exposing these under- examined connection bottlenecks and contextualizing them alongside permitting delays and curtailment practices in Germany, Italy, France, the UK and the US, we aim to establish a foundation for future academic research dedicated to aligning renewable-generation growth with grid modernization.

The structure of this paper follows a problem-solution-discussion format, focusing on the real-world impact of energy policy and infrastructure on climate goals. A brief Introduction Explains the European Union's climate goals, increasing solar investments, and warming trends

supporting PV adoption. Section 2, The Energy Resources in Poland, describes Poland's energy mix and the growing role of photovoltaics. Section 3, Methodology, section 4, Refusals to Connect to the Power Grid, details the grid's inability to accommodate new PV systems and provides European and global context. Section 5, Conclusion, argues for urgent grid modernization as a prerequisite to renewable energy development.

2. The energy resources in Poland

Renewable Energy Sources (RES) are based on natural, ecological, and inexhaustible resources. By producing energy, RES does not affect climate change and the greenhouse effect. Unfortunately, in Poland, more than 60% of the generated electric energy is still produced from coal (Figure 2).

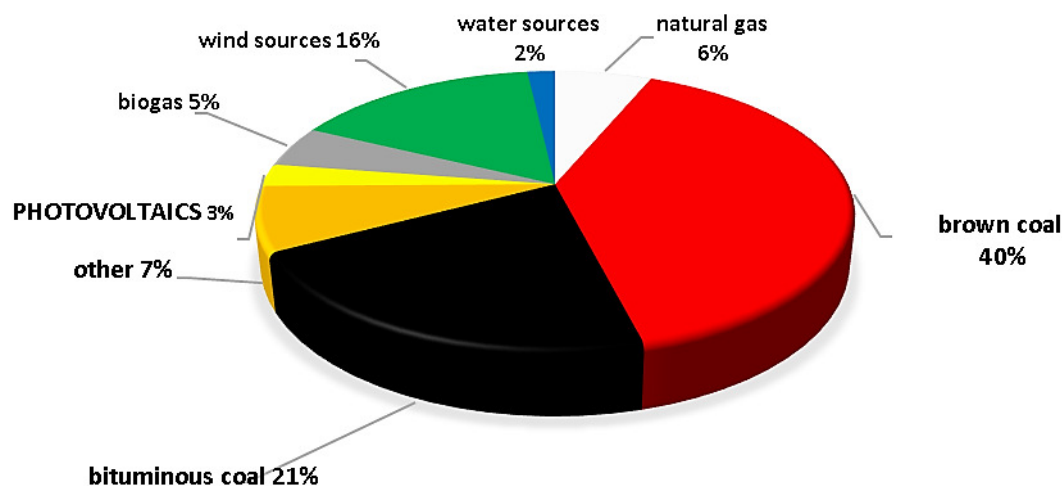


Figure 2. Structure of electricity in Poland in January-March 2023.

Source: Based on ARE, 2023, 12.2024.

The largest amount of energy was generated by brown coal 40%. In second place is bituminous coal, with 21%, and wind was third on the podium, with 16%. In total, energy produced from Renewable Energy Systems from January to March 2023 in Poland accounted for 26% of all energy generated. As a result of such a production structure, the price of electric energy in Poland is the highest in the European Union.

SolarPower Europe identifies European Union solar leaders in 2022-2023 (Figure 3). Germany is Europe's biggest solar market in 2022-2023, followed by Spain, Italy, and Poland in fourth place.

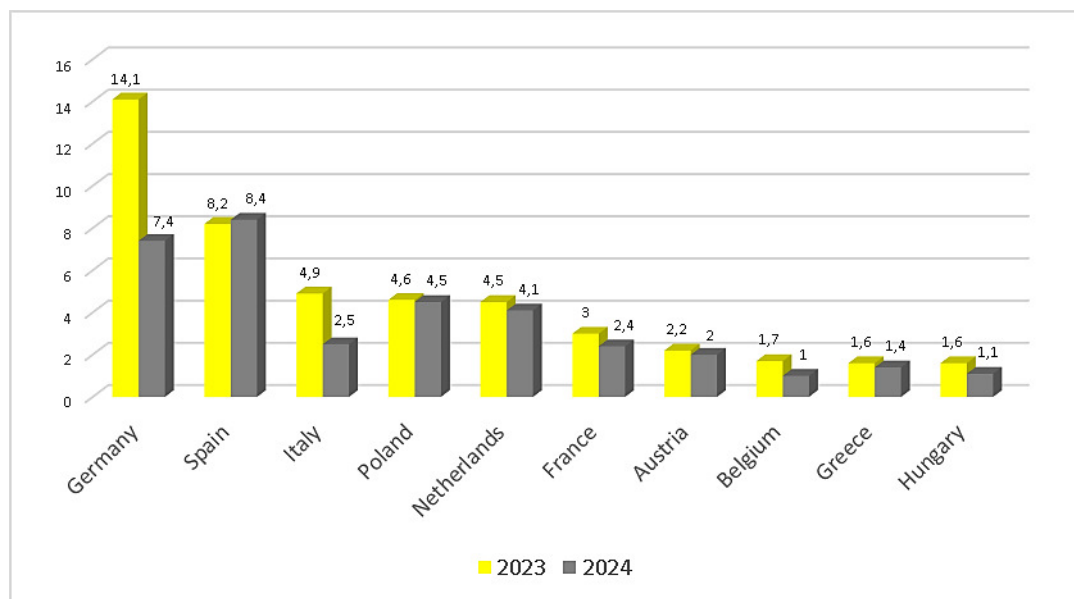


Figure 3. Top 10 EU solar leaders in 2022-2023 (numbers represent GW).

Source: Solar Power Europe, 2024, 12.2024.

Photovoltaics have the largest share of the green Renewable Energy Sources in Poland (Figure 4). In the face of rising electricity prices, interest in investing in renewable energy installations continues to grow.

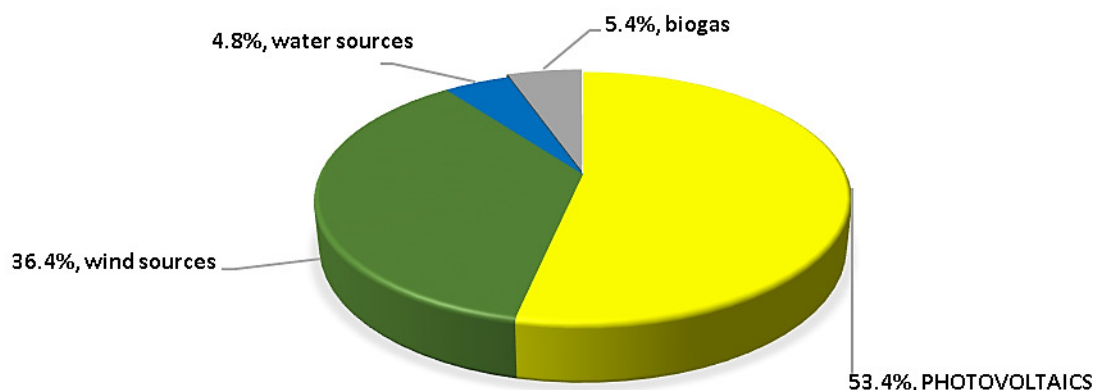


Figure 4. Renewable Energy Sources in Poland in 2022.

Source: EON, 2024, 12.2024.

As much as 53.4% of the renewable electricity generated in Poland is from solar power. Next in line is wind (36.4%). A smaller contribution to green energy in Poland is water (4.8%) and biomass and biogas (5.4%).

According to the Renewable Energy Institute, the photovoltaic market in Poland will continue to maintain its growth in the coming years.

3. Methodology

The selection of sources and countries analyzed in the article was driven by two main criteria: (1) the relevance of the data to the issue of grid connection constraints for renewable energy, and (2) the availability of up-to-date, credible reports and publications that reflect both national and international perspectives. While the focus was primarily on Poland due to its urgent infrastructural challenges and high number of connection refusals in 2022 and early 2023.

For the characterization, we chose countries that are leaders in solar power deployment (Poland, Germany, Italy, France, Spain), and country facing critical grid challenges that mirror Poland's (United Kingdom, United States).

The research was conducted through desk-based analysis. This included industry reports, government publications, academic articles, media interviews, and data provided by organizations such as Eurelectric, PVTech, Berkeley Lab, and the European Solar Power Market Outlook.

The publication dates of sources used in the article range primarily from 2022 to 2025. This time frame was selected to ensure the relevance and accuracy of the data, especially given the rapid developments in renewable energy deployment and grid management strategies in recent years.

4. Refusals to connect to the power grid

As indicated by eurelectric.org, the European continent encompasses 10 million kilometers of power lines. This distance is equivalent to 13 round trips to the moon and back. Notwithstanding the impressive outcomes, Europe is curbing solar generation due to an excess supply.

Provisions of the Energy Law in Poland require electricity system operators to connect renewable energy installations to the grid first. However, it turns out that in the whole investment process, obtaining the appropriate connection conditions becomes the biggest problem. Renewable energy sources, specifically photovoltaic farms, but also wind farms, hydroelectric power plants, energy storage, are mainly receiving refusals.

In 2022 and the first quarter of 2023 in Poland in total 30 357 applications for connection photovoltaics sources of energy to the electricity grid were rejected (Raport Rynek Fotowoltaiki w Polsce, 2023). In Poland, the necessity for the modernization of the grid is driven by two primary factors. Firstly, the country is currently undergoing a significant transformation in its energy sector, which necessitates the updating of infrastructure to accommodate the emerging

renewable energy sources and the increasing demand for electricity. Secondly, the age of the existing grid is a contributing factor to its modernization requirements. Most components are over 25 years old, with a substantial proportion exceeding 40 years.

Mark Hutchinson, director for Asia at the Global Wind Energy Council, in an interview with the Financial Times on 11 June 2023 said: “I don’t know of any country where the grid is not currently some level of obstacle to the energy transition” (Hutchinson, 2023). What is unfortunately very true. A good example of this are solar energy European leaders shown in Figure 3. What challenges are they facing? We can find the answer to this question in *EU Market Outlook For Solar Power*: “the large amount of solar projects under development in the country are facing tight permitting challenges”.

In Italy: “the authorization of projects remains a challenge. Permitting can take a long times, depending on the region” (EU Market Outlook For Solar Power, 2023).

PV-Tech also flags grid connection bottlenecks in France: “the speed with which new solar projects are being commissioned is faster than the pace at which the grid can be expanded”, undermining deployment (PVTech, 2024).

This is not a problem only for European Union countries. Thomas Johnson, editor of the journal *New Civil Engineer*, wrote: “The United Kingdom is currently experiencing a connectivity logjam of projects, which is restricting renewable energy projects from connecting to the grid. As of October 2023, there were 1492 projects, or 371 GW, waiting in the queue” (Johnson, 2023).

As stated in the publication *Queued Up*, at the conclusion of 2023, the number of active grid connection requests exceeded twice the total installed capacity of the power plant fleet in the United States (BerkleyLab, 2025).

Eninrac reports that permitting in the European Union often takes 7-10 years—or more—and EPC (Engineering, Procurement, and Construction) delays of 12-18 months are common in Spain and Germany (Insights, 2025).

We can learn important lessons from the example of German initiatives. Germany have taken a multi-pronged approach to managing the oversupply of solar power—combining grid curtailment, market reforms, energy storage roll-outs and demand-side measures.

In 2024, German transmission system operators curtailed about 30,304 GWh of renewables (mostly PV) to prevent network congestion, down slightly from 34,297 GWh in 2023. Operators are financially compensated as though generation had continued uninterrupted, but curtailment reduced system stress (PV Magazine, 2025).

From November 2024, most new wind and solar plants must sell power directly on the open market rather than bilaterally to grid operators, aligning incentives to absorb oversupply and reducing reliance on fixed-rate schemes (Reuters, 2024).

A new law, effective March 2025, removes guaranteed feed-in tariffs during negative-price periods for PV systems commissioned after enactment. New installations without smart meters must also cap grid export at 60%, incentivizing self-consumption or storage (Reuters, 2024).

Beyond batteries, pilots of smart inverters and virtual power plants under way to shift demand into solar peaks. These include dynamic pricing schemes and AI-driven forecasts to balance generation and consumption in real time (CLOU GLOBAL, 2025).

5. Conclusion

The dynamic expansion of photovoltaic capacity in Poland has highlighted a significant structural constraint: the national electricity grid is outdated and insufficiently scaled to accommodate the growing volume of distributed solar generation. Between 2022 and early 2023, more than 30,000 PV connection applications were rejected, demonstrating a systemic obstacle that jeopardizes Poland's climate and energy security objectives.

This issue reflects a critical imbalance in policy and investment priorities. While financial incentives have effectively stimulated PV deployment, there has been inadequate parallel investment in grid infrastructure. As a result, the technical capacity of the transmission and distribution systems has not kept pace with renewable energy growth. To ensure system reliability and avoid further curtailments or delays, infrastructure modernization must be prioritized ahead of additional renewable energy rollouts.

Failure to address these infrastructural limitations risks increasing electricity costs and weakening Poland's ability to meet both national and European Union decarbonization targets. Current grid constraints contradict the strategic goals of achieving net-zero emissions by 2050 and hinder the broader transition to a resilient, low-carbon energy system.

The purpose of this article was not to provide a solution to the existing problem, but to point out that such a problem exists and generates further problems and threatens the country's energy security. The author will only allow himself to mention that to overcome these challenges, a realignment of energy sector investments is required. Only through coordinated development of generation and transmission infrastructure can the full potential of solar energy be realized.

Who should react first in this situation? It seems that the academic community should take this responsibility.

Although climatic conditions increasingly favor the deployment of PV systems, the underlying technological and infrastructural readiness must be addressed as a matter of priority to ensure a sustainable and efficient energy transition.

Proposed Research Agenda: the implementation of targeted research pathways will provide academics with clear methodological starting points for addressing the grid-connection challenges that have been identified. Three suggestions are given based on experience while searching for data during the writing of this article.

The development of Standardized Data Frameworks is of paramount importance. The creation of an open-access, harmonised database of grid parameters and connection requests is essential for enabling cross-regional analyses.

Geospatial Grid Modelling – the employment of GIS-based power-flow simulations at regional and substation levels is a methodology that has been proven to facilitate the identification of local bottlenecks and the quantification of curtailment risks.

The techno-economic storage integration process involves the conduct of sensitivity studies on distributed storage and demand response. These studies utilize capacity-expansion and dispatch models to evaluate cost-benefit trade-offs.

This article has some limitations. First, this study is based entirely on a review of secondary sources and literature. This approach limits the empirical depth of the analysis. As a result, certain technical nuances - such as detailed load flow dynamics or localized network performance - cannot be fully verified by this study. Second, the geographic focus of the study limits the generalizability of the conclusions. The analysis focuses on the Polish electricity system and its specific regulatory and infrastructure context, although comparative examples from other countries are cited. Because Poland's energy mix, grid characteristics and policy environment differ from those in other regions, the conclusions drawn here may not be directly applicable elsewhere.

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References

1. Acke, D. (2023). *EU solar reaches record heights of 56 gw in 2023 but warns of clouds on the horizon*. Retrieved from: <https://www.solarpowereurope.org/press-releases/new-report-eu-solar-reaches-record-heights-of-56-gw-in-2023-but-warns-of-clouds-on-the-horizon>
2. ARE (2023). Retrieved from: www.are.waw.pl.
3. Castronuovo, E.D., Canavero, F. (2009). Technical and economic aspects of grid connection of renewable energy sources in distributed generation: A review. *Renewable and Sustainable Energy Reviews*, 13(8), 1900-1919.

4. CEENERGYNEWS (2024). *CEE's grids urgently need modernisation and investment to boost renewables momentum in the region*. Retrieved from: <https://ceenergynews.com/voices/cees-grids-urgently-need-modernisation>
5. Communication on REPowerEU (2022). *Joint European Action for more affordable, secure and sustainable energy*. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52022DC0230>
6. Dance, S. (2024). *The flip side of Europe's extreme heat: More solar energy potential*. Retrieved from: <https://www.washingtonpost.com/climate-solutions/2023/04/20/europe-sun-solar-renewables-extreme-heat/>
7. Del Río, P., Mir-Artigues, P. (2014). A cautionary tale: Spain's solar PV investment bubble. *Renewable and Sustainable Energy Reviews*, 35, 161-170.
8. EMBER (2020). *Poland's Wholesale Electricity Prices Rise to the Highest in Europe*. Retrieved from: <https://ember-climate.org/commentary/2020/10/23/polands-electricity-prices-rise-to-the-highest-in-europe/>
9. EON (2024). *Odnawialne źródła energii – co warto wiedzieć o OZE?* Retrieved from: <https://eon.pl/dla-domu/portal-o-odnawialnych-zrodlach-energii/zielona-energia/odnawialne-zrodla-energii>
10. *European Green Deal* (2019). Retrieved from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en
11. *European state of climate* (2022). Retrieved from: https://climate.copernicus.eu/sites/default/files/custom-uploads/ESOTC2022/PR/ESOTCsummary2022_final.pdf
12. Gajdzik, B., Wolniak, R., Nagaj, R., Grebski, W.W., Romanyshyn, T. (2023). Barriers to Renewable Energy Source (RES) Installations as Determinants of Energy Consumption in EU Countries. *Energies*, 16(21), 7364. <https://doi.org/10.3390/en16217364>
13. Ge, M., Friedrich, J., Vigna, L. (2020). *4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors*. Retrieved from: <https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors>
14. Gręda, D. (2021). *Institute of Renewable Energy*. Retrieved from: <https://www.iew.pl/pl/aktualnosci/1466-europejski-przemysl-fotowoltaiczny-chce-wsparcia-w-ramach-europejskiego-zielonego-ladu>
15. Hutchinson, M. (2023). *Gridlock: how a lack of power lines will delay the age of renewables*. Retrieved from: <https://www.ft.com/content/a3be0c1a-15df-4970-810a-8b958608ca0f>
16. Johnson, T. (2023). 50GW of capacity made available for connection to the grid early following new measures. *New Civil Engineer*. Retrieved from: <https://www.newcivilengineer.com/latest/50gw-of-capacity-made-available-for-connection-to-the-grid-early-following-new-measures-22-11-2023/>

17. Johnstone, P., Newell, P. (2018). Sustainability transitions, energy justice, and poverty: Towards a new research agenda. *Energy Research & Social Science*, 39, 117-124.
18. Kakaras, E., Koumanakos, A.K., Doukelis, A. (2012). Pressurized fluidized bed combustion (PFBC) combined cycle systems. In: *Combined Cycle Systems for Near-Zero Emission Power Generation*. Elsevier. Retrieved from: <https://doi.org/10.1533/9780857096180.220>
19. Martinopoulos, G. (2020). Are rooftop photovoltaic systems a sustainable solution for Europe? A life cycle impact assessment and cost analysis. *Appl. Energy*, 257, 114035, <https://doi.org/10.1016/j.apenergy.2019.114035>
20. *Nauka o Klimacie* (2023). Retrieved from: <https://naukaoklimacie.pl/aktualnosci/zmiany-sredniej-temperatury-rocznej-na-mapie-polski/>
21. PV Magazine (2025). *PV curtailment jumps 97% in Germany in 2024*. Retrieved from: https://www.pv-magazine.com/2025/04/03/pv-curtailment-jumps-97-in-germany-in-2024/?utm_source
22. Raport (2024). *Rynek Fotowoltaiki w Polsce 2023*. Retrieved from: <https://ieo.pl/pl/raport-rynek-fotowoltaiki-w-polsce-2023>
23. Rataj, M., Berezovska, I. (2025) Assessing Fire Risks in Photovoltaic Panels: A Literature Review in the Context of Blackout Concerns. *Energies*, 18, 3407. <https://doi.org/10.3390/en18133407>
24. Renewable Energy Directive (2024). Retrieved from: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en
25. Reuters (2024). *Germany to mandate open market sales for new wind, solar plants*. Retrieved from: https://www.reuters.com/business/energy/germany-mandate-open-market-sales-new-wind-solar-plants-2024-11-13/?utm_source
26. Reynolds, T. (2025). *Capturing Abundance: Managing Surplus Solar Generation in Germany's*. Retrieved from: https://clouglobal.com/capturing-abundance-managing-surplus-solar-generation-in-germanys-grid/?utm_source
27. *Solar Power Europe* (2024). Retrieved from: <https://www.solarpowereurope.org/insights/market-outlooks/eu-market-outlook-for-solar-power-2022-2026-2>
28. *SolarPower Europe* (2023). *EU Market Outlook for Solar Power*. Retrieved from: [eu-market-outlook-for-solar-power-2023-2027](https://www.solarpowereurope.org/insights/market-outlooks/eu-market-outlook-for-solar-power-2023-2027)

LEADERSHIP IN THE AGE OF AI IN THE CONTEXT OF EFFECTIVELY CONNECTING TECHNOLOGY TO TEAMS

Edyta SKARZYŃSKA

Management Institute, Warsaw University of Life Sciences; edyta_skarzynska1@sggw.edu.pl,
ORCID: 0000-0003-1269-0996

Purpose: This study aimed to analyze the opinions of leaders and employees regarding the implementation and functioning of artificial intelligence (AI) in organizations, focusing on key aspects such as trust in AI, leadership competencies, perceived impact on the organization, and readiness for change.

Design/Methodology/Approach: Statistical analysis was conducted using SPSS and R software to compare the views of leaders and employees across domains. The analysis included t-tests for differences between groups and multiple regression to identify key factors influencing AI implementation success. Data from leaders and employees were collected and analyzed in four themes: trust in AI, leadership competencies, perceived organizational impact of AI, and readiness for change.

Findings: Significant differences were found between leaders and employees in their perceptions of AI. Leaders generally reported higher trust in AI, greater confidence in their AI competencies, and a more positive view of its impact on organizational performance. On the other hand, employees expressed more concerns about AI limiting creativity and were less confident in management's ability to manage AI adoption effectively. Additionally, employees perceived greater openness to change compared to leaders. Multiple regression analysis highlighted that employee perceptions of leaders were the strongest predictor of AI implementation success.

Originality: This research offers a comprehensive comparison of how AI is perceived by different organizational roles, emphasizing the crucial role of leadership perception in the success of AI implementation. The study contributes new insights into the dynamics of AI adoption, leadership, and employee engagement in the context of technological innovation.

Keywords: leadership, artificial intelligence, trust, technology.

Category of the paper: Viewpoint.

1. Introduction

The integration of artificial intelligence in leadership is transforming traditional paradigms, which requires new competencies and strategies (Madanchian et al., 2024). The contemporary business landscape, driven by technological progress, requires leaders to redefine their roles and management methods. Leaders must adapt to changes driven by artificial intelligence, balancing technological progress with human traits such as empathy, communication skills, and the ability to build relationships (Milton, Al-Busaidi, 2023). Developing "leadership intelligence" is key here, encompassing emotional and cultural intelligence, strategic thinking, creativity, and lifelong learning (Westover, 2024). In the face of increasing automation and digital transformation, leaders face many challenges. These include solving problems related to work displacement, promoting ethical decision-making using artificial intelligence, and managing human-AI collaboration (Singh, 2023). Such challenges require an advanced understanding of the technology and anticipating long-term social and economic consequences.

Additionally, leaders should foster a culture of continuous learning that will enable employees and organizations to adapt to dynamically changing market conditions. It is also important to develop ethical guidelines for AI to ensure its responsible and fair use. At the same time, increasing emotional intelligence is becoming crucial to enable effective communication and management in diverse teams where human staff members work with AI systems (Singh, 2023). Integrating AI into leadership requires a balanced approach that combines technological innovation with preserving basic human traits such as morality, responsibility, and the ability to build trust (Madanchian et al., 2024). Organizations that want to implement such an approach effectively should prioritize holistic leadership development. A key aspect here is cultivating adaptive capabilities that will allow leaders to leverage the potential of AI to achieve business goals effectively. Fostering interdisciplinary competencies such as problem-solving, systems thinking, and building an inclusive organizational culture is becoming the foundation for achieving long-term success in a dynamically changing environment (Westover, 2024). Consequently, the future of leadership depends on the ability of leaders to flexibly adapt to new technological realities while maintaining the coherence of the organization's values and mission. Effective integration of AI requires a fundamental change in organizational culture due to its transformative impact on work practices and decision-making processes (Murire, 2024). Organizations must adapt their culture to support a data-driven mindset crucial for the effective use of AI. This cultural change includes promoting innovation, agility, and continuous learning while addressing challenges such as employee resistance and ethical concerns (Murire, 2024). Adopting the principles of mutual symmetry can foster inclusive environments that value transparency and honesty, which are essential for responsible AI implementation (Maddula, 2018). Research indicates a strong positive relationship between organizational culture, AI capabilities, and organizational performance. To ensure successful AI implementation,

organizations should focus on effective leadership, clear communication, and investment in skills development (Murire, 2024). This holistic approach to cultural transformation is essential for long-term success and competitiveness in the AI-driven digital economy.

2. Leadership in the Age of Artificial Intelligence

Transforming traditional leadership involves moving from hierarchical, rigid structures to more flexible, collaborative models that adapt to changing environments. Transformational leadership emphasizes expressing new visions, demonstrating passion and confidence, and aligning individual aspirations with organizational goals. Transformational leadership is key in facilitating the integration of AI and HR digitalization in organizations (Estherita et al., 2023). It promotes employee performance and innovation while managing the uncertainty associated with AI adoption (Matsunaga, 2021). In the context of AI, transformational leaders must balance AI capabilities with human insight, ethics, and emotional intelligence. They must adapt their strategies based on the stage of development of AI systems, focusing on setting a vision and building relationships. Effective team communication mediates the positive impact of transformational leadership on team performance in AI development projects (Sun, 2024). However, digital leadership skills mitigate these effects, emphasizing the importance of technological competence (Matsunaga, 2021). As AI takes over more leadership roles, organizations must continually evaluate and adapt their leadership approaches to maximize the benefits of AI integration while minimizing disruptions (Estherita et al., 2023). Technology increasingly mediates leadership processes, and the concept of e-leadership has been highlighted, requiring leaders who are communication-oriented, supportive, and able to create stable environments. Effective leaders build personal relationships, champion stakeholder causes, and use symbolic behaviors to bridge the mission (McMullen, Adobor, 2011). Social entrepreneurs are key bridges between innovation managers and technology-reflective individuals in public-private partnerships. As technology leaders, middle managers make pedagogical interventions to overcome intra-organizational boundaries and support agile working methods, focusing on adaptation through collaboration, interdependence, flexibility, and communication (Gustafsson et al., 2012). These interventions aim to influence knowledge creation and promote collective learning. As organizations navigate increasingly unstable, uncertain, complex, and ambiguous environments, leaders must adapt to effectively bridge the gap between technology and people (Paliszkievicz et al., 2023). Inspiring teams to embrace technology as a supporting tool rather than a threat involves addressing various challenges. Virtual teams, enabled by advances in IT, offer opportunities for organizational development but require careful management of information security and human factors. While robots are still primarily seen as tools, there is potential for positive integration in teams, performing

dangerous tasks, and enabling humans to focus on creative work (Krawczyk-Bryłka, Nowicki, 2024). Building effective virtual teams requires attention to goal setting, member selection, group rule setting, idea generation, and decision-making processes (Krawczyk-Bryłka, 2016). Knowledge and innovation are key organizational resources that should be integrated into management processes (Skarzyńska, 2023). Changing the managerial mindset to recognize the strategic value of diverse employee knowledge is essential to achieving sustainable competitive advantage (Baruk, 2008). Organizations can foster an environment that supports technology adoption and team collaboration by addressing these aspects.

The role of leadership in implementing is crucial and multifaceted, encompassing strategic, operational, and cultural aspects. Leaders set the direction for the entire process, deciding where and how the technology should be applied, as well as defining business objectives and managing the risks associated with implementation (Sun, 2024). They are also responsible for building trust and acceptance of AI among employees through transparent communication, explaining the benefits and limitations of the technology, and personal involvement. Effective leaders support the development of digital competencies within their organization by organizing training, facilitating learning processes, and helping teams adapt to a changing work environment (Gao, 2024). At the same time, they act as guardians of ethical AI implementation, ensuring privacy and data security and counteracting algorithmic bias. The implementation of artificial intelligence often requires a change in organizational culture—towards greater openness to data, human-technology collaboration, and continuous improvement. Leaders play a catalytic role in this change by modeling values and attitudes that foster innovation (Sun, 2024). Ultimately, it is leaders who are responsible for whether AI is perceived as an opportunity for growth or as a threat within the organization. Their flexibility, vision, and ability to integrate people with technology determine whether AI implementation will bring real benefits.

3. The Impact of Artificial Intelligence on Team Dynamics

AI has emerged as a promising tool for increasing team effectiveness in various ways. AI can augment human teams by improving coordination, knowledge sharing, decision-making, and performance evaluation (Khakurel, Blomqvist, 2022). Studies have shown that AI-assisted teams demonstrate improved communication, adaptability to disruptions, and broader solution space exploration (Song et al., 2022). AI can provide team diagnostics, process management, and interventions that match or even exceed human capabilities in some aspects. However, there are still challenges to the widespread adoption of AI for team improvement, including concerns about social interaction, privacy, and ethics (Khakurel, Blomqvist, 2022). To effectively implement it in team environments, organizations should consider a multi-step

process for analyzing and improving team performance (Webber et al., 2019). As this technology continues to evolve, it has significant potential to revolutionize teamwork and increase overall team effectiveness.

New technologies significantly affect traditional duties in various sectors. In libraries, despite the growing role of technology, it is still possible to effectively provide services in traditional forms. In the professional sphere, technical progress accelerates changes in the content of work and forms of employment, leading to the redefinition of professions and careers (Walczak-Duraj, 2022). AI redefines the concepts of intelligence, creativity, and intellectual work, changing the traditional gatekeeping model in the media in favor of algorithmic information selection. In journalism, AI leads to deanthropocentrism, where human interpretation of events is replaced by technological entities (Gruchola, 2022). At the same time, the development of AI poses new challenges in the field of competition law, especially in the context of using algorithms by entrepreneurs (Wieczerzyńska, 2022). Despite potential threats, AI also offers opportunities to increase efficiency and innovation. Finding a balance between the use of technology and maintaining human creativity and ethics in the new technological reality becomes crucial.

Technology redefines traditional responsibilities but does not always completely replace them. Recent studies highlight the emergence of new AI-related positions in various sectors. These include AI ethics officers, AI operations managers, and AI explainer engineers, who are key to ensuring ethical standards and optimizing AI system performance (Ejjami, 2024). The demand for AI skills in the workplace has increased, emphasizing communication, problem-solving, creativity, teamwork, and AI-specific competencies (Squicciarini, Nachtigall, 2021). New roles, such as Chief Data Officer, Chief AI Officer, and Chief Robotics Officer, have also emerged in the data ecosystem. While AI adoption is leading to changes in hiring patterns and skill requirements at the plant level, its aggregate impact on employment and wage growth in AI-exposed occupations and industries remains modest (Acemoglu et al., 2022). These findings underscore the need for continuous skill development and appropriate governance to fully leverage AI's potential while considering ethical implications (Ejjami, 2024). Integrating AI into teams, therefore, poses new leadership challenges. Trust issues can arise, with initial overestimation of AI capabilities leading to decreased trust over time. Human-AI teams often underperform due to poor team cognition and inadequate mutual understanding (Schmutz et al., 2024). Effective collaboration requires AI to develop mental models, self-awareness, theory of mind, and the ability to express and explain mental states. AI must also adapt goals, communication, and decision-making to humans while demonstrating cognitive competence, reinforcement learning, and semantic communication (Hagemann et al., 2023). Despite AI's potential to improve team performance in specific contexts, its underdevelopment limits wide-scale adoption (Webber et al., 2019). Overcoming these challenges requires interdisciplinary collaboration between computer science and psychology and developing a solid theoretical framework to realize the full potential of human-AI

collaboration (Schmutz et al., 2024). Framing AI care as personalized, using AI to support rather than replace human decisions, and addressing issues such as bias and data privacy can help build trust and acceptance (Longoni et al., 2019; Li, Abangbila, 2024). Understanding and solving these problems is crucial for successfully implementing AI (Yang et al., 2024).

4. Strategies for Effectively Connecting Technology with Teams

Building trust and acceptance of AI is crucial for its widespread adoption and successful implementation. Key factors influencing AI acceptance include perceived usefulness, ease of use, and technology readiness (Rane et al., 2024). Transparency, accountability, and fairness in the development and application of AI are essential to earning public trust (Westover, 2024). Organizations should ensure that AI systems are explainable, considering user needs and context to promote trust and acceptance (Theis et al., 2023). Regulatory frameworks, ongoing education, and skills development are essential to address ethical and data privacy concerns (Rane et al., 2024). A user-centered approach to designing and implementing AI systems is crucial, as is collaboration between industry, academia, and policymakers. Despite low trust in AI systems, Australians generally accept or tolerate AI, expecting careful governance and regulation (Lockey et al., 2020). Increasing AI skills and addressing social issues are essential to building trust and realizing the full potential of AI. Zhang et al. (2023) identified four key communication strategies for AI teammates, emphasizing the importance of proactive communication in building trust and situational awareness. Carter and Wynne (2024) proposed a theoretical framework for AI-human team effectiveness, emphasizing the need to understand the potential negative implications of AI integration. Sycara and Lewis (2004) explored the types of assistance AI can provide to teams that prove beneficial. Webber et al. (2019) explored the potential of AI for team diagnostics and improvement, proposing a multi-step process for analyzing and increasing team effectiveness in organizations. Together, these studies emphasize the importance of effective communication, building trust, and carefully considering the role of AI in team decision-making processes. The studies emphasize developing AI and leadership skills for non-technical managers to implement responsible AI solutions effectively (Salazar-Gómez et al., 2022). The Human Education AI Teaming (HEAT) framework proposes an innovative approach to enable collaboration between domain experts and AI systems, focusing on knowledge transfer rather than technical skills (McCall et al., 2021). Learning science research plays a key role in designing AI educational technologies, and interdisciplinary partnerships are recommended to bridge the gap between AI developers and educators (Luckin, Cukurova, 2019). Educational programs are being developed to meet the needs of various learners, from military personnel to the general public, incorporating various learning methods and experiential approaches. These efforts are intended to prepare individuals and organizations

for the growing impact of AI across industries and societies. To foster trust and ensure human autonomy, it is essential to establish ethical principles and develop an appropriate regulatory framework for the development of AI.

Ethical leadership is essential in organizations using AI technology because it helps address bias and privacy concerns (Uddin, 2023). Leaders must establish ethical standards and promote transparency in AI-based environments. However, AI does not have an ethical compass; human choices ultimately shape ethical decisions (De Cremer, Kasparov, 2021). Organizations can make responsible AI choices by approaching them methodically. While AI can increase the efficiency and accuracy of data-driven decision-making by educational leaders, misuse can harm stakeholders. Potential risks include reinforced biases, conflicts with moral values, and data security issues. To harness the potential of AI and minimize negative consequences, leaders must uphold ethical principles, cultivate responsible AI cultures, and prioritize stakeholder interests (Uddin, 2023). Ongoing research on ethical leadership in AI-based enterprises is essential to shaping ethical behavior and ensuring responsible AI implementation.

5. The Future of Leadership in the Context of Technology and Teams

The future of leadership in the context of AI technologies and teams will require a transdisciplinary approach, integrating multiple disciplines to address complex challenges. AI will be a strategic enabler, empowering leaders with predictive analytics and faster decision-making capabilities (Madanchian et al., 2024). However, human skills such as empathy, creativity, and intuition will remain key, creating a hybrid leadership model. Leaders must adapt to manage distributed teams, embrace diversity, and support continuous learning. The concept of "leadership intelligence" will become increasingly important, encompassing emotional intelligence, cultural intelligence, and strategic thinking. Organizations should focus on developing these skills in emerging leaders through personalized learning, global exposure, and coaching (Westover, 2024). While AI integration poses challenges such as ethical concerns and privacy issues, it also offers opportunities for more flexible and data-driven leadership practices (Madanchian et al., 2024). AI can improve team coordination, communication, and performance, especially during disruptions (Song et al., 2022). It can empower human teams by improving knowledge sharing, supporting decision-making, and assessing team performance (Khakurel, Blomqvist, 2022). However, adopting AI in team settings faces challenges, including issues with social interaction, design concerns, and ethical considerations (Khakurel, Blomqvist, 2022). Researchers propose a multi-step process for analyzing and improving teams using AI (Webber et al., 2019). The future of AI-human teaming in design can be conceptualized using a 2x2 matrix that considers AI focus (tool vs. guide) and modality (reactive vs. proactive) (McComb et al., 2023). As AI continues to evolve, it offers unique opportunities to support team problem-solving and increase team effectiveness.

6. Material and methods

6.1. Data collection and sample characteristics

The survey was conducted among employees and people holding management positions in companies using artificial intelligence. The research instrument was based on previous work by Rožman, M., Tominc, P., Miller, B. (2023), Sun, N. (2024), and Gao, P. (2024). The main survey, conducted from October to December 2024, was preceded by a pilot study in September on a group of 30 employees—the pilot study aimed to verify the comprehensibility of the questions included in the survey. As a result of the pilot study, the survey was modified. Ultimately, six sections were obtained for survey measurement. The survey contained closed, open, and semi-open questions. It was divided into thematic sections measuring specific variables. The first section consisted of metrics. The second section consisted of questions regarding the level of trust in AI. The variables from the second section were qualitative and ordinal (1 - strongly disagree, 2 - disagree, 3 - undecided, 4 - agree, and 5 - strongly agree). The third section concerns the competencies of leaders in AI management. The subsequent sections were based on the competencies of leaders in AI management, the perception of the impact of AI on the organization, readiness for change, and the success of AI implementation.

Participation in the study was voluntary, and the survey was conducted using computer-assisted online interviewing (CAWI). The research group includes leaders and employees representing various organizations implementing AI solutions. A total of 342 completed questionnaires were obtained. Among the respondents, 121 leaders (managers, project managers, and team leaders) and 221 employees (specialists, analysts, and members of operational teams) were distinguished. Table 1 presents the distribution of respondents according to their sociodemographic characteristics. The validity of the survey was assessed based on the percentage of total explained variance. At the same time, reliability was checked using Cronbach's alpha coefficient (1951), using thresholds adopted in social research, which are 0.5 and 0.45, respectively (Taber, 2018).

Table 1.
Sociodemographic characteristics of respondents

Variable name	Categories	n	%
Sex	Female	189	55.26
	Small	153	44.73
Position	Employee	221	64.61
	Leader	121	35.38
Professional experience	Up to 5 years	72	21.05
	From 5 to 10 years	85	24.85
	From 10 to 20 years	152	44.44
	Over 20 years	33	9.64
Experience in working with AI technology	Under 1 year	52	15.20
	From 1 to 5 years	118	34.50
	From 5 to 15 years	144	42.10
	Over 15 years old	28	8.18

Source: Own elaboration.

6.2. Statistical approach

The collected statistical material was analyzed using SPSS version 27.0 software and the R environment.

6.3. Data analysis

Table 2 presents the results of a comparative analysis of the opinions of leaders and employees on various aspects of the implementation and functioning of artificial intelligence (AI) in organizations. Four main thematic areas were considered: the level of trust in AI, leaders' competencies, perception of the impact of AI on the organization, and readiness for change and implementation success.

For each category, mean scores (M) and standard deviations (SD) in both groups were presented, as well as the results of the student's t-test (t) and the corresponding p values (p), which indicate the statistical significance of differences between groups. Positive t values indicate higher average leader scores, while negative ones indicate higher average employee scores. The analysis allows us to assess in which areas there are significant differences in the perception of AI between these two groups, which may constitute an important basis for further actions in implementing new technologies in organizations.

The analysis of the results indicates significant differences in the perception of artificial intelligence (AI) between leaders and employees in several key areas. Regarding the level of trust in AI, there was no significant difference in the assessment of the potential of AI to improve organizational performance ($t = -0.98$, $p = 0.328$). Both groups rated this aspect similarly, although the average was slightly higher among employees ($M = 3.9$) than leaders ($M = 3.8$). However, employees were much more likely to perceive AI as an opportunity than leaders ($t = -3.98$, $p < 0.001$), and leaders declare greater trust in AI-supported decisions than employees ($t = 3$, $p = 0.001$). In the area of leader competencies, leaders assess their preparation for managing AI implementation significantly higher ($M = 4.3$) than employees ($M = 3.3$), which was confirmed by high statistical significance ($t = 9.63$, $p < 0.001$).

Table 2.

Comparative analysis of the opinions of leaders and employees

	Leaders		Employees		Student's t-test	
	M	SD	M	SD	t	p
Level of trust in AI						
AI can significantly improve organizational performance	3.8	0.73	3.9	0.88	-0.98	0.328
The use of AI is more of an opportunity than a threat	3.5	0.88	3.9	0.79	-3.98	<0.001
I trust AI-supported decisions	3.4	0.91	3.0	1.02	3.32	0.001
Leadership competencies						
Our leaders are trained enough to manage AI implementation	4.3	0.52	3.3	0.97	9.63	<0.001
Leaders understand the potential of AI technology for our organization	4.5	0.63	3.7	0.84	8.42	<0.001
Leaders actively support AI adoption in the team	4.4	0.57	3.5	0.93	8.88	<0.001

Cont. table 2.

Perception of AI's impact on the organization						
AI is changing the way leaders make decisions	3.7	0.88	4.2	0.72	-5.26	<0.001
AI improves teamwork efficiency	4.1	0.71	4.4	0.62	-3.76	0.002
AI can limit human creativity in an organization	3.4	0.94	3.9	0.84	-4.67	<0.001
Readiness for change						
The organization provided appropriate training related to AI implementation	4.3	0.63	2.9	1.04	12.37	<0.001
The team is open to the changes resulting from the introduction of AI	3.4	0.99	4.1	0.68	-7.18	<0.001
I am ready to work with new AI technologies	4.7	0.43	4.4	0.55	4.77	<0.001
Successful AI implementation						
AI has contributed to improving the efficiency of our work	4.2	0.65	3.6	0.86	6.15	<0.001
AI has reduced the number of operational errors	4.1	0.72	3.3	0.93	7.54	<0.001
The AI implementation process in our organization ran smoothly	4.5	0.52	3.5	0.84	10.90	<0.001

Source: Own elaboration.

Similarly, leaders are more positive about their understanding of AI's potential ($t = 8.41$, $p < 0.001$) and active support for AI adaptation in teams ($t = 8.88$, $p < 0.001$) compared to employees. In the context of AI's impact on the organization, employees are more likely to agree that AI changes the way leaders make decisions ($t = -5.26$, $p < 0.001$), and they appreciate more the impact of AI on improving teamwork efficiency ($t = -3.76$, $p = 0.0002$). At the same time, employees assess the risk of limiting creativity in the organization due to the implementation of AI higher ($t = -4.67$, $p < 0.001$). In terms of readiness for change, leaders have a more positive assessment of providing appropriate training related to AI implementation ($t = 12.37$, $p < 0.001$) and believe that their teams are less open to changes resulting from the introduction of AI than the employees themselves ($t = -7.18$, $p < 0.001$). Moreover, leaders declare greater readiness to work with new AI technologies ($t = 4.77$, $p < 0.001$). Finally, leaders more positively assess the impact of AI on work efficiency ($t = 6.15$, $p < 0.001$), reduction of the number of operational errors ($t = 7.5$, $p < 0.001$) and the course of the AI implementation process in the organization ($t = 10.90$, $p < 0.001$) compared to employees. This indicates clear differences between both groups' perceptions of AI implementation success.

Next, a multiple regression was performed based on the following variables: the number of hours of leader training, leaders' experience with AI technology, and employees' perception of leaders on the success of AI implementation (Table 3).

Table 3.
Multiple regression

Independent variables	Coefficient	Standard error	t-statistic	p-value	Confidence interval 95%
Constant	-1.0043	0.505	-1,990	0.087	(-2.198, 0.189)
Number of hours of leadership training	0.1803	0.087	2.077	0.076	(-0.025, 0.386)
AI Experience	-0.9682	0.487	-1.987	0.087	(-2.120, 0.184)
Employees' perception of leaders	1.5385	0.271	5.672	0.001	(0.897, 2.180)

Source: Own elaboration.

The analysis results show that Employees' perception of leaders has the strongest impact on the success of AI implementation, confirmed by a statistically significant coefficient of 1.5385 ($p = 0.001$). This means that employees' positive perception of leaders significantly improves the effectiveness of AI implementation. In the context of leadership in the AI era, where technology is still a novelty, leaders perceived as competent, supportive, and open to innovation become crucial for successfully integrating new technologies with teams. Leaders who build trust and are authorities in the eyes of their employees have a better chance of effectively managing the process of implementing AI technology. About hours of leader training, the results indicate a moderate, although not fully significant, effect on AI implementation success. The coefficient of 0.1803 ($p = 0.076$) suggests that more hours of leader training may support their readiness to implement AI technologies. However, the evidence for the full significance of this effect is somewhat weaker, as the p -value is borderline significant. In contrast, Leaders' experience with AI technology shows a negative coefficient (-0.9682, $p = 0.087$), suggesting that leaders' greater experience with AI technology may be associated with slightly lower AI implementation success. However, this result is not statistically significant, and its negative nature may indicate that excessive dependence on previous experience and established work methods may limit leaders' flexibility in adapting to new technologies and approaches.

In summary, the analysis's results confirm that the key to the success of AI implementation in organizations is employees' perception of leaders and their ability to build trust and support in the team. Although the number of hours of leader training has some positive impact, leaders' experience with AI technology is not a key factor. Leadership in the AI era requires flexibility, openness to innovation, and employee trust, the foundation for effectively integrating technology with teams.

7. Summary and conclusions

The conducted research provided valuable information on the differences in the perception of artificial intelligence by leaders and employees and their impact on the success of implementing this technology. The research indicates the key role of leaders in implementing AI and the need to adapt implementation strategies to employees' various expectations and concerns. The results showed that the key factor in the success of AI implementation is employees' positive perception of leaders and their ability to build trust and support the team in adapting to new technologies. The research indicates that leaders' trust in AI is greater than employees' trust in this technology. Leaders responsible for the management and decisions regarding the implementation of AI are more convinced of its potential and benefits for the organization. They are more likely to see it as a tool that can improve operational efficiency

and enable better decision-making. Although generally open to technology, employees show greater concerns about its impact on their daily work and the potential loss of control over decision-making processes. Moreover, employees' perception of AI as a threat to creativity is also a significant factor that can inhibit the full adaptation of this technology in the organization. In the context of leadership competencies, the research results indicate that leaders assess their preparedness for AI implementation significantly higher than employees. Leaders assess themselves as well-trained and competent in implementing AI technologies, which may be due to their more direct involvement in decision-making processes and greater knowledge of AI applications in the organization. Employees not involved in the implementation feel less confident about how AI technology will affect their roles and tasks. These differences may also result from employees' lack of training and information about AI, indicating the importance of providing appropriate educational resources for both groups. In terms of the perceived impact of AI on the organization, leaders and employees showed different opinions on the impact of this technology on decision-making processes and teamwork effectiveness. Leaders were more convinced that AI significantly improves teamwork effectiveness and helps decision-making.

On the other hand, employees were more likely to fear that AI would limit their creativity and autonomy in decision-making. This may result from the fear that technology will replace them in creative processes, which often arouses resistance to its implementation. Interestingly, research results indicate that employees are more likely to perceive AI-related changes as threatening organizational culture and the way of working. At the same time, leaders see it as an opportunity to improve processes. Research also indicates significant differences in the perception of AI implementation success between leaders and employees. Leaders have a more positive assessment of the impact of AI on improving work efficiency and reducing operational errors, which may result from their better access to the results and data on the functioning of technology in the organization.

On the other hand, employees are less convinced of AI's effectiveness, which may result from the lack of full information about the implementation and its actual effects. Therefore, there is a need for transparency in the implementation process so that leaders and employees have a full picture of the benefits and challenges of AI. Regression analysis has shown that employee perceptions of leaders have the greatest impact on the success of AI implementation. Positive perceptions of leaders perceived as competent, open to innovation, and supporting implementation processes are crucial for the effectiveness of AI implementation. This confirms that the role of leaders in building trust and supporting teams in adapting to new technologies is extremely important. In addition, the number of hours of training leaders receive positively impacts AI implementation success. However, this effect is not fully statistically significant, suggesting that other factors, such as leader experience or organizational structure, may be equally important. In contrast, leaders' experience with AI technology hurts implementation success, suggesting that excessive attachment to previous experience and traditional working methods may limit leaders' flexibility in adapting to new technologies.

The study's findings emphasize the key role of employees' positive perception of leaders in the effective implementation of artificial intelligence. To translate these observations into practical actions, it is worthwhile to recommend specific solutions that support leaders. First and foremost, training that develops both digital competencies and soft skills, such as empathetic communication and managing resistance to change, is essential. Additionally, it is worth implementing programs that foster trust in AI, such as workshops on the ethical use of technology that encourage open dialogue among employees. These activities should be complemented by the use of tools to assess the organization's readiness to implement AI, which will enable better planning of the transformation process and tailoring support to the actual needs of teams.

However, these results should be treated with caution, as the study had some limitations to consider when interpreting the results. First, the study was conducted in organizations that have already implemented or are in the process of implementing AI, which may limit the sample's representativeness. The results could differ in organizations that are just considering implementing this technology. Second, the subjective nature of the responses of both leaders and employees may affect the reliability of the results. Each group may have had different expectations and experiences, which could have distorted their assessments.

Future research should consider expanding the sample to include organizations from different industries, sizes, and regions. This would allow for more diverse results and provide a better understanding of how different factors affect the AI implementation process in different contexts. In addition, it is worth conducting long-term studies to assess changes in AI perceptions and implementation effectiveness over time when the technology is fully adopted. Another direction is to analyze the impact of the AI implementation stage on the success of the technology, as organizations may encounter different challenges in different implementation phases. Additionally, future research could consider the impact of external factors, such as legal regulations, organizational culture, or support from external technology consultants, which can significantly impact the AI implementation process in an organization. These research directions can contribute to deepening knowledge on the effective implementation of AI in organizations, allowing for better adjustment of implementation strategies to the needs of both leaders and employees.

References

1. Acemoglu, D., Anderson, G.W., Beede, D.N., Buffington, C., Childress, E.E., Dinlersoz, E., Zolas, N. (2022). *Automation and the workforce: A company-level view from the 2019 Annual Business Survey* (No. w30659). National Bureau of Economic Research.
2. Baruk, J. (2008). The essence of knowledge as a source of innovation. *Organization Review*, 7, 6-10.
3. Carter, W., Wynne, K.T. Integrating artificial intelligence into team decision-making: Toward a theory of AI–human team effectiveness. *European Management Review*.
4. De Cremer, D., Kasparov, G. (2021). AI should augment human intelligence, not replace it. *Harvard Business Review*, 18(1).
5. Ejjami, R. (2024). Revolutionizing Moroccan education with AI: a path to customized learning. *International Journal for Multidisciplinary Research*, 6(3).
6. Estherita, S., Vasantha, D.S., Sungeetha, D. (2023). *Artificial Intelligence and HR Digitalization Facilitated by Transformational Leadership*. 2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS), 1-6.
7. Gao, P. (2024). The Role of Cross-cultural Leadership and Leader-member Exchange in Enhancing Organizational Performance in the Era of Big Data and AI Integration: A Study of Chinese Companies' Investments in South Korea. *Journal of Information Systems Engineering and Management*, 9(2), 24617.
8. Gruchola, M. (2022). Artificial intelligence technology in journalism and the perspective of journalist's deanthropocentrism. *Annals of Social Sciences*, 50(2), 59-82.
9. Gustafsson, S., Wilhelmson, K., Eklund, K., Gosman-Hedström, G., Zidén, L., Kronlöf, G. H., Dahlin-Ivanoff, S. (2012). Health-promoting interventions for persons aged 80 and older are successful in the short term—results from the randomized and three-armed elderly persons in the risk zone study. *Journal of the American Geriatrics Society*, 60(3), 447-454.
10. Hagemann, T., Czechowski, P., Ghosh, A., Sun, W., Dong, H., Noé, F., Hoffmann, A. (2023). Laminin α 4 Expression in Human Adipose Tissue Depots and Its Association with Obesity and Obesity-Related Traits. *Biomedicine*, 11(10), 2806.
11. Khakurel, J., Blomqvist, K. (2022, May). Artificial intelligence augmenting human teams. A systematic literature review on the opportunities and concerns. In: H. Degen, S. Ntoa (eds.), *International Conference on Human-Computer Interaction* (pp. 51-68). Cham: Springer International Publishing.
12. Krawczyk-Bryłka, B. (2016). Intercultural challenges in virtual teams. *Journal of Intercultural Management*, 8(3), 69-85.
13. Krawczyk-Bryłka, B., Nowicki, K. (2024). Challenges of cooperation with a robot as a team member. *Krakow Review of Economics and Management*, 1(1003), 97-115.

14. Li, X., Abangbila, L. (2024). Resistance to medical artificial intelligence: Integrating AI awareness, AI risks, and displacement of responsibility. *Journal of Infrastructure, Policy, and Development*, 8(11).
15. Lockey, S., Gillespie, N., Holm, D., Someh, I.A. (2021). *A review of trust in artificial intelligence: Challenges, vulnerabilities, and future directions*, 5463-5472.
16. Longoni, C., Bonezzi, A., Morewedge, C.K. (2019). Resistance to medical artificial intelligence. *Journal of Consumer Research*, 46(4), 629-650.
17. Luckin, R., Cukurova, M. (2019). Designing educational technologies in the age of AI: A learning sciences-driven approach. *British Journal of Educational Technology*, 50(6), 2824-2838.
18. Madanchian, M., Taherdoost, H., Vincenti, M., Mohamed, N. (2024). Transforming Leadership Practices through Artificial Intelligence. *Procedure Computer Science*, 235, 2101-2111.
19. Maddula, S.S. (2018). The impact of AI and Reciprocal symmetry on organizational culture and leadership in the digital economy. *Engineering International*, 6(2), 201-210.
20. Matsunaga, M. (2021). Uncertainty management, transformational leadership, and job performance in an AI-powered organizational context. *Communication Monographs*, 89, 118-139.
21. McCall, L. (2005). The complexity of intersectionality. *Signs: Journal of women in culture and society*, 30(3), 1771-1800.
22. McComb, C., Boatwright, P., Cagan, J. (2023). Focus And Modality: Defining A Roadmap to Future Ai-Human Teaming in Design. *Proceedings of the Design Society*, 3, 1905-1914.
23. McMullen, R.S., Adobor, H. (2011). Bridge leadership: A case study of leadership in a bridging organization. *Leadership & Organization Development Journal*, 32(7), 715-735.
24. Milton, J., Al-Busaidi, A. (2023). The new role of leadership in the AI era: Educational sector. *SHS Web of Conferences*, Vol. 156. EDP Sciences, p. 09005.
25. Murire, O.T. (2024). Artificial Intelligence and Its Role in Shaping Organizational Work Practices and Culture. *Administrative Sciences*, 14(12), 316.
26. Paliszkievicz, J., Gołuchowski, J., Skarzynska, E. (2023). The role of trust in leadership: Literature review. *Communication, Leadership, and Trust in Organizations*, 81-98.
27. Rane, N.L., Paramesha, M., Choudhary, S.P., Rane, J. (2024). Artificial intelligence, machine learning, and deep learning for advanced business strategies: a review. *Partners Universal International Innovation Journal*, 2(3), 147-171.
28. Rožman, M., Tominc, P., Milfelner, B. (2023). Maximizing employee engagement through artificial intelligent organizational culture in the context of leadership and training of employees: Testing linear and non-linear relationships. *Cogent Business & Management*, 10(2), 2248732.
29. Salazar-Gomez, A.F., Bagiati, A., Minicucci, N., Kennedy, K.D., Du, X., Breazeal, C. (2022, October). Designing and implementing an AI education program for learners with

- diverse backgrounds at scale. *2022 IEEE Frontiers in Education Conference (FIE)* (pp. 1-8). IEEE.
30. Schmutz, J.B., Outland, N., Kerstan, S., Georganta, E., Ulfert, A.S. (2024). AI-teaming: Redefining collaboration in the digital era. *Current Opinion in Psychology*, 101837.
 31. Singh, S. (2023). Leadership Challenges and Strategies in the Era of AI Transformation. *2023 International Conference on Computational Science and Computational Intelligence (CSCI)*, 119-124.
 32. Skarzyska, E. (2023). Basic elements of leadership. In: P. Pietrzak, K. Łukasiewicz (eds.), *Modern Management. Fundamentals of Management* (pp. 151-162). Warsaw: CeDeWu.
 33. Song, B., Soria Zurita, N.F., Gyory, J.T., Zhang, G., McComb, C., Cagan, J., Stump, G., Martin, J., Miller, S.W., Balon, C., Yukish, M.A. (2022). Decoding the agility of artificial intelligence-assisted human design teams. *Design Studies*, 79, 101094.
 34. Squicciarini, M., Nachtigall, H. (2021). *Demand for AI skills in jobs: Evidence from online job postings*.3.
 35. Sun, N. (2024). Investigating the Mediating Role of Team Communication in the Relationship between Leadership Style and Team Performance in AI-based Interaction Systems Development. *Journal of Internet Services and Information Security*, 14, 144-162.
 36. Sycara, K., Lewis, M. (2004). Integrating intelligent agents into human teams. In: E. Salas, S.M. Fiore (Eds.), *Team cognition: Understanding the factors that drive process and performance* (pp. 203-231). American Psychological Association.
 37. Theis, S., Jentsch, S., Deligiannaki, F., Berro, C., Raulf, A.P., Bruder, C. (2023, July). Requirements for explainability and acceptance of artificial intelligence in collaborative work. In: H. Degen, S. Ntoa (eds.), *International Conference on Human-Computer Interaction* (pp. 355-380). Cham: Springer Nature Switzerland.
 38. Uddin, A.S.M. (2023). The Era of AI: Upholding Ethical Leadership. *Open Journal of Leadership*, 12(04), 400-417.
 39. Walczak-Duraj, D. (2022). Changes in contemporary work, professions, and occupations. *Acta Universitatis Lodzianis. Folia Sociologica*, 81, 5-27.
 40. Webber, S.S., Detjen, J., MacLean, T.L., Thomas, D. (2019). Team challenges: Is artificial intelligence the solution? *Business Horizons*, 62(6), 741-750.
 41. Westover, J. (2024). The Role of AI & Leadership Intelligence in Building Tomorrow's Leaders. *Human Capital Leadership Review*, 14(3).
 42. Wiczerzyńska, B. (2022). Search in antitrust law and the practice of the President of the Office of Competition and Consumer Protection. *Legal and Constitutional Studies*, 58, 547-562.
 43. Yang, Y., Ngai, E.W., Wang, L. (2024). Resistance to artificial intelligence in health care: Literature review, conceptual framework, and research agenda. *Inf. Manag.*, 61, 103961.
 44. Zhang, Z., Zhang, A., Li, M., Zhao, H., Karypis, G., Smola, A. (2023). Multimodal chain-of-thought reasoning in language models. *arXiv preprint arXiv:2302.00923*

ARTIFICIAL INTELLIGENCE AND THE SUSTAINABLE CITY: HOW TECHNOLOGY TRANSFORMS URBAN FUTURES

Joanna SZAREK-ORLECKA^{1*}, Paulina CADER²

¹ University of Agriculture in Cracow; joanna.szarek@urk.edu.pl, ORCID: 0000-0001-9885-8424

² University of Agriculture in Cracow; paulina.cader@urk.edu.pl, ORCID: 0009-0009-6954-8975

* Correspondence author

Purpose: The purpose of this article is to study the role of technology in key areas of sustainable cities, such as infrastructure and transportation management, waste management, energy consumption or quality of life of residents. In addition, a ranking of selected European cities was constructed in terms of the adaptive potential of artificial intelligence in the perspective of sustainable urban development.

Design/methodology/approach: The research used a taxonomic method, a comparative method and a literature study.

Findings: The greatest potential for adapting strategic solutions using artificial intelligence to create smart cities in light of achieving the Sustainable Development Goals, among the cities accepted for analysis, was demonstrated by Paris, where for almost a decade now local authorities have focused on implementing the city as a platform model.

Originality/value: The article addresses current trends in regional development, in particular, the development of the smart city, taking into account the challenges of implementing artificial intelligence. The research is focused on the possibilities of using new technologies in the adaptation of urban communities to such phenomena as an aging population, or the implementation of sustainable development strategies. This is an important and innovative approach in regional research.

Keywords: artificial intelligence, sustainability, smart cities, urban technologies.

Category of the paper: Research paper.

1. Introduction

Progressive urbanization, urban population growth, and the growing challenges of climate change are making cities prime areas for implementing innovative solutions to support the idea of sustainable development (Niedziela-Wawrzyniak, 2023). Today's socio-economic and environmental challenges call for modern, open-ended governance models that will enable urban residents to not only maintain their current standard of living, but also raise it while maintaining environmental sustainability. One of the more promising tools in this regard is

artificial intelligence (AI), which offers advanced capabilities for data processing, process automation and efficient management of urban resources (Blicharz, 2023).

Despite the growing interest in smart cities, the role of artificial intelligence in the implementation of sustainable urban development strategies is still under-researched. There is a lack of in-depth and comprehensive studies to assess to what extent European cities are actually implementing AI-based solutions in their development policies, and what real impact these technologies have on improving the quality of life of residents, the efficiency of resource management and reducing negative environmental impacts.

The purpose of the article is to study the role of technology in key areas of sustainable cities. Referring to the main objective, a ranking of selected European cities in terms of the adaptive potential of artificial intelligence in the perspective of sustainable urban development was constructed. The analysis of this issue prompts the key research questions: To what extent are European cities using AI to support sustainable development? Which areas of city functioning are most susceptible to transformation through this technology? In which areas can the development of artificial intelligence positively affect regional development? With regard to the research questions, a research hypothesis was formulated: artificial intelligence and new technologies are leveling social problems in smart cities.

The structure of the article includes a review of the literature on sustainable cities and the role of artificial intelligence in their transformation, the methodology of the study based on taxonomic and comparative analysis, the presentation of the results, and conclusions on the role of artificial intelligence in creating more sustainable urban spaces. The issue addressed not only answers the existing research gap, but also brings new value by proposing to local authorities the adaptation of AI in the context of urban sustainability and current socio-regional challenges. The study focuses on the role of technology in key areas of sustainable city operations, such as infrastructure and transportation management, education or quality of life for residents.

2. The importance of artificial intelligence in shaping smart cities

2.1. Artificial intelligence in the context of sustainable urban development

The origins of the development of artificial intelligence can be traced back to the 1950s, when Alan Mathison Turing published a landmark article entitled “Computer Machinery and Intelligence” in the pages of the Oxford journal *Mind*. At the very beginning of his paper, Turing offered readers a reflection on the fundamental question: “Can machines think?”, which has become one of the key issues in the further development of AI research (Rashid et al., 2024).

Artificial intelligence is present today in almost all areas of life. Its capabilities are used in business, IT, security systems, agriculture, as well as in everyday activities, among others. Such a wide application confirms its versatility, innovative nature and rapid pace of development. AI's particularly great potential is evident in working with huge data sets from the Internet, as well as in tasks requiring creativity or evaluation and analysis (Szews, 2024). AI is particularly effective in analyzing large data sets generated in digital environments, as well as in tasks requiring creativity, evaluation and decision-making (Ljepava, 2022). Artificial intelligence is increasingly applied in many spheres of socio-economic life. It is being used as a key tool in the strategic planning of manufacturing enterprises, assisting supply chain management and supporting managers at various decision-making levels. Increasingly, cities and regions are also implementing AI-based solutions to improve the management of daily processes and increase the efficiency of public administration (Czyzewska-Misztal, 2024).

In the context of developing sustainable cities, artificial intelligence is becoming an increasingly important tool to support both urban planning and urban infrastructure management. Its use can significantly improve decision-making processes, increase the efficiency of managing urban resources and services, and improve the quality of life of residents. AI can play a key role in creating intelligent transportation systems, monitoring air pollution, managing energy, and responding to social needs in real time (Blicharz, 2023).

Sustainable development is based on three key foundations: meeting human needs, ensuring social justice, and taking into account environmental constraints. This means consciously and responsibly shaping the relationship between economic development, care for the environment - especially the natural environment - and the realization of various human needs, which largely affect the quality of life (Mierzejewska, 2015).

2.2. Smart city technologies and the integration of AI into urban policies

The term "Smart City" has begun to reflect the key needs of residents of modern cities. The term is most often associated with openness to modern solutions, the ability to adapt dynamically, and the use of innovative technologies to improve the quality of life in urban spaces (Czemiel-Grzybowska, 2023).

Today's cities are facing increasingly complex challenges, such as economic crises, climate change, aging populations, infrastructure overload, the emergence of online retail, and the need to ensure a high quality of life for residents (Podgórnjak-Krzykacz, Przywojska, 2023). In response to these problems, the smart city concept, which aims to create more efficient, sustainable and crisis-resilient urban structures by integrating modern technologies, including artificial intelligence (AI), into urban policies, is gaining importance (Widuch, 2022).

The term smart city can be defined in different ways, but all theoretical approaches emphasize that these are cities that use information and communication technologies (ICT) to solve social and development problems. A smart city is one that simultaneously develops modern technological infrastructure and invests in human and social capital, offering residents

access to e-services and digital solutions to support daily life (Legutko-Kobus, 2021). Integrating AI with city policies is becoming the foundation of modern governance - supporting urban planning, transportation, waste management, environmental protection, as well as security and civic participation (Lee and Lee, 2015).

In the context of integrating AI into urban policies, it is worth noting selected European cities that represent different levels of sophistication and adaptation strategies. In cities such as Paris, Madrid, Rome, Brussels, Budapest, Helsinki, Riga, Vilnius and Tallinn, there is a noticeable increase in the importance of AI as a tool to support the implementation of smart city strategies. For example:

- Paris is investing in AI-based urban platforms to manage mobility, air quality and energy, while developing a “city as a platform” model (Arduin et al., 2016).
- Madrid is pursuing a strategy of advanced digital transformation of urban space, based on the integrated development of social, environmental and economic components. A key element of this strategy is the use of real-time data to increase the efficiency of public services and improve emergency management systems (Orejon-Sanchez et al., 2022).
- Budapest is focusing its efforts on developing a modern transportation infrastructure, using digital technologies to improve the city's operations. The city government is implementing public transportation management systems that rely on data analysis to enable more efficient route planning and optimize the operation of public transportation and city services (Hamadneh, Jaber, 2023).
- Helsinki is developing the “City as a Service” concept, which aims to create citizen-centered city services. Here, AI is supporting urban planning, transportation management, digital healthcare and predicting demand for public services, among other things. The city also relies on transparency - residents have access to data on the operation of AI-based systems, which increases public trust and promotes acceptance of innovations (Anttiroiko, Sahamies, 2022).

However, the implementation of AI in urban policies is not a uniform process - it depends on many factors, such as the level of digital sophistication, availability of data, competence of officials, infrastructure and the organizational culture of the administration. Equally important are mechanisms for collaboration with the private sector and academia to create innovation ecosystems.

3. Methodology

The study consisted in developing a ranking of selected European cities on the basis of characteristics describing the level of regional development. The basic element of the analysis was the selection of a group of diagnostic variables that best reflect the degree of development of cities. The initial set of diagnostic characteristics was selected from available statistical data on the basis of a substantive criterion. The components of the substantive criterion were the purpose and subject of the study, as well as the time frame in which the study was conducted (Szarek, 2021). In addition, the selection of variables was determined by the availability and completeness of empirical data, which were obtained from the databases of the statistical office of the European Union (Eurostat). As a result, ten diagnostic variables of the set of diagnostic characteristics were qualified for the study. All of the variables selected for the study were identified as stimulants. Stimulants are characteristics that have a positive impact on the analyzed area. The first step in the calculation was the estimation of Pearson's linear correlation coefficient. Pearson's linear correlation coefficient takes values in the range of $[-1, 1]$.

The closer this value is to one, the stronger the relationship is. In the literature, it is assumed that $r_{xy} < 0.3$ – designates an insignificant correlation; $0.3 < r_{xy} \leq 0.5$ – average correlation; $r_{xy} > 0.5$ – clear correlation. The Pearson's linear correlation coefficient was estimated using the following formula:

$$r_{xy} = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n \sum X^2 - (\sum X)^2] * [n \sum Y^2 - (\sum Y)^2]}} \quad (1)$$

where:

r_{xy} – Pearson's linear correlation coefficient,

n – number of elements in the set,

X – explanatory variable,

Y – explained variable (Chudy-Hyski, 2006).

The criterion used for the classification of features was the value of the sum of modules of the correlation coefficient number for individual variables (s.m.), and namely $\{s.m. < 8\}$ was the determining condition for qualification of diagnostic features for creation of the ranking.

The next criterion for the selection of diagnostic variables was their sufficiently high degree of variation. The degree of differentiation of individual characteristics was estimated on the basis of the coefficient of variation. It was established that the value of the coefficient of variation of the studied diagnostic variables should exceed ($>10\%$), which means that the trait indicates significant variation (Szarek-Orlecka, 2025).

Continuing with the analysis of selected diagnostic variables, standardization was performed using the formula:

$$z_{it} = \frac{z_{it} - \bar{x}_i}{s_i} \quad (2)$$

where:

$$\bar{x}_i = \frac{1}{n} \sum_{t=1}^n x_{it} \quad (3)$$

$$s_i = \left[\frac{1}{n} \sum_{i=1}^n (x_{it} - \bar{x}_i)^2 \right]^{0,5} \quad (4)$$

where: z_{it} – standardized value of the diagnostic feature x_i over time t (Murawska, 2010).

Using estimated standardized values of the diagnostic features, a index of standardized sums for individual regions was calculated according to the formula:

$$Z'_{it} = \frac{(\sum z_{it})}{n} \quad (5)$$

where: n – number of diagnostic variables.

The natural breaks method divides into five classes, where:

- class 1: $Z'_{it} > 2.00$,
- class 2: $2.00 > Z'_{it} > 0.00$,
- class 3: $0.00 > Z'_{it} > -0.5$,
- class 4: $-0.50 > Z'_{it} > -0.80$
- class 5: $-0.80 > Z'_{it} > -1.00$.

The survey made it possible to rank selected European cities based on their level of regional development. An important element of the study was the adequate selection of diagnostic variables that met statistical, substantive and data availability criteria. Five class of regional development were identified. Class 1 included cities with the highest level of regional development. Class 2 is represented by cities with relatively high, but not the highest level of development. Class 3 includes cities with a moderate level of development. Class 4 includes cities with a low level of development, in need of development support or intervention, while the final class five includes cities with the lowest level of regional development.

The survey made it possible not only to assess the relative level of development of cities, but also to identify areas requiring support in the context of spatial planning and regional policy.

4. Results

The first step in the creation of a ranking of selected European cities in terms of regional development was the estimation of correlations between diagnostic variables, which is presented below (Table 1).

Table 1.

Set of variables characterizing the potential for implementing new technologies and artificial intelligence as a response to the challenges facing selected cities

Symbol*	Diagnostic variables
X _{1(s)}	population living in private households (excluding institutional households)
X _{2(s)}	lone pensioner (above retirement age) households
X _{3(s)}	number of registered cars per 1000 population
X _{4(s)}	economically active population, total
X _{5(s)}	total employment/jobs (work place based)
X _{6(s)}	employment (jobs) in mining, manufacturing, energy (nace rev. 2, b-e)
X _{7(s)}	employment (jobs) in trade, transport, hotels, restaurants (nace rev. 2, g to i)
X _{8(s)}	employment (jobs) in information and communication (nace rev. 2, j)
X _{9(s)}	employment (jobs) in financial and insurance activities (nace rev. 2, k)
X _{10(s)}	employment (jobs) in professional, scientific and technical activities; administrative and support service activities (nace rev. 2, m and n)

* (s) – stimulant, (d) – destimulant.

Source: own elaboration.

The starting point for further research was the matrix of coefficients of correlation between potential diagnostic features (Table 2).

Table 2.

Matrix of correlation between analyzed diagnostics variables

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
X1	1.00	0.98	0.08	1.00	0.99	0.95	0.98	0.98	0.97	0.97
X2	0.98	1.00	0.16	0.97	0.94	0.92	0.93	0.93	0.96	0.91
X3	0.08	0.16	1.00	0.04	-0.03	-0.08	0.07	-0.04	-0.06	0.06
X4	1.00	0.97	0.04	1.00	0.99	0.96	0.99	0.99	0.97	0.98
X5	0.99	0.94	-0.03	0.99	1.00	0.97	0.99	0.99	0.96	0.98
X6	0.95	0.92	-0.08	0.96	0.97	1.00	0.95	0.96	0.94	0.93
X7	0.98	0.93	0.07	0.99	0.99	0.95	1.00	0.99	0.92	0.99
X8	0.98	0.93	-0.04	0.99	0.99	0.96	0.99	1.00	0.94	0.99
X9	0.97	0.96	-0.06	0.97	0.96	0.94	0.92	0.94	1.00	0.90
X10	0.97	0.91	0.06	0.98	0.98	0.93	0.99	0.99	0.90	1.00

Source: author's calculations.

Using the next criterion for the selection of diagnostic variables, namely a sufficiently high degree of variability, no reduction in diagnostic variables was made (Table 3). For no diagnostic variable did the estimated coefficient of variation take values below 10%. The variation in the adopted characteristics indicates high significance between variables.

Table 3.

Numerical characteristics of diagnostic features in selected cities

Characteristic	Diagnostic variables									
	X _{1(s)}	X _{2(s)}	X _{3(s)}	X _{4(s)}	X _{5(s)}	X _{6(s)}	X _{7(s)}	X _{8(s)}	X _{9(s)}	X _{10(s)}
Maximum	12936,8	687,0	0,6	6710,6	6165,9	444,7	1395,9	433,3	354,3	1047,3
Arithmetic mean	3786,1	209,4	452,54	1960,8	1858,9	153,3	473,7	131,7	81,3	337,4
Standard deviation	3764,3	190,8	0,08	1948,9	1805,2	124,1	419,5	130,8	101,2	335,9
Coefficient of variation (%)	99,42	91,12	19,13	99,40	97,11	80,97	88,57	99,28	124,51	99,59

Source: author's calculations.

Based on an examination of the coefficient of variation and linear correlation coefficient, four diagnostic variables were selected (Table 4).

Table 4.

Set of diagnostic variables selected for creation of ranking

Symbol*	Diagnostic variables
X _{1(s)}	population living in private households (excluding institutional households)
X _{2(s)}	lone pensioner (above retirement age) households
X _{4(s)}	economically active population, total
X _{5(s)}	total employment/jobs (work place based)
X _{6(s)}	employment (jobs) in mining, manufacturing, energy (nace rev. 2, b-e)
X _{7(s)}	employment (jobs) in trade, transport, hotels, restaurants (nace rev. 2, g to i)
X _{8(s)}	employment (jobs) in information and communication (nace rev. 2, j)
X _{9(s)}	employment (jobs) in financial and insurance activities (nace rev. 2, k)
X _{10(s)}	employment (jobs) in professional, scientific and technical activities; administrative and support service activities (nace rev. 2, m and n)

* (s) – stimulant.

Source: own elaboration.

Using a taxonomic method, a ranking of the nine European cities selected for the study was created, reflecting the potential for the development of artificial intelligence and new technologies, as a response to the challenges facing the selected urban centers (Table 5).

Table 5.

Ranking of European cities according to the standardized sum index

Class	City
1	Paris
2	Madrid
3	Roma, Budapest, Brussel
4	Helsinki, Riga, Vilnius
5	Tallin

Source: own elaboration.

The final distribution of cities was influenced by the nine diagnostic variables indicated in Table 4. The variables illustrate the scale of the phenomenon of the possibility of implementing solutions using artificial intelligence as part of smart city and sustainable development strategies, referring to the number of residents, their level of education, wealth, or loneliness.

5. Discussion and Conclusions

Smart cities aim to effectively manage the progressive process of urbanization, energy consumption, care for the environment, appreciate the financial and living standards of residents, and increase the capacity of human capital to effectively use and implement modern information and communication technologies (ICT). Multisectoral cooperation plays an important role in the smart city project, starting with smart transportation, cyber security,

smart grids (SG), and next-generation communications supported by UAVs (5G and B5G) (Ullah et al., 2020). All of the previous smart city sectors are heavily influenced by big data analytics and the effective use of artificial intelligence, machine learning and DRL-based techniques that can increase their efficiency and scalability in a smart city project.

Nowadays, it is often indicated in the literature that waste management is one of the biggest challenges facing the world, whether in developed or developing countries. Population growth has led to a significant deterioration in the hygienic situation of the waste management system (Venkatesh et al., 2022). Many solutions are being implemented in the smart city to support waste management.

Smart infrastructure, an essential component of smart cities, is equipped with wireless sensor networks that autonomously collect, analyze and transmit structural data, called “smart monitoring” (Luckey et al., 2021). The goals of intelligent monitoring, indicated in the literature, can also respond to sustainable development goals. Artificial intelligence-based applications targeting smart city residents have been adopted by various developing and developed countries around the world. Artificial intelligence is and will be an indispensable part of the smart city (Ashwini, 2022). In addition, urban mobility has seen significant innovations through artificial intelligence applications such as autonomous vehicles (AVs), electric vehicles (EVs) and unmanned aerial vehicles (UAVs). The impact of artificial intelligence can be seen in the areas of energy management and sustainable development practices, health care, environmental management, or the industrial sector (Szpilko, 2023).

The conducted study of the literature on the subject and the analysis of statistical data using the taxonomic method made it possible to verify the research hypothesis and formulate theoretical, methodological and pragmatic conclusions. A positive verification of the research hypothesis was made, indicating that artificial intelligence and new technologies level social problems in smart cities. As part of the methodological conclusions, it should be pointed out that the taxonomic methods used, made it possible to categorize the cities selected for the study in terms of the development potential of the smart city and to indicate the similarities of the ongoing changes in the analyzed metropolises. The main conclusion of a theoretical nature is that the topic of smart city considerations in combination with sustainable development and artificial intelligence has become a permanent part of economic science. Referring to the pragmatic insights of the research, first of all, there is a noticeable increase in the importance of artificial intelligence as a tool to support the implementation of smart city strategies. Secondly, the implementation of AI in urban policy is a multi-factor process. It depends not only on the level of digital sophistication, the availability of data, the competence of officials, the infrastructure and organizational culture of the administration, cooperation with the private sector and academia, but also and perhaps most importantly on the residents. Thirdly, smart city development strategies are a kind of response to the realization of sustainable development goals. The suggestion for local authorities with custody of smart city development is to focus even more on the needs of local residents in terms of education about sustainable lifestyles and the use of artificial intelligence.

References

1. Anttiroiko, A.V., Sahamies, K. (2022, June). *Designing city service ecosystems: the case of the city of Espoo in the capital region of Finland*. International Conference on Human-Computer Interaction. Cham: Springer International Publishing, pp. 139-157.
2. Arduin, P., Negre, E., Rosenthal-Sabroux, C. (2016). *Knowledge and decision for smart cities initiatives: cases of Paris and Nice*. 2016 International Conference on Industrial Informatics and Computer Systems (CIICS). <https://doi.org/10.1109/iccsii.2016.7462421>
3. Ashwini, B.P., Savithramma, R.M. (2022). *Artificial Intelligence in Smart city applications: An overview*. 2022 6th international conference on intelligent computing and control systems (ICICCS). IEEE, pp. 986-993.
4. Blicharz, J. (2023). *Inteligentne miasta i sztuczna inteligencja*. Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.
5. Chudy-Hyski, D. (2006). Ocena wybranych uwarunkowań rozwoju funkcji turystycznej obszaru [The evaluation of chosen conditions of development of tourism function of an area]. *Infrastruktura i ekologia obszarów wiejskich, No. 1*. Polska Akademia Nauk [Polish Academy of Sciences].
6. Czemieli-Grzybowska, W. (2023). Trendy rozwoju zrównoważonej przedsiębiorczości technologicznej opartej na sztucznej inteligencji. *Akademia Zarządzania*, 7(4).
7. Czyżewska-Misztal, D. (2024). Wykorzystanie sztucznej inteligencji na rzecz rozwoju miast i regionów. In: *Droga do zrównoważonej gospodarki światowej* (pp. 43-52). Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu.
8. Hamadneh, J., Jaber, A. (2023). Modeling of intra-city transport choice behaviour in Budapest, Hungary. *Journal of Urban Mobility*, 3, 100049. <https://doi.org/10.1016/j.urbmob.2023.100049>
9. Lee, S., Lee, D. (2015). A study on analysis & outlook of smart city based on actual cases. *International Journal of Smart Home*, 9(7), 181-188. <https://doi.org/10.14257/ijsh.2015.9.7.18>
10. Legutko-Kobus, P. (2021). E-partycypacja i Iso 37120 jako wyznacznik implementacji rozwoju zrównoważonego w Smart City. *Studia Ecologiae Et Bioethicae*, 19(1), 71-82. <https://doi.org/10.21697/seb.2021.19.1.06>
11. Ljepava, N. (2022). Ai-enabled marketing solutions in marketing decision making: AI application in different stages of marketing process. *TEM Journal*, 1308-1315. <https://doi.org/10.18421/tem113-40>
12. Luckey, D., Fritz, H., Legatiuk, D., Dragos, K., Smarsly, K. (2021). *Artificial intelligence techniques for smart city applications*. Proceedings of the 18th International Conference on Computing in Civil and Building Engineering: ICCCBE 2020. Springer International Publishing, pp. 3-15.

13. Mierzejewska, L. (2015). Zrównoważony rozwój miasta – wybrane sposoby pojmowania, koncepcje, modele. *Problemy Rozwoju Miast*, vol. 12, no. 3.
14. Murawska, A. (2010). Klasyfikacja województw pod względem rozwoju gospodarczego za pomocą metod taksonomicznych [Classification of provinces in terms of economic development by means of taxonomic methods]. *Polskie Stowarzyszenie Zarządzania Wiedzą, Seria: Studia i Materiały*, No. 33.
15. Niedziela-Wawrzyniak, S. (2023). Zielone ściany w środowiskach miejskich: katalizatory innowacji i zdolności adaptacyjnych miast. *Zeszyty Naukowe Wyższej Szkoły Technicznej W Katowicach*, 17, 21-42. <https://doi.org/10.54264/0073>.
16. Orejon-Sanchez, R.D., Crespo-Garcia, D., Andres-Diaz, J.R., Gago-Calderon, A. (2022). Rozwój inteligentnych miast w Hiszpanii: porównanie wskaźników technicznych i społecznych w odniesieniu do miast europejskich. *Zrównoważone miasta i społeczeństwo*, 81, 103828.
17. Podgórnika-Krzykacz, A., Przywojska, J. (2023). Skoncentrowana na ludziach transformacja miast w kierunku inteligentnego zrównoważonego rozwoju. *Władza Sądzenia*, 25, 70-87. <https://doi.org/10.18778/2300-1690.25.05>
18. Raszyd, K.I., Wesołowska, A., Tomaszewska, K. (2024). Sztuczna Inteligencja w nauce – jak studenci wykorzystują AI w edukacji wyższej. *Akademia Zarządzania*, 8(3).
19. Szarek, J. (2021). *High-Tech Sector in The Benelux Countries Compared to The Remainder of The European Union – A Taxonomic Analysis*. Proceedings of the 38th International Business Information Management Association Conference (IBIMA): Digital healthcare solutions for remote care delivery and better patient outcomes. K.S. Soliman (ed.), Proceedings of the ... International Business Information Management Association Conference, 2021, International Business Information Management Association, pp. 4264-4271, ISBN 978-0-9998551-7-1
20. Szarek-Orlecka, J. (2025). *Taxonomic measurement of regional diversification of the level of innovation in Poland*. Proceedings of the 45th International Business Information Management Association Conference (IBIMA): Business, Marketing, Management, and Human Resources Conference. K.S. Soliman (ed.), Proceedings of the ... International Business Information Management Association Conference, 2025, International Business Information Management Association, ISBN: 979-8-9867719-6-0
21. Szews, P. (2024). Sztuczna inteligencja w digital marketingu. *Media i Społeczeństwo*, 20(1).
22. Szpilko, D., Naharro, F.J., Lăzăroiu, G., Nica, E., de la Torre Gallegos, A. (2023). *Artificial intelligence in the smart city—a literature review*.
23. Ullah, Z., Al-Turjman, F., Mostarda, L., Gagliardi, R. (2020). Applications of artificial intelligence and machine learning in smart cities. *Computer Communications*, 154, 313-323.

24. Venkatesh, A.N., Naved, M., Fakih, A.H., Kshirsagar, P.R., Vijayakumar, P. (2022). An approach for smart city applications using artificial intelligence. *AIP Conference Proceedings*, Vol. 2393, No. 1. AIP Publishing.
25. Widuch, A. (2022). Koncepcje Smart City w wybranych miastach Zagłębia Ruhry. *Academic Review of Business and Economics*, 2, 37-52. <https://doi.org/10.22367/arbe.2022.02.03>

USING ARTIFICIAL INTELLIGENCE IN THE DEVELOPMENT OF SHARING SMART CITIES: THE GENERATION C PERSPECTIVE

Anna Irena SZYMAŃSKA

Krakow University of Economics; szymansa@uek.krakow.pl, ORCID: 0000-0002-1973-2696

Purpose: The primary aim of this article is to explore the self-declared interest in and adoption of AI-enabled solutions among members of Generation C as urban space users. The analysis underscores the pivotal role of artificial intelligence as a key driver in the development of smart cities, particularly with regard to the optimisation of resource allocation within the sharing economy.

Design/methodology/approach: The research concept is based on a literature review regarding the evolution of society in the context of economic and technological transformations, as well as on qualitative research employing the focus group interview (FGI) method. The collected empirical material was subjected to a semantic field analysis, resulting in the reconstruction of two definitions.

Findings: The analysis of two reconstructed definitions provided insight into how the participants perceive AI. The first definition presents AI in a positive light, defining it as a technology of the future that streamlines decision-making processes, automates tasks, and increases the efficiency of operations in areas such as science, medicine, and resource management.

The second definition focuses on the negative aspects of AI, such as its reproductive nature, the risk of errors in data analysis, and the likelihood of increased unemployment and social inequalities. A significant threat also remains the risk of privacy violations, data theft, and the lack of transparency in AI system operations. The research revealed that representatives of Generation C perceive AI in an ambivalent manner. However, they emphasized the necessity of implementing legal regulations and oversight mechanisms aimed at limiting potential abuses and ensuring the ethical use of this technology.

Research limitations/implications: The study focused only on Generation C, which limits the possibility of a broader perspective on the subject. Future research should include other age groups to explore generational differences in AI adoption.

Originality/value: This study explores Generation C attitudes toward AI within the context of the Sharing Smart City concept and the sharing economy. It also offers a conceptualization of the "Sharing Smart City" model as a citizen-centered paradigm of urban development. The findings provide valuable insights for both technology developers and policymakers responsible for its legal regulation.

Keywords: consumer behaviour, Generation C, sharing economy, sharing smart city, smart citizens.

Category of the paper: research paper.

1. Introduction – synergy between the Sharing Economy and Smart City concepts

The concepts of sharing economy and smart city are mutually interconnected. Both are based on the idea of more efficient resource utilization and require an appropriate level of digitalization within urban spaces. The smart city concept is grounded in the extensive use of information and communication technologies (ICT) to enhance efficiency, reduce costs, and improve the quality of life in urban areas (EC, 2013). It is viewed as an innovative approach aimed at addressing various social challenges. On the other hand, the sharing economy relies on the collaborative use of underutilized resources, facilitated by ICT in densely populated cities (Zvolska et al., 2019). The sharing economy is often defined through terms such as collaborative economy, access economy, or platform economy, although these terms are not synonymous (Szymańska, 2017). Both concepts are distinguished, among other things, by their focus on innovations driven by the needs of citizens and consumers, as well as the pursuit of more rational resource management (material, skills, time, data) through ICT (Gori et al., 2015). As a result, greater attention is paid to environmental protection and sustainable development (reduction of CO₂ emissions, extension of product life cycles, urban environmental protection). The use of ICT, along with new technologies equipped with AI solutions, is crucial for both concepts, enabling more effective management of urban infrastructure and supporting the development of sharing platforms.

In the context of smart cities, AI enhances the interactivity and efficiency of urban infrastructure, raising residents' awareness. An example of the synergy between these concepts is shared mobility systems, such as city bike systems (e.g., Barclays Cycle Hire), which use ICT to facilitate access and reduce transaction costs. Meanwhile, AI facilitates predicting the accuracy of shared vehicle rides, achieving prediction effectiveness of up to 95% (Zvolska et al., 2019; Kubik, 2022). It is important to emphasize that the use of AI in supporting shared mobility systems represents an innovative approach, paving the way for the automation of the evaluation of rides.

The development of smart cities creates a natural environment for the sharing economy due to the concentration of potential users and available resources (Jonek-Kowalska, Wolniak, 2022). Furthermore, both smart cities and the sharing economy are viewed as promising approaches to addressing the challenges associated with sustainable urban development, contributing to the advancement of digitally supported green urbanism (Hollands, 2008; McLaren, Agyeman, 2015; Zvolska et al., 2019). On a global scale, AI plays an increasingly significant role in transforming purchasing decisions toward more sustainable choices, interacting with e-commerce platforms and the sharing economy. Virtual assistants and AI-powered platforms can promote energy-efficient behaviours (Palomo-Domínguez, Zemlickienė, 2022). The management of complex networks in smart cities, such as electricity

grids or multimodal transportation systems, can also leverage a combination of pattern identification and the connection of various actors, representing a potential application domain for AI (Ernst et al., 2019).

The concept of the sharing economy, also known as the collaborative economy, access-based consumption, or platform economy (Jonek-Kowalska, Wolniak, 2022; Ratilla et al., 2021; Szymańska, 2017), is defined as a socio-economic system based on the sharing or mutual provision of both material and immaterial resources (such as services, time, skills, data), between individuals or groups, often through digital platforms (Zvolska et al., 2019; Veretennikova, Kozinskaya, 2022; Ratilla et al., 2021). Belk (2014) defines the sharing economy as the process of distributing what we own for others' use and accepting what others provide for our use. Hamari et al. (2016) view the sharing economy as a peer-to-peer activity involving obtaining, giving, or sharing access to goods and services, coordinated via online community platforms. The literature highlights that the traditional consumption model based on ownership is being reconfigured in favour of access to resources (Bardhi, Eckhardt, 2012; Belk, 2014; Ratilla et al., 2021; Veretennikova, Kozinskaya, 2022; Frenken, 2017; Schor, 2017). Botsman and Rogers (2010) are among the principal scholars who contributed to the popularization of the concept of collaborative consumption. In work *What's Mine Is Yours: The Rise of Collaborative Consumption*, they systematized examples of collaborative consumption into product-service systems, redistribution markets, and collaborative lifestyles, highlighting key principles of this model such as critical mass, unused capacity, belief in the commons, and trust between strangers. Meanwhile, Bardhi and Eckhardt (2012) introduced the concept of the spread of access-based consumption, where consumers prefer access to goods and are willing to pay for temporary access rather than purchasing and owning the goods. An overview of key sharing economy characteristics is provided in Table 1.

Table 1.

Key characteristics of the Sharing Economy

Key Characteristics	Description
resource sharing	Repeated utilization of assets that would otherwise remain unused or rarely used in the traditional model, e.g., car-sharing, short-term apartment rentals, coworking spaces.
access over ownership	The ability to temporarily access goods and services instead of permanently owning them; model addresses the need for flexibility and cost reduction associated with ownership.
utilization of idle assets	Sharing economy platforms facilitate the identification and commercialization of underutilized or idle assets owned by individuals or organizations. As a result, resource efficiency improves, fostering a shift towards access-based models.
community role	Activities based on user interactions, fostering a sense of community and trust.
value co-creation	The co-creation of value between providers and consumers is a fundamental aspect of this model, directly linked to participation in collaborative consumption. Sustainability and environmental protection play a crucial role in this process.

Source: own study based on: Bardhi, Eckhardt, 2012; Belk, 2014; Ratilla et al., 2021; Veretennikova, Kozinskaya, 2022; Jonek-Kowalska, Wolniak, 2022; Grönroos, 2011; Hamari et al., 2016; Szymańska, 2017.

The concept of a smart city is complex and multidimensional, with no single, universally accepted definition. However, the prevailing view in the literature is that a smart city leverages information and communication technologies (ICT) strategically to enhance residents' quality of life, improve urban governance efficiency, and promote sustainable development (Zvolska et al., 2019; Veretennikova, Kozinskaya, 2022; Lazaroïu, Roscia, 2012). Smart cities strive to integrate urban systems and services through advanced digital infrastructure, facilitating more effective data collection, analysis, and utilization to support informed decision-making (Zvolska et al., 2019; Mora et al., 2017).

The literature review, which forms the foundation of the above considerations, has revealed a significant research gap in the conceptualization and development of the Sharing Smart City - an interdisciplinary synthesis of the sharing economy and smart city paradigms. These two approaches exhibit complementary characteristics in resource allocation and technological deployment. Both models emphasize the critical role of integrating information and communication technologies (ICT) and advanced technological solutions, including artificial intelligence (AI), into decision-making and operational processes. An essential exogenous driver of the Sharing Smart City concept is undoubtedly smart citizens - a well-educated and creative group of urban stakeholders who actively adopt technological innovations to shape an intelligent city based on sharing economy principles. Their competencies, innovativeness, and ability to collaborate, supported by widespread access to ICT, create added value by improving both the quality of life and urban ecosystem efficiency.

2. Super Smart Society - Society 5.0

The information revolution, which has driven the development and widespread adoption of information and communication technologies, and consequently the rise of professions related to information and modern technologies, has contributed to the emergence of the information society (post-industrial society), referred to as Society 4.0. A primary role in its development is undoubtedly played by knowledge and its utilization. According to Mark E. Hepworth, the process of wealth creation and the generation of new jobs within the post-industrial economy is dominated by the production of information based on network infrastructure (both computer and telecommunications) (Hepworth, 1990). Information is a defining feature of the modern world. The omnipresence of media, the expansion and specialization of information-related professions, and the development of the Internet all contribute to making membership in the information society an evident reality.

The knowledge-based economy is a central element of Society 4.0, whose defining feature should be innovation, viewed as a collective research effort in which the exchange of information and resources plays a crucial role, along with access to goods without the need to

acquire ownership (various solutions from the sharing economy sector). 'Knowledge and technological and market skills, which form the foundation of innovation, are intangible by nature and are therefore acquired through learning by doing, learning by using, and through interactions with customers, suppliers, and businesses from related industries' (Majewska et al., 2013). Digital technologies are not just an area, but a dimension of modern human existence. This shift in perspective leads to the understanding that digital communication technologies are considered not only as a separate field but also as an integral component present in other domains of human activity, facilitating their functioning (Du Vall, 2019).

The response to what some scholars have already identified as the fifth industrial revolution (Furmanek, 2014; Blicharz, 2023) may be found in the proposal of the Society 5.0 concept, understood as a modern, forward-looking, and human-centered society, where the integration of cyberspace and the real world is achieved through the use of cutting-edge technologies such as artificial intelligence, the Internet of Things, robotics, and big data. The super-intelligent society aims to create a world in which essential goods and services are provided to everyone, at any time and place, regardless of region, age, gender, language, or other limitations. Its goal is to simultaneously achieve economic growth and prosperity while overcoming social challenges, thereby contributing to the well-being of the global community (Du Vall, 2019).

Table 2. presents a comparison of social transformations, beginning with the Hunter Society 1.0 and ending with the latest concept of the Super Smart Society 5.0. These transformations are responses to economic changes, the development of new technologies, and the emergence of solutions such as artificial intelligence, the Internet of Things, robotics, and big data. The analysis is conducted within the context of the three waves of civilization proposed by Alvin Toffler.

It is important to note the significant impact of rapid technological development and the social challenges associated with adapting to these fast-paced changes in recent years. According to Toffler, the third wave not only accelerates the flow of information but also alters the very structure of information, which influences human behaviour. These transformations have been termed "future shock", which is caused by three interconnected sets of phenomena: transience, novelty, and diversity. They lead to "physical and psychological exhaustion resulting from the overload of physical adaptive mechanisms in the human body, as well as decision-making mechanisms" (Toffler, 1974; Augustyniak, 2014). This exhaustion is a response to the excess of stimuli that reach individuals on both the affective and cognitive levels.

Table 2.*Realization of Society 5.0 with its evolutions and involvement of emerging technologies*

Toffler's Waves of Civilization	Development of industry	Development of society
-	Subsistence economy (gathering-hunting-fishing)	Hunting Society 1.0 Hunter-gatherer society
First wave – 8000 BCE – 1650/1759 agricultural revolution, the transformation of nomadic tribes into settled communities engaged in agriculture; production of food and raw materials	manufacturing economy (agricultural and livestock)	Agriculture Society 2.0 pre-industrial, trade-based society
Second wave – 1650 (England)/ 1750 (Western Europe) – 1955/1970 Industrial Revolution, industrialization, cheap labour, mass production	Industry 1.0 - mechanisation, industrialisation steam engine, internal combustion engine, electric motors, atomic energy	Industrial Society 3.0 hierarchically organised, class division, power hierarchy, 'iron cage' phenomenon (Weber)
Third wave – 1955/1970 – until now technological and post-industrial revolution, occurs in the most developed cities new methods of acquiring and utilizing knowledge, advanced technology "super-symbolic economy"	Industry 2.0 – Human relations, urban expansion	Information Society 4.0 (post-industrial) Innovation, knowledge and its application, exchange of information and resources (sharing economy), learning by doing, learning by using
	Industry 3.0 – technologically advanced, information revolution	
	Industry 4.0 – process automation, Artificial Intelligence (AI)	Super Smart Society 5.0 modern, human-centred, integrating cyberspace and the real world through cutting-edge technologies
	Industry 5.0 – symbiosis between humans and technology, sustainable development	

Source: own study based on: Toffler, 2006; Du Vall, 2019; Mishra, Thakur, Singh, 2022; Szymańska, 2024.

The rapid development of information and communication technologies, along with the significant acceleration in the implementation of novel solutions - particularly in urban areas - forces society to adapt to on-going transformations. Adaptive processes are characterized by considerable variability in the pace of their execution and the tools implemented, depending on various factors (e.g., demographic, socio-economic, cultural, and psychological).

The above considerations, along with the belief (supported by numerous scientific studies) that the group most interested in and open to technological innovations consists of young and educated individuals, led to the decision to conduct direct market research using focused group interviews as a research tool.

3. Research Methodology

Between October and November 2024, direct research was conducted using Focus Group Interviews (FGI) as the research method. Focus Group Interviews (FGI), which belong to the group of qualitative research methods, allow for the exploration of specific behaviour,

motivations, attitudes, associations, and cognitive patterns related to the research topic. Furthermore, they enable the study of subjective phenomena that are difficult to measure quantitatively.

The research provided an in-depth examination of the use of artificial intelligence (AI) solutions by members of Generation C, who are also users of urban spaces – a key factor in the evolution of smart cities. Undoubtedly, access to such solutions and the ability to utilize them in daily life significantly enhances the position of young urban citizens compared to other residents.

This publication presents the results of an analysis of qualitative data collected during five focus group interviews conducted with individuals born after 1990 (Generation C – the connected generation: connect, communicate, change), who are considered digital natives. Members of Generation C represent the group most open to innovation, demonstrating a greater interest in the possibilities these innovations offer and in applying them to daily life. The characteristics that distinguish Generation C include (Hardey, 2011; Szymańska, 2022):

- membership determined not by age, but by upbringing in a digital environment and the internet era (digital natives),
- above-average creativity,
- a desire to influence the surrounding world (control),
- communication and establishing relationships with others online (connection),
- creating bonds with friends on the internet (community),
- lack of knowledge about a world without computers,
- ease of navigating virtual reality, with parallel functioning in both the real and virtual worlds,
- new technologies being an inseparable part of their lives - constant connectivity, lack of ability to function without the internet, social media, smartphones, laptops, and other such electronic devices,
- preference for health over intense work,
- focus on content creation and introducing changes to the existing reality, while showing little interest in seeking information in the virtual environment.

The research process consisted of several stages, which are presented in Figure 1.

A total of 56 individuals participated in the FGIs, distributed across 5 focus groups, with each group consisting of 10 to 12 participants. The FGI participants were selected through purposive sampling. They were urban residents, students aged 21-24. The respondents' gender distribution was as follows: 80.3% (45 respondents) were female, and 19.7% (11) were male. The majority of the respondents, 67.8% (38), were already employed.

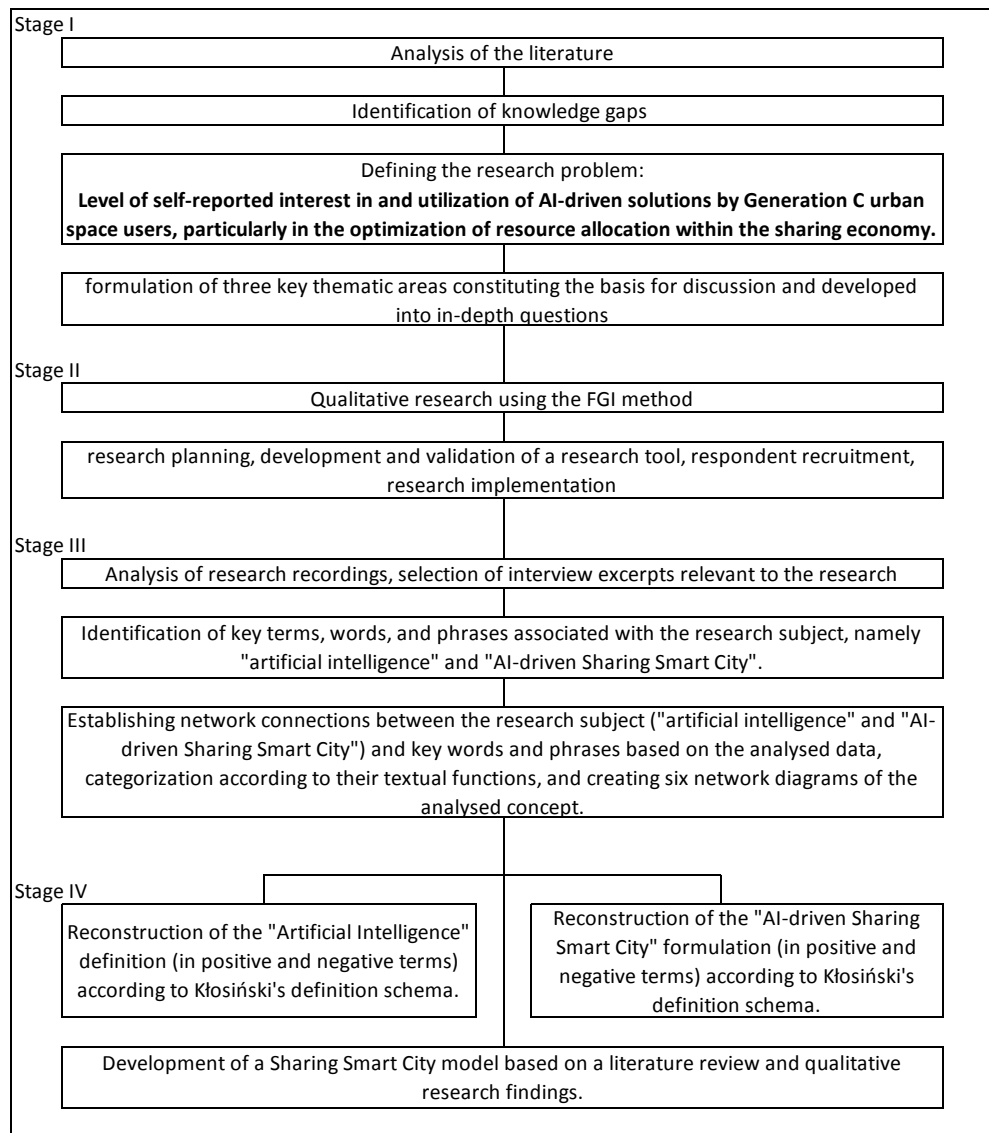


Figure 1. Procedure of the conducted qualitative research.

Source: own study.

The meetings were conducted based on a pre-prepared, standardized script that outlined the general research framework. The level of activity and engagement of the respondents in the discussions varied across the different groups, and the course of each interview depended on the individual responsiveness of the participants and the topics discussed. The use of probing questions enhanced the intensity of the discussions and led to the acquisition of more detailed information.

The primary objective of the research was to assess the level of interest in and use of artificial intelligence (AI)-driven solutions by members of Generation C, who are also users of urban spaces, with a particular focus on improving resource efficiency within the sharing economy model. Based on this objective, three key thematic areas were formulated, which served as the foundation for the conversations and were subsequently expanded upon through probing questions during the discussions (Figure 2).

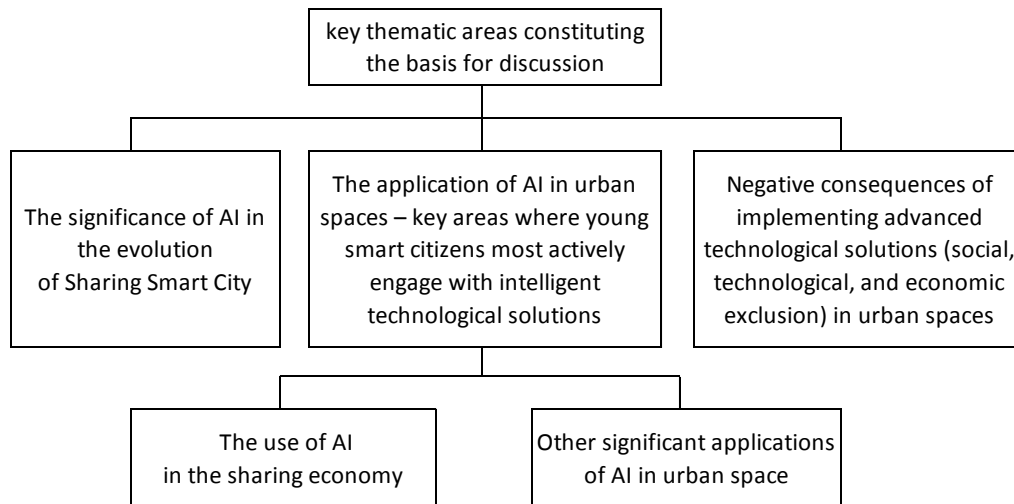


Figure 2. Critical concepts developed during the FGI discussion.

Source: own study.

The collected research material was coded into segments corresponding to the research problem posed. Subsequently, the gathered empirical data was analysed using the semantic field method. The research employed an open approach within the adopted methodological framework, with the assumption that the approach could be developed as needed. The semantic field method allows for the placement of the subject within its semantic context, thereby reconstructing the actual stance of the authors of the statements towards the phenomenon under study (Sińczuch, 2014). The semantic field analysis "provides researchers and change initiators with an opportunity to carry out the communication process in a non-invasive manner, tailored to the social reality as perceived by practitioners – those social actors on whom the occurrence (or non-occurrence) of social change will ultimately depend" (Dudkiewicz, 2015).

The semantic field of a given concept is the "network of its connections with other words, phrases, expressions, and concepts appearing in the analysed text, which enables the interpretation of its full meaning or set of meanings in which it has been used" (Robin, 1980). The modification proposed by M. Kłosiński to the method above involves creating one or several definitions of the subject, considering the individual networks of terms. B. Fatiga's team stated that this is an open methodological proposal, which can be developed depending on the needs. Emotionally charged expressions are analysed in terms of their frequency and co-occurrence. The networks of connections are categorized according to the roles played by the words in the analysed text in relation to the key word. The most commonly identified functions are as following: specifications, associations, oppositions, equivalents, descriptions of the subject's actions, and descriptions of actions towards the subject (Research Practices, 2015; Robin, 1980; Kłosiński, 1994).

4. Research results

The research employing focus group interviews facilitated an in-depth exploration of the subject and the collection of detailed data on the studied phenomenon. The interaction was structured around posing questions, eliciting responses, and fostering spontaneous discussions among respondents, adhering to the principles of "brainstorming" and the "snowball effect". A key discussion theme was the integration of artificial intelligence (AI)-driven solutions into the daily lives of Generation C members, who are also urban space users. Special attention was given to the application of AI solutions within the broadly defined domain of sharing economy activities, which could significantly contribute to the advancement of the Sharing Smart City concept. Based on the transcription of respondents' statements, a compilation of expressions corresponding to specific functions within the semantic field was developed. By analysing the resulting network of key word associations, a reconstructed definition of the artificial intelligence (AI) phenomenon was formulated.

Positively, respondents described AI as the technology of the future - an advanced system based on intelligent algorithms. AI accelerates and simplifies human work, significantly saving time, suggesting solutions, and facilitating decision-making. These intelligent, modern technologies enable the personalization of services, contribute to increased work efficiency, and lead to greater accessibility of information. According to the respondents, artificial intelligence aids in disease diagnosis, enables the personalization of medical treatments, optimizes urban traffic management, facilitates obstacle detection in autonomous cars, and analyses data from internet communications, recognizing patterns in user behaviour. It supports data analysis in video surveillance systems and assists in fraud detection in financial analysis. AI also simplifies the analysis of large datasets, optimizes resource utilization in cities (e.g., electricity, water), and enables the forecasting of extreme weather events. Considering this understanding of artificial intelligence, there is a call for education aimed at preparing individuals to work with new technologies and creating ethical and responsible algorithms.

In contrast, analysing the negative connotations attributed to artificial intelligence by young respondents, it emerges as a logical machine that operates in a reproductive manner, processing what humans have already done. AI, when viewed negatively, is associated with calculation errors and the need for supervision due to inefficient self-learning (hallucinations). Furthermore, it generates feelings of fear, anxiety, and reluctance to engage with it. The actions of AI systems are not always fair or transparent in terms of data acquisition methods. By taking over human labour, AI may contribute to an increase in unemployment. The implementation of this technology is associated with high costs for purchasing devices and software, and it may lead to greater inequality in society and technological exclusion. In light of this perception of AI, respondents emphasize the need for the creation of legal regulations to control the development and use of AI across various industries, the introduction of oversight systems for

AI algorithms to ensure accountability and avoid abuses, and the development of technological solutions to protect users' personal data (Szymańska, 2024).

In the next stage of the study, a reconstructed definition was formulated to clarify how study participants perceive the application of AI in urban spaces, with particular emphasis on sharing. The semantic field of the examined concept was found to be ambiguous, carrying both positive and negative emotional connotations, as reflected in the number and nature of the identified keywords.

Respondents referred to the versatility of AI-driven solutions, highlighting their application in various aspects of urban space management, such as optimizing parking systems, addressing city congestion, regulating and managing traffic flows, and enhancing video surveillance. They also pointed to AI's role in fleet management within the sharing economy (carsharing, vehicle-sharing, carpooling), real estate management (short-term rentals), and healthcare (monitoring air and noise pollution, tracking waste generation, and optimizing electricity and water consumption). Additionally, they emphasized the economic benefits for individual citizens, including cost savings, rational resource management, and access to goods without the necessity of ownership. AI was also recognized for its contributions to education and knowledge acquisition (training, information exchange) and strengthening local communities. As a result, two definitions were developed, each capturing a narrower perspective on the studied phenomenon, specifically its role in private life, professional activities, and urban environments. The first definition outlines the positive aspects of the subject under investigation (Table 3).

Table 3.

The positive aspects of AI in urban spaces with consideration of the sharing economy

subject of the semantic field	<i>AI in urban spaces with consideration of the sharing economy</i> (positive perception of the subject)
equivalents	efficient urban sharing models, intelligent exchange and sharing platforms, digital urban planning, advanced urban systems, optimized urban environment, innovative urban infrastructure, adaptive urban systems, efficient city management, integrated urban technologies, responsive city, intelligent sharing platform
definitions	co-creates value in urban spaces, solves problems, facilitates city residents' lives, suggests optimal mobility solutions, increases accessibility to urban services, supports urban mobility, enhances the quality of urban life, creates an intelligent living environment, promotes local initiatives for clothing and item exchange, detects fraud and abuse in sharing economy systems, personalizes sharing economy application interfaces for different user groups
oppositions	risk of abuse, risk of personal data theft, inefficient urban resource management, high city maintenance costs, low efficiency of public transport, waste of goods, excessive waste generation, high housing rental costs
associations	social integration and cooperation, intelligent solutions, modern technologies, optimization of urban resource utilization, fast decision-making, service personalization, convenience and flexibility in service use, increased efficiency, digital security, support for people, improved information accessibility, the opportunity to generate income by sharing one's resources

Cont. table 3.

actions of the subject	Optimizing urban traffic management; analysing internet communication data; matching supply and demand in the sharing economy; optimizing the distribution of bike and scooter stations based on usage data; automatically managing pricing in car-sharing and rental systems; supporting fraud detection; optimizing resource utilization in cities (e.g., electricity, water)
actions towards the subject	education to prepare individuals for working with new technologies, creating ethical and responsible algorithms, promoting the exchange of best practices in AI implementation in urban environments

Source: own study.

In contrast, the second definition focused on the negative aspects of the studied phenomenon. It is worth noting that negative opinions expressed by respondents constituted a relatively substantial proportion of all recorded statements (Table 4).

Table 4.

The negative aspects of AI in urban spaces with consideration of the sharing economy

subject of the semantic field	<i>AI in urban spaces with consideration of the sharing economy</i> (negative perception of the subject)
equivalents	logic machine, information processing algorithm, data analysis systems, digital manager of the city fleet, automated system for sharing vehicles and other goods
definitions	processes what people have already done, operates in a reproductive manner, collects data on routes and user habits, categorizes residents based on their transportation behaviours, limits access to sharing for those without the app
oppositions	saves time, suggests and solves problems, facilitates decision-making, enables full user control over their data, provides equal access to public transport
associations	calculation errors, need for supervision (hallucinations), inefficient self-learning, limited trust, reluctance to engage with artificial intelligence, the risk of digital exclusion for people without access to the app
actions of the subject	actions of the systems are not always fair or transparent in terms of data acquisition; it may lead to increased inequality in society and technological exclusion, limit the availability of vehicles in less profitable areas of the city, make vehicle availability dependent on the user's rental history
actions towards the subject	creating legal regulations to control the development and use of AI in various industries, introducing oversight systems for AI algorithms to ensure accountability and avoid abuses, developing technological solutions to protect user personal data in the context of AI development, creating regulations to limit the rapid growth of the sharing economy

Source: own study.

5. Conclusions

The concepts of the sharing economy and smart city are interrelated, both driven by the idea of more efficient resource utilization and requiring a certain level of digitalization in urban spaces. The sharing economy plays a key role in implementing the smart city concept -referred to as the Sharing Smart City. This is reflected in the following actions: (1) more efficient use of city resources, leading to cost reductions for municipal authorities, (2) improved urban space management, including pollution and degradation reduction, congestion mitigation, and stimulation of local entrepreneurship, and (3) the introduction of new technological

solutions to enhance residents' quality of life, optimize resource management, and increase access to information.

The Sharing Smart City concept represents a paradigm of urban development in which innovation is driven not only by central administrative bodies but by active and creative residents, referred to as super smart citizens (Figure 3). Their endogenous intellectual and entrepreneurial potential initiates and co-develops the implementation of advanced technological solutions based on the sharing economy model.

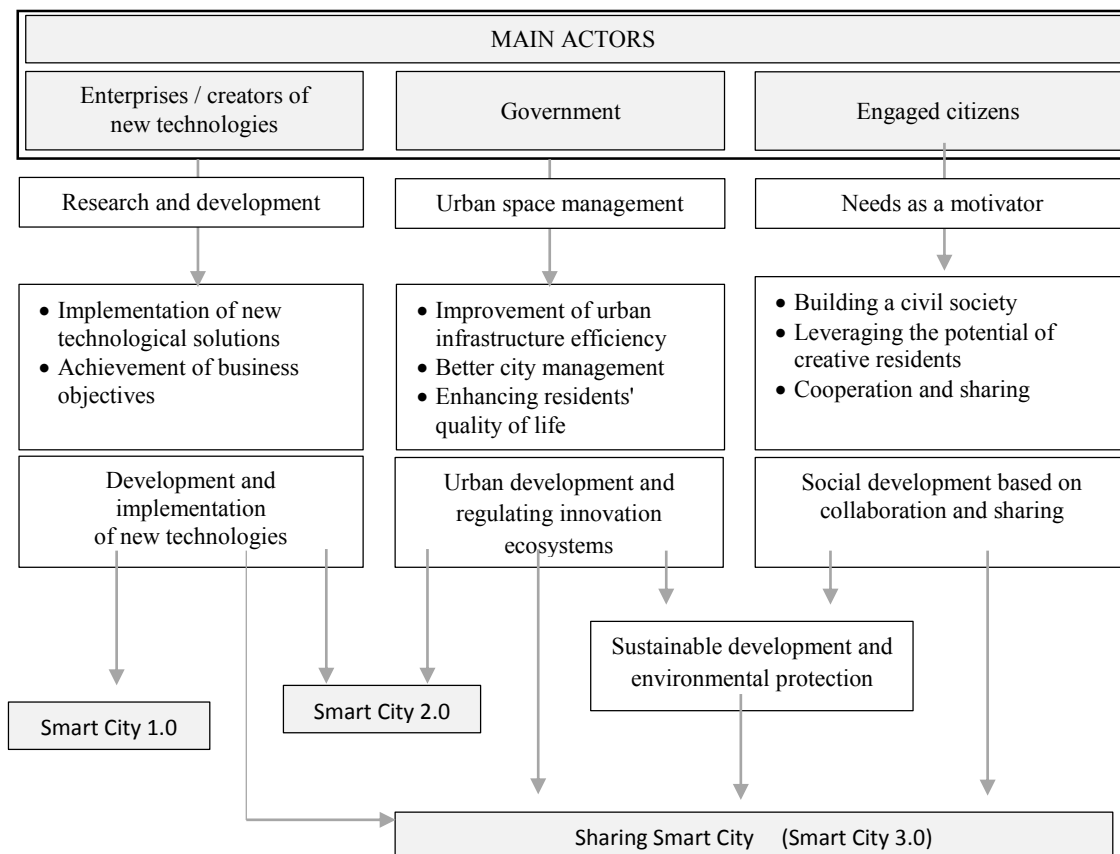


Figure 3. Sharing Smart City Model.

Source: Own study based on a literature review and on: Szymańska, 2024.

The bottom-up activity of residents leads to a significant increase in the efficiency of urban resource allocation through the optimization of their use within collaborative consumption models. Super smart citizens, possessing digital skills and openness to innovation, actively participate in the creation and adoption of sharing economy platforms, resulting in:

- reducing operational costs for the city by minimizing resource waste and optimizing infrastructure,
- increasing productivity and innovation at the local level by stimulating entrepreneurship based on sharing,

- improving residents' quality of life by increasing access to diverse services and resources under more flexible and economic conditions,
- strengthening social capital and cohesion within local communities by promoting interaction and cooperation among residents.

Human capital, characterized by high qualifications, creativity, and the ability to cooperate with the support of ICT and AI, is a fundamental driver of Sharing Smart City development. The engagement of smart society in initiating and co-creating solutions based on the idea of sharing serves as the key engine driving the transformation of cities into smart and sustainable urban ecosystems.

6. Limitations

Presented research findings serve as a foundation for further analysis of the level of interest in and adoption of artificial intelligence (AI) solutions by members of Generation C, who simultaneously act as users of urban spaces. Conducting similar studies among representatives of other age groups could yield valuable insights. It can be hypothesized that these groups may be less proficient in utilizing AI-enabled devices and consequently less receptive to adopt new technological solutions.

An important direction for further research could be the application of a longitudinal approach, which would allow for capturing the dynamics of attitudes toward AI over time and gaining a deeper understanding of adaptation processes in the context of rapid technological transformation in urban environments. At the same time, to increase the validity and practical relevance of the analysis, methodological triangulation could be employed - complementing qualitative analysis with quantitative research (e.g., surveys) and expanding the research sample. Such an approach would facilitate the formulation of more generalizable conclusions and provide a basis for assessing the extent to which AI-based solutions can foster the development of the sharing economy in urban environment.

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References

1. Augustyniak, M. (2014). Social conflicts in Alvin Toffler's concept. *UWM Studia Prawnoustrojowe*, 26.
2. Bardhi, F., Eckhardt, G.M. (2012). Access-Based Consumption: The Case of Car Sharing. *Journal of Consumer Research*, 39(4), 881-898.
3. Belk, R. (2014). Sharing versus Pseudo-Sharing in Web 2.0. *Anthropologist*, 1(1), 7-23.
4. Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, 67(8), 1595-1600.
5. Blicharz, J. (2023). Intelligent Cities and Artificial Intelligence: Selected Theoretical and Legal Aspects. *e-Monografie*, 211, 11.
6. Botsman, R., Rogers, R. (2011). *What's mine is yours: how collaborative consumption is changing the way we live*. HarperCollins.
7. Du Vall, M. (2019). Superintelligent Society Focused on People: A Brief Overview of the Concept of Society 5.0. *Państwo i Społeczeństwo*, XIX(2).
8. Dudkiewicz, M. (2006). Zastosowanie analizy pola semantycznego i analizy gloss dla zaprezentowania sposobu postrzegania świata społecznego. *Przegląd Socjologii Jakościowej*, 2, 1, 33-52.
9. Ernst, E., Merola, R., Samaan, D. (2019). Economics of artificial intelligence: Implications for the future of work. *IZA Journal of Labor Policy*, 9(4).
10. European Commission (2013). *The Sharing Economy: Accessibility Based Business Models for Peer-to-Peer Markets*. Business Innovation Observatory.
11. Fatyga, B. (ed.) (2015). *Research Practices*. Warszawa: Instytut Stosowanych Nauk Społecznych UW.
12. Frenken, K., Schor, J. (2017). Putting the sharing economy into perspective. *Environmental Innovation and Societal Transitions*, 23, 3-10.
13. Furmanek, W. (2018). The Fifth Industrial Revolution: Explanation of the Concept. *Edukacja – Technika – Informatyka*, 2/24, 276.
14. Gori, P., Parcu P.L., Stasi M.L. (2015). *Smart Cities and Sharing Economy*. Robert Schuman Centre for Advanced Studies Research, 96.
15. Grönroos, C. (2011). Value co-creation in service logic: A critical analysis. *Marketing Theory*, 11(3), 279-301.
16. Hamari, J., Sjöklint, M., Ukkonen, A. (2016). The Sharing Economy: Why People Participate in Collaborative Consumption. *Journal of the Association for Information Science and Technology*, 67(9), 2047-2059.
17. Hardey, M. (2011). Generation C: content, creation, connections and choice. *International Journal of Market Research*, 53, 6.
18. Hepworth, M.E. (1990). *Geography of the Information Economy*. New York/London, 7.

19. Hollands, R.G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City*, 12(3), 303-320.
20. Jonek-Kowalska, I., Wolniak, R. (2022). Sharing Economies' Initiatives in Municipal Authorities. *Sustainability*, 14(4), 2064.
21. Kłosiński, M. (1994). Semantyczna analiza pojęć „bezrobocie” i „bezrobotny” („bezrobotni”) w wypowiedziach prasowych. *Kultura i Społeczeństwo*, 38(3).
22. Kubik, A. (2022). The Energy Consumption of Electric Scooters Used in the Polish Shared Mobility Market. *Energies*, 15(8193).
23. Lazaroiu, G.C., Roscia, M. (2012). Definition methodology for the smart cities model. *Energy*, 47(1), 326-332.
24. Majewska, J., Truskolaski, S. (2013). Usługi wiedzochłonne w stymulowaniu innowacyjności w Polsce. *Gospodarka Narodowa*, 1-2, 92.
25. McLaren, D., Agyeman, J. (2015). *Sharing cities: A case for how to make a billion friends*. MIT Press.
26. Mishra, P., Thakur, P., Singh, G. (2022). Sustainable Smart City to Society 5.0: State-of-the-Art and Research Challenges. *SAIEE Africa Research Journal*, 113(4), 152-164.
27. Mora, L., Bolici, R., Favot, M. (2017). Smart City Governance for Sustainability: A Systematic Literature Review. *Sustainability*, 9(6), 1009.
28. Palomo-Domínguez, G., Zemlickienė, V. (2022). Towards a Sustainable E-Commerce Through Artificial Intelligence and Sharing Economy. In: *The Management of Digital Business Transformation*. Cham: Springer, 153-171.
29. Ratilla, V.P., Ratilla, J.P., Ratilla, M.P. (2021). The Sharing Economy and Digital Platforms: A Systematic Review and Research Agenda. *Cogent Business & Management*, 8(1), 1997245.
30. Robin, R. (1980). Badanie pól semantycznych: doświadczenia Ośrodka Leksykologii Politycznej w Saint-Cloud. In: M. Głowiński (ed.), *Język i społeczeństwo*. Warszawa: Czytelnik.
31. Schor, J.B. (2017). *Debating the Sharing Economy*. *Great Transition Initiative*, 1-19.
32. Sińczuch, M. (2014). Obraz weteranów w mediach na podstawie analizy wybranych publikacji internetowych. *Bezpieczeństwo. Obronność. Socjologia. Biuletyn*, 2, 54-60.
33. Szymańska, A.I. (2017). Sharing economy jako nowy trend w zachowaniach konsumentów. *Marketing i Rynek*, 23(9), 417-425.
34. Szymańska, A.I. (2022). Sharing economy w okresie pandemii COVID-19 - analiza pola semantycznego. *Studies of the Industrial Geography Commission of the Polish Geographical Society*, 36(4), 132-147.
35. Szymańska, A.I. (2024). *Empowering Young Citizens with Artificial Intelligence: A Key Driver for Smart City Evolution. Empower Businesses and Create Economic Development in Digital Future: Vision 2030*.
36. Toffler, A. (1974). *Future Shock*, 543.

37. Toffler, A. (2006). *Third Wave*. Poznań: Kurpisz.
38. Veretennikova, A., Kozinskaya, M. (2022). Sharing Economy in the Context of Sustainable Development: Typology of Business Models. *Sustainability*, 14(19), 12200.
39. Zvolska, L., Lehner, M., Voytenko Palgan, Y., Mont, O., Plepys, A. (2019). Governing the sharing economy for sustainability. *Current Opinion in Environmental Sustainability*, 41, 1-7.

STRESS AND THE RISK OF OCCUPATIONAL BURNOUT IN LOGISTICS AND FREIGHT MANAGEMENT

Milena ŚRĘBOWATA^{1*}, Marta BRZozowska², Anna CIESIELSKA³

¹ Jan Kochanowski University of Kielce, Management Institute; milena.srebowata@ujk.edu.pl,
ORCID: 0009-0007-5356-6920

² Jan Kochanowski University of Kielce, Management Institute; marta.brzozowska@ujk.edu.pl,
ORCID: 0000-0003-3072-0562

³ Jan Kochanowski University of Kielce, Management Institute; anna.ciesielska@ujk.edu.pl,
ORCID: 0000-0001-7757-473X

* Correspondence author

Purpose: The utilitarian purpose of the study was to verify the level of stress among employees involved in logistics and freight forwarding management and the risk of their susceptibility to occupational burnout.

Design/methodology/approach: The article is based on empirical research using questionnaires to measure stress (PSS-10) and to measure occupational burnout (LBQ), so it is based on data obtained from a control research group and statistical analysis. This was made possible by a comparative analysis of the group from the logistics industry and blue-collar workers in the surveyed organizations. The subject area is freight management and work psychology.

Findings: The article charts the high level of stress in the group of respondents on freight forwarding management and among logisticians, as they are professional groups at significant risk of burnout. The results are alarming, as they are pointing to very high levels of stress among logisticians and freight forwarders.

Research limitations/implications: The research focused on the SME sector, specifically on small shipping and logistics companies, so the results may be specific to this sector, and the sample was relatively small, which is a kind of limitation that makes the research conducted exploratory and preliminary. In the future, it would be advisable to conduct a longitudinal study and increase the research sample to see how the research would be consistent across a larger group for different transport industry converters.

Practical implications: The empirical results can provide valuable guidance for human resource management in the logistics industry. In this area it is worth introducing practical strategies and methods of stress management and it is also necessary to introduce new standards for the development of career paths and reskilling opportunities among employees, so as to effectively counteract the phenomenon of professional burnout.

Originality/value: This is the first research that spars the level of stress in the context of the risk of burnout among representatives of the logistics industry is new. Previous ones have parsed these phenomena, without an explicit link.

Keywords: stress, occupational burnout, freight management.

Category of the paper: empirical and scientific research.

1. Introduction

Stress is an indispensable part of life and is reflected in various aspects of life, especially in professional ones. And depending on the specifics of the industry, it can occur among employees in varying degrees of intensity, nevertheless it is important to manage it properly. Among other things, it is the main culprit of occupational burnout. And occupational burnout, in turn, is a phenomenon that can be encountered in various industries, which involves a long-term syndrome resulting from physical emotional physical and mental exhaustion. Its direct consequences can be a reduction in the quality of work, a loss of motivation, or an increase in absenteeism and even resignation from the workplace. Nevertheless, it is largely the sector and industry that determine the magnitude of this threat. In logistics and transportation management, due to their characteristics and dynamics, this problem can be of great importance. The purpose of this study is to examine the relationship of stress levels and the risk of burnout and their interrelationship among employees associated with logistics and transportation management. Transport managers, logisticians, or freight forwarders work under a lot of time pressure and have to coordinate many processes simultaneously often without having a full picture of the situation, which translates into the stress they feel. This is not an easy or routine job and therefore requires a lot of commitment and effort on their part. Such conditions can also lead to occupational burnout. Thus, there is an assumption that the specifics of the industry result in higher levels of stress, and that this stress is directly related to higher levels of risk of burnout. The literature indicates that stress among logistics and distribution personnel is associated with low levels of well-being (Fruscione et al., 2024) and that one of the most important problems encountered in the management of employees in the logistics sector is their decrease in job satisfaction and commitment (Yener et al., 2014) for this reason it was assumed that there may be a link between these phenomena.

2. Logistics management challenges

Due to high pace of economy development there is a greater need for fast and agile approach in logistics management. Very fragile on one hand, on the other very turbulent environment causes lots of challenges for logisticians. The logistics industry has undergone significant changes in recent years, driven by technological advances, changing customer expectations and globalization. One of the most important trends in logistics is the automation and digitization of processes. The introduction of technologies such as artificial intelligence (AI) (Brzozowska, et al., 2023), the Internet of Things (IoT), Big Data (Hopkins, Hawking, 2018) and blockchain (Choi, Siqin, 2022) has significantly impacted the way supply chains are managed. Driven by

those changes, logistics management has become an agile, virtual world where machines and people work together. Above mentioned technologies have impact on operations, strategic business models, pace of work, but first of all, influence work of people who carry out the logistic processes. Due to that, there is a greater need for new competences, not only technological ones, but people need to be prepared better for the fast pace of analytical thinking.

Changing customer expectations are also having a huge impact on the logistics industry. Today, consumers expect fast, flexible and low-cost deliveries. In response to these demands, logistics companies need to invest in new technologies that allow them to develop more agile operating models. An important example is logistic of last-mile delivery (Kolańska-Morawska et al., 2023). The implementation of autonomous vehicles, robots or drones in deliveries, could significantly revolutionize this market segment in the future. It means that more operations can be done by machines, however on the other hand people are still needed, because behind each of those innovations should stand a human who is making strategic decisions. That decision can make difference in usage of technology, machine or model of business. Due to that people need to be preparing for responsibilities concerning the effects of their attitude towards these technological advancements.

In contrast, one of the key drivers of change in modern logistics is the concept of sustainability, which is the result of both regulations and growing consumer awareness (Kolańska-Morawska et al., 2022). Companies are increasingly paying attention to the green aspects of their operations, aiming to reduce CO₂ emissions and minimize their negative impact on the environment. The introduction of electric vehicles, the optimization of delivery routes and the use of renewable energy sources are just some of the measures being taken to increase the sustainability of supply chains.

Due to all of these challenges, logistic industry is changing constantly, and logisticians are trying to keep up with the pace of those changes. Whole industry in Poland, but also worldwide develops very fast as there is still increase in demand for logistic services. Taking into account global logistics, it needs to be pointed that there is a greater need for fast and reliable transport models. Intermodal connections are those which are needed the most (Tadić et al., 2021). What is more, also reliability is a key aspect of those activities. Due to the different international relations conflicts, unfortunately reliable transport corridors are not very stable (Xiaoxiang, Chengfeng, 2021; Dávid et al., 2023). Because of those problems, risk management in logistic operations has become one of the crucial factors.

Another important part of the logistics nowadays, are above mentioned last-mile deliveries and growing importance of CEP sector (CEP – courier, express, parcel). Courier companies are nowadays operating in a very polarized model, as they need to be open to the needs of their customers (which in most cases are e-commerce sales companies) and on the other hand they need to meet the requirements of their customers' customers (which are people buying online). This duality in processes is hard to achieve as on one hand there is a need for low cost operations, but on the other there flexibility and fast delivery expectations (Ghazal et al., 2025).

Considering such requirements it is expected that courier companies will be very agile in their processes, and they have to adjust very fast to the requirements of the customers.

Taking into account all of the above mentioned factors, logistics management requires special competences – technological, communications, reliable and stress resilience. It can be hard to achieve as the pace of all of the changes is huge. Due to that there can be assumed that working in logistics operations can cause lots of psychological problems.

3. The relationship of stress and risk of occupational burnout in logistics and transport management

Work-related stress or occupational stress is something that cannot be avoided. Every job with the challenges it presents is stressful in some way, it is the management of strategies to respond to it that is important especially in terms of its severity. In simpler terms, certain task situations, or generalizing in general, certain industries, can prove to be greater or lesser triggers of it. According to the Cox approach presented here, stress is a response to specific demands of the work environment that so absorb an individual that they threaten his or her well-being (Molek-Winiarska, 2020). This is important especially in the context that in a stressful environment the phenomenon of occupational burnout occurs. This issue was particularly emphasized by Maslach, since her studies emphasized that prolonged exposure to stress in the organization is one of the important factors causing occupational burnout (Kraczla, 2013).

In the logistics industry, due to the fact that it is a job that often requires large amounts of mental and physical strength from the employee, stress among workers is a common occurrence. One of the most recent studies shows that there is a very high workload among logistics and distribution employees due to the increasing demands pressure effort difficulties and associated stress (Lara-Calle, Prado, 2023). The aforementioned stress can affect performance standards and affect low employee productivity this in turn prevents the employee from meeting the expectations of superiors and affects the success of the company. Unfortunately, feeling stressed by logistics workers often further exacerbates the problems they face, and this aforementioned stress, in and of itself, can be a very pathological self-perpetuating machine (Ramlawati, 2019). And it is for the structure that the different stress power of the logistics industry is not an important aspect of job burnout. According to a study conducted in logistics companies, a trend was observed that the longer an employee works, the higher the decrease in job satisfaction and the decrease in commitment can be observed (Yener et al., 2014). The complexity of the challenges workers face also makes it much harder to stay motivated in the profession (Meriem, 2019). Thus, this argument leads to the formulation of three research hypotheses, namely:

1. Employees in the logistics and freight management industry will manifest high levels of stress and high levels of occupational burnout.
2. Employees in the logistics and freight management industry will manifest high levels of occupational burnout.
3. If the stress level of employees in the logistics and transportation management industry is high, their level of burnout will also be high.

In summary, stress and risk of burnout in logistics appear to be specific and, on the basis of the literature, it can be assumed with a high degree of probability that there are specific relationships between them. Their verification will give a better picture of the specificity of work in logistics and transport management and will allow the introduction of appropriate solutions to counteract them.

4. Methodology

Two questionnaires were used in the empirical study. The first is the *Perceived Stress Scale/ Skala Odczuwanego Stresu* (PSS-10) by Cohen, Kamarck and Mermelstein, and in the Polish adaptation by Juczynski and Oginska-Bulik, which measures the intensity of stress based on subjective feelings of subjects. It is a questionnaire that meets standards and standardization. The reliability of the scale has been established Cronbach's α coefficient was 0.90. It consists of several simple questions that must be answered by referring to a five-point scale (Molek-Winiarska, 2020). A respondent can receive a maximum of 40 points, and these are scaled. A score from zero to 13 is considered low, from 14 to 19 moderate and from 20 upwards high (Juczynski, Oginska-Bulik, 2009). The second tool, on the other hand, is the *Link Burnout Questionnaire/ Inwentarz wypalenia zawodowego* (LBQ) by Santinello, which was adapted to Polish conditions by Jaworowska. The test consists of 4 scales sequentially from psychophysical exhaustion loss of professional effectiveness deterioration of relations with recipients and how many from lurking. Respondents must answer 24 questions on a six-point scale. It is assumed that high thinking of the results of 3 dimensions indicates high professional burnout. In its case, the Cronbach's α value and measures of reliability and relevance are good. These meet standardization and state norms have been developed for the Polish adaptation. It can be determined with a high degree of probability that someone is at risk of burnout. (Jaworowska, 2014).

Both of the tools described were used to study the research group and the control group. The research group consisted of people working in positions such as logistician, freight forwarder, transportation manager, dispatcher before supply chain analyst, transportation planner, logistics engineer fleet coordinator, or logistics operations manager. The control group, on the other hand, consisted of people unrelated to the logistics industry holding positions

involving manual labor. These included plumbers, plasterers, laborers, road builders or maintenance workers. Age, gender, education level, financial level, marital status, and work preferences varied. The only controlled parameter was the selection of respondents on the basis of separation into those in the logistics industry and those not in the industry, the rest of the parameters were not controlled. The procedure for completing the questionnaires was that the tests were completed at a ten-minute interval. The time for completing the questionnaires was limited as recommended by the authors. A total of 60 people participated in the study, and they were evenly divided into a control group and a research group. In the study, the independent variable is the level of stress intensity while the dependent variable is the level of job burnout, to this should also be included a categorical variable for employees in the logistics and transportation management industry and manual workers unrelated to this industry. What is noteworthy is that the employees taking part in the research came from the SME sector.

5. Research results

The collected data from the empirical study was statistically analyzed using the *Jamovi* program. Below (figure 1, figure 2) will be presented from the *Perceived Stress Scale* in the form of sten for a better illustration of the results obtained.

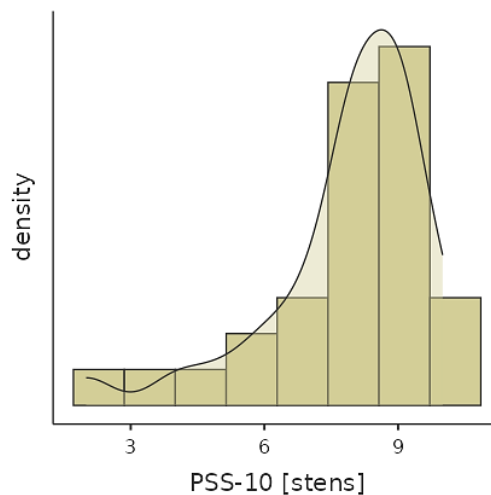


Figure 1. Histogram of the density of PPS-10 scores in the research group.

Source: own elaboration based on *Jamovi*.

As can be seen in the chart, the majority of respondents experience stress at the level of 6 to 8 sten, for the fact that in the case of this tool States of one to 3 indicate a low level of stress, stages 4 to 7 an average level of stress and stages 8 to 10 a high level of stress it can be clearly seen that the majority of respondents in the study group experience a medium to high level of stress with a clear trend towards higher values. This confirms hypothesis one, according to which employees in the logistics and transportation management industry will manifest high

levels of stress. The arrangement of the histogram, on the other hand, indicates a negative skewed distribution, which is decidedly asymmetric will increase the concentration of results on higher values, i.e. those corresponding to higher levels of stress. At the same time, it should be noted that the distribution of the results is not normal and is negatively skewed, which, in addition to the distribution of the density curve, is also confirmed by the Shapiro-Wilk test result of 0.832 (so $p < 0.001$).

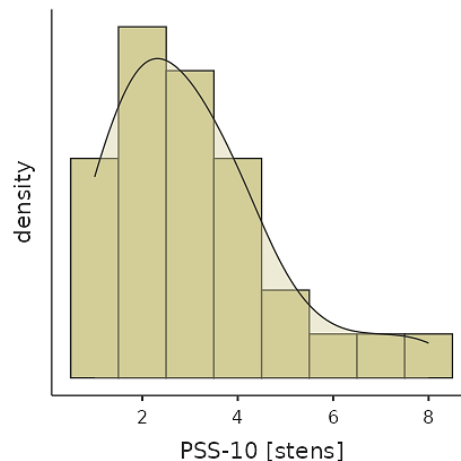


Figure 2. Histogram of the density of PSS-10 scores in the control group.

Source: own compilation based on *Jamovi*.

The histogram showing the results of the control group, on the other hand, shows that this group is primarily dominated by those experiencing low levels of stress, which also supports hypothesis one. The opposite trend can be observed here, which clearly indicates that the effect observed in the study group is the result of the procedure used. The results are complementary when examining the intensity of stress. As for the distribution, it is right skewed as shown not only by the histogram, but also by the result of the Shapiro-Wilk test, which is 0.893 ($p < 0.001$), meaning that the distribution is asymmetric with a clear trend. In addition to reinforcing hypothesis one, this may also provide a rationale for the conclusion that manual workers experience relatively low levels of stress. On the other hand, the results of the LBQ questionnaire will be considered slightly differently, because in this case, in order to find high levels of job burnout, it is necessary to find high scores on at least 3 of the 4 scales of this complex phenomenon. Therefore, as a simplification, this article will use a variable categorizing into low medium and high burnout. That is, if the person surveyed manifests 3 or 4 low sten scores for each scale, this will be included as a low level of job burnout, and similarly in the case of 3 or 4 This will be understood as a high level of job burnout. As part of the categorization in the following considerations, the level of low burnout will take the value of one average value of 2 and high burnout will take the value of 3. The remaining cases will be treated as medium level. At the same time, it should be emphasized that this is not equivalent to the state scale used for the first tool, since those are standardized and comparable for the entire population, and these represent a kind of statistical categorization. The following shows the results obtained in this respect (figure 3, figure 4, table 1, table 2).

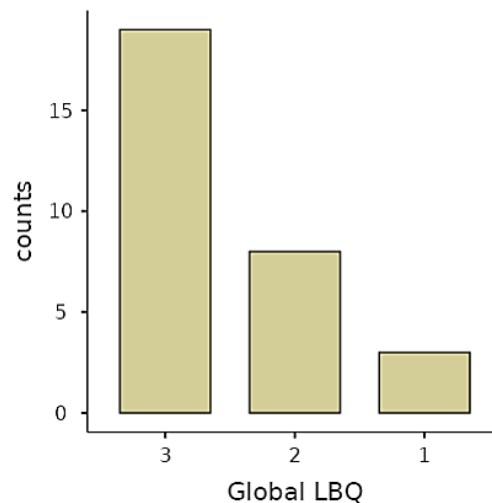


Figure 3. Graph with LBQ summary results for the research group.

Source: own elaboration based on *Jamovi*.

Table 1.

Global LBQ frequencies in the research group

Global LBQ	Quantities	% of the total	% accumulated
3	19	63.3%	63.3%
2	8	26.7%	90.0%
1	3	10.0%	100.0%

Source: own elaboration based on *Jamovi*.

Figure 3 shows that high levels of job burnout were most often observed among the study group. More than 60 percent of employees of representatives of the logistics industry, i.e. the majority according to the frequency table, show a high level of job burnout which confirms hypothesis two and suggests that there is a significant problem in this group. The results clarify quite homogeneously and provide an important premise for further analysis in this regard.

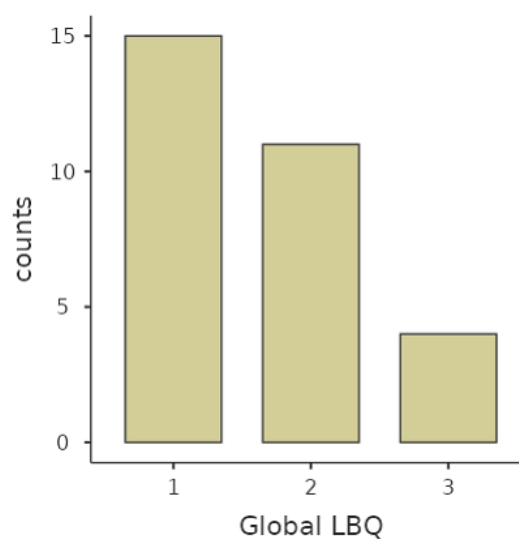


Figure 4. Graph with LBQ summary results for the control group.

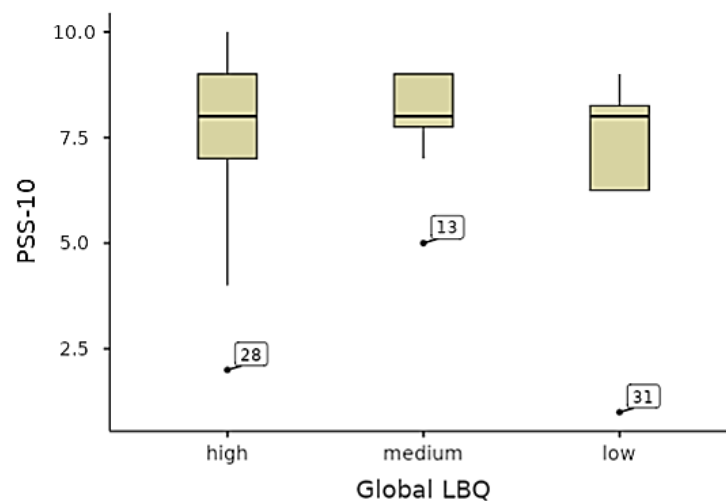
Source: own elaboration based on *Jamovi*.

Table 2.*Global LBQ frequencies in the control group*

Global LBQ	Quantities	% of the total	% accumulated
1	15	50.0%	50.0%
2	11	36.7%	86.7%
3	4	13.3%	100.0%

Source: own elaboration based on *Jamovi*.

Figure 4 on the other hand, shows an inverse relationship in the control group and, more specifically, the level of burnout among manual workers is overwhelmingly low. This is also confirmed in Table 2. of the frequency of categorized LBG, where the vast majority of the Respondents manifested a low or medium level of professional burnout. The results obtained in the control group using the questionnaire used reinforce the confirmation of hypothesis two. It seems that the control group, due to specific working conditions, is not as exposed to the risk of burnout. This could also be an interesting premise for further research. Below on the following graphs that is, on the fifth and sixth will be presented box plots which in turn will show whether hypothesis three is right.

**Figure 5.** PSS-10 box plot for global LBQ in the research group.Source: own elaboration based on *Jamovi*.

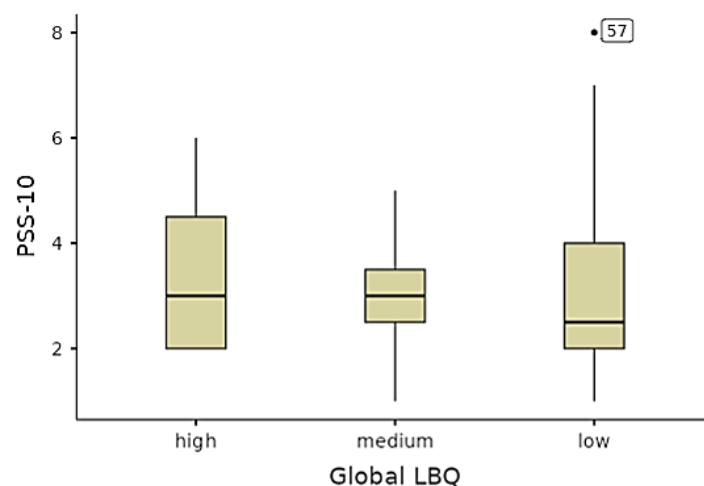


Figure 6. PSS-10 box plot for global LBQ in the control group.

Source: own elaboration based on *Jamovi*.

The box plot, the graph corresponding to the sixth graph, shows that those with high occupational burnout experience the highest level of perceived stress in addition to that their median stress score is high, and the scatterplot shows that most of them also have high stress. Based on this, it can be concluded that there is an actual trend that the higher the occupational burnout, the higher the level of perceived stress for those in the logistics industry. As for the sixth chart, there those with high job burnout experience medium or low levels of stress. These box plots show that there is a consistent relationship between burnout and stress in both groups, but the scale of stress in the research group is much higher. In order to complete the results and have confidence in them below in table three descriptive statistics were presented, for this a one-way non-parametric ANOVA was performed for both groups in table four, and then these results were compared pairwise using the DSCF method.

Table 3.

Descriptive satellites for the study and control group

Research group										
Descriptive statistics		N	M	SD	K	SEk	S	SEs	W	p
Global LBQ wobec PSS-10	high	19	8	2.10	2.19	1.01	-1.47	0.524	0.848	0.006
	medium	8	8.00	1.36	2.57	1.48	-1.54	0.752	0.809	0.036
	low	4	8.00	3.70	3.71	2.62	-1.90	1.01	0.737	0.029
Control group										
Descriptive statistics		N	M	SD	K	SEk	S	SEs	W	p
Global LBQ wobec PSS-10	high	4	3	1.19	-1.29	2.62	0.855	1.01	0.863	0.272
	medium	11	3.00	1.22	-0.109	1.28	-0.196	0.661	0.912	0.255
	low	14	2.50	2.13	0.702	1.15	1.19	0.597	0.859	0.029

Source: own elaboration based on *Jamovi*.

The table with descriptive statistics provides information that the research group is dominated by positive kurtosis and negative skewness, which indicates that the data is clustered at higher values, while the control group has negative kurtosis and less significant skewness, which suggests that the distributions are more dispersed and symmetrical. From the third table

itself, one can infer indirectly the existence of a relationship. It can be read from it that in the group of employees from the logistics industry indeed this level of stress is higher and also that they actually also have a higher level of job burnout. Taking into account the p-value and the Shapiro-Wilk test in both the control and research groups, it should be borne in mind that most distributions are not normal. Therefore, checking the relationship must be done on the basis of a non-parametric statistical test, in the case of this research it is the Kruskal-Wallis test shown below.

Table 4.

One-factor nonparametric ANOVA for both groups

Test Kruskal-Wallis						
	Research group			Control group		
	X ²	df	p	X ²	df	p
PSS-10	6.498	2	0.03	6.151	2	0.04

Source: own elaboration based on *Jamovi*.

Due to the fact that there is no normal distribution, it was necessary to check with the Kruskal-Wallis test whether there are statistically significant differences in the distributions of the dependent variable of the level of stress in the two groups.

Table 5.

Pairwise comparison by the method of DSCF

Pairwise comparisons – PSS-10					
		Research group		Control group	
		W	p	W	p
high	medium	1.389	0.005	1.345	0.004
high	low	1.236	0.003	1.879	0.003
medium	low	1.245	0.004	1.732	0.004

Source: own elaboration based on *Jamovi*.

Analyzing the results from the one-factor ANOVA and pairwise comparison, significant conclusions can be drawn first. Kruskal-Wallis test showed that the result in the research group and the control group is statistically significant ($p < 0.05$). On the other hand, a pairwise comparison of the results with post-hoc tests showed that in all 3 comparisons between pairs in the research group and the control group, statistically significant differences were found in the level of burnout in relation to perceived stress. Based on this, a general conclusion can be made regarding the statistical significance of the studies conducted that in both groups, a significant proxy for the level of professional burnout is the level of stress. Thus, all 3 stated hypotheses were confirmed.

6. Discussion

The empirical research conducted in this work on stress and burnout in the logistics and transportation management industry provided important insights in this regard. First, it was found that there are very high levels of stress among employees in this industry. Secondly, this group is also characterized by high levels of perceived burnout. And finally, the study shows that the higher the level of perceived stress, the higher the level of job burnout among supply chain workers as well. In the literature, one could find considerations of stress or job burnout, but so far the study and mutual correlation in this sector have not been investigated. What is important is that even despite such a small sample, the results of the study were statistically significant. That is, based on them, it can be assumed with a high degree of certainty that there is such a general trend in the logistics industry as a whole.

The literature on the subject highlighted the complex dynamics and quite exhaustive nature of this industry, this research is an important complement to this from the studies you could learn that work in the logistics sector is exhausting imposes very high pressure and is quite difficult due to which the workload of employees is significant (Lara-Calle, Prado, 2023) and that the stress that occurs there can have destructive effects (Ramlawati, 2019) and finally that the aforementioned stress leads in the long term to a decrease in employee motivation and commitment (Yener et al., 2014) This also made us assume that the level of job burnout due to the stress there may be high, and to what extent these phenomena may interact. It seems, therefore, that the results from this article are not only consistent with what can be found in other articles on the subject, but also send an alarming message, as the problem of stress and burnout in logistics must be somewhat downplayed if their levels are so high. This provides very important lessons for further research explorations in this area.

The conclusion of this article is clear the level of stress intensity in the group of employees associated with the logistics and transportation management industry is high, job burnout is also high. In addition, it is also known that stress is an important predictor of job burnout, as there is a relationship between these variables identified in this research. Indeed, the higher the level of perceived stress in logistics workers, the proportionally higher the level of job burnout in them. As was said at the beginning, it is very possible that this is influenced by some kind of specificity related to the challenges faced by employees in this industry (Fruscione et al., 2024). Therefore, it is important to develop methods of such stress management logistics to minimize the risk of professional burnout as much as possible, and this issue should be given due attention in scientific studies.

7. Summary

Identifying the intensity of stress levels and the intensity of job burnout levels and their possible correlation with each other in the logistics and transportation management industry was the utilitarian goal of this article. Taking into account the discourse of scientists, emphasizing the fact of high workload in this industry, as well as struggling with stress, the possibility of stress-related problems or job burnout in this group was taken into account. Based on the literature, it was hypothesized that the level of stress in the logistics industry will be high that the level of job burnout will be high, and that there is a relationship between the two in that the higher the level of stress, the higher the job burnout in the group. To test these hypotheses, a questionnaire study was conducted using the PPS-10 and LBQ measuring stress and job burnout, respectively, in two groups on 60 people in the SME sector. The first was the target group, or research group, were representatives but employees from the logistics and transportation management industry, and the control group were blue-collar workers not associated with the industry. The collected data were analyzed in detail statistically and eventually confirmed all three hypotheses. The results obtained in the work can be useful both in the context of human resource management before logistics and in the psychology of work and can contribute to the reflection on the question of how to properly manage stress among logistics employees so as not to lead to their professional burnout. Practical implications mainly focus on the need to develop methods for coping with stress and occupational burnout and their implementation in the logistics environment. For this purpose, certain methods and tools can be used, such as, for example, mindfulness, mindfulness meditation, wellness programs or EAPs (De Simone, Vargas, Servillo, 2021). This certainly provides an important rationale for further research, as well as for using the information obtained to develop methods and strategies to manage stress and counteract burnout.

References

1. Brzozowska, M., Kolasińska-Morawska, K., Sułkowski, Ł., Morawski, P. (2023). Artificial-intelligence-powered customer service management in the logistics industry. *Entrepreneurial Business and Economics Review*, Vol. 11, No 4, p. 109-121. DOI: 10.15678/EBER.2023.110407
2. Choi, T.-M., Siqin, T. (2022). Blockchain in logistics and production from Blockchain 1.0 to Blockchain 5.0: An intra-inter-organizational framework. *Transportation Research Part E: Logistics and Transportation Review*, Vol. 160, 102653. <https://doi.org/10.1016/j.tre.2022.102653>

3. Dávid, A., Blaško S., Ficzer, P. (2023). The impact of the war in Ukraine on inland water transport in the Danube region. *Transportation Research Procedia*, Vol. 74, pp. 188-193. <https://doi.org/10.1016/j.trpro.2023.11.129>
4. De Simone, S., Vargas, M., Servillo, G. (2021). Organizational strategies to reduce physician burnout: a systematic review and meta-analysis. *Aging clinical and experimental research*, 33, 883-894.
5. Fruscione, S., Malta, G., Verso, G., Calascibetta, A., Martorana, D., Cannizzaro, E. (2024). Correlation among job-induced stress, overall well-being, and cardiovascular risk in Italian workers of logistics and distribution. *Frontiers in Public Health*, 12, 1358212, p. 4.
6. Ghazal, A., Narayanan, S., Adeniran, I.O., Kehrt, C., Antoniou, C. (2025). Analysis of logistics measures of CEP service providers for the last-mile delivery in small- and medium-sized cities: A case study for the Aachen city region. *European Transport Research Review*, Vol. 17, no. 5. <https://doi.org/10.1186/s12544-025-00706-z>
7. Hopkins, J., Hawking, P. (2018). Big Data Analytics and IoT in logistics: a case study. *The International Journal of Logistics Management*, Vol. 29, No. 2, pp. 575-591. <https://doi.org/10.1108/IJLM-05-2017-0109>
8. Jaworowska, A. (2014). *LBQ – Kwestionariusz Wypalenia Zawodowego – polska normalizacja. Podręcznik*. Warszawa: Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego, s. 5.
9. Juczyński, Z., Ogińska-Bulik, N. (2009). *NPSR: narzędzia pomiaru stresu i radzenia sobie ze stresem*, p. 2.
10. Kolasińska-Morawska, K., Brzozowska, M., Dziedzic, D. (2023). Innovations in last mile logistics - analysis of customer satisfaction with the service of delivery logistics operators using parcel machines. *LogForum*, Vol 3, no. 7, pp. 411-422. DOI: 10.17270/J.LOG.2023.852
11. Kolasińska-Morawska, K., Sułkowski, Ł., Buła P., Brzozowska, M., Morawski, P. (2022). Smart Logistics – Sustainable Technological Innovations in Customer Service at the Last-Mile Stage: The Polish Perspective. *Energies*, 15, 6395. <https://doi.org/10.3390/en15176395>
12. Kraczla, M. (2013). Wypalenie zawodowe jako efekt długotrwałego stresu. *Zeszyty Naukowe Wyższej Szkoły Humanitas Zarządzanie*, 14(2), pp. 69-81.
13. Lara-Calle, A., Prado, D. (2023, July). *Psychosocial Risk and Work Stress in Logistics and Distribution*. International Conference on Human-Computer Interaction Cham: Springer Nature Switzerland, pp. 84-89.
14. Meriem, E. (2019). *Stress In Logistics and Supply Chain Management*. Economic and Social Development: Book of Proceedings, pp. 58-63.
15. Molek-Winiarska, D. (2020). Interwencje antystresowe w organizacji Modele. *Zarządzanie. Efektywność*, Vol. 304. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, p. 30.

16. Molek-Winiarska, D. (2020). *Interwencje antystresowe w organizacji Modele. Zarządzanie. Efektywność*. Wydawnictwo Uniwersytetu Ekonomicznego, p. 88.
17. Ramlawati, R. (2019). The effect of work environment, stress, and job satisfaction on employee turn over intention. *Management Science Letters*, 9.
18. Tadić, S., Kovač, M., Krstić, M., Roso, V., Brnjac, N. (2021). The Selection of Intermodal Transport System Scenarios in the Function of Southeastern Europe Regional Development. *Sustainability*, 13(10), 5590. <https://doi.org/10.3390/su13105590>
19. Xiaoxiang, Z., Chengfeng, H. (2021). Systems Evaluation for Operational Risks of International Transport Corridors: A Case Study of China-Pakistan-Iran-Turkey International Transport Corridor. *Discrete Dynamics in Nature and Society*, Iss. 1, 3438872. <https://doi.org/10.1155/2021/3438872>
20. Yener, D., Oskaybaş, K., Dursun, T. (2014). The effects of burnout on organizational commitment in logistics sector. *Işletme Araştırmaları Dergisi*, 6(2), pp. 15-25.

EXPLORATORY FACTOR ANALYSIS IN EXPLAINING SHORT-TERM HOUSEHOLDS FINANCIAL SECURITY

Tomasz TYLEC

Krakow University of Economics; tylect@uek.kakow.pl, ORCID: 0000-0002-2998-3720

Purpose: The aim of the analysis is to detect and identify the fundamental factors determining the short-term financial security of the household within the concept of households financial fragility and to present the observable variables in the form of synthetic factors.

Design/methodology/approach: In the analysis of the diagnostic features of the studied phenomenon, factor analysis was used, which also included the related analysis of principal components, encompassing a group of methods that enable the reduction of the set of diagnostic features to the smallest number of collective synthetic variables that are consistent within groups but different between groups.

Findings: The application of factor analysis enabled the detection of synthetic factors from a significant number of variables analyzed. Based on a review of the literature related to the short-term financial security of the household, these factors were interpreted in the context of the analyzed phenomenon.

Research limitations/implications: The basic problem in the conducted analysis is the limited availability of detailed data allowing for an in-depth analysis of the phenomenon of financial vulnerability of households.

Practical implications: Identifying the fundamental factors determining the analyzed phenomenon of financial vulnerability of households may provide an incentive for further discussions and indicate the direction of further, in-depth analyses within the framework of the presented conclusions.

Social implications: The conclusions from the analysis allow to understand the key factors that may determine the short-term financial security of a household, what may determine the type of actions taken by public authorities, and thus into greater financial stability of the entire household sector.

Originality/value: The study allows to indicate key diagnostic features determining the phenomenon of short-term financial security of households, which is analyzed within the framework of the concept of household financial vulnerability (fragility). The analysis is based on the available data set of the Eurostat database. The results of the analysis fit into the overall research on the phenomenon of financial fragility and can be a contribution to further discussion and further in-depth analyses.

Keywords: short-term household financial security, financial fragility (vulnerability), exploratory factorial analysis.

Category of the paper: Research paper.

1. Introduction

The level of financial security household security is determined by the ability to meet needs, especially basic needs. In the short term, the financial security of a household is captured by the concept of financial fragility (vulnerability). Within this concept, households that are overly indebted are considered to be vulnerable, but they are also characterized by the inability to cope with monthly expenses and a persistent imbalance in their budget, arrears in utility bills, difficulties in shopping for groceries or paying rent (Anderloni et al., 2012). Azzopadi et al. (2019) additionally draw attention to the fact that the lack of short-term financial fragility of a household may also result from factors other than debt, such as: low income and low overall level of wealth, suboptimal management of household finances and economic shocks.

Further extending the concept of financial fragility (vulnerability), financially vulnerable consumers are also considered to be those who are unable to cover unexpected expenses quickly (even if they are small) or, conversely, those households whose income is sufficient to cover only previously planned expenses (Torricelli et al., 2012). This means that even with a high credit burden, but in the absence of unforeseen events, such households do not have financial problems. Thus, financially vulnerable households can be considered to be those that are not indebted, but have no financial reserves (or a low level of them), as well as households with positive or even significant assets but low liquidity. Therefore, in this approach, financial fragility of a household can be treated as the inability to cope with unexpected expenses due to an insufficient level of liquid assets (Torricelli et al., 2012). This extends the financial sensitivity analysis based on debt analysis to include assets held and their liquidity level (Ampudia, Vlokhoven, Żochowski, 2016).

In the broadest sense, financial fragility is measured by consumers' inability to meet household needs, cope with unexpected expenses, and survive in the event of a crisis (Daud et al., 2018) or macroeconomic shock (Jappelli et al., 2013). In this sense, non-indebted consumers are also considered financially vulnerable when they are unable to meet unexpected expenses, whether due to insufficient savings or the inability to access emergency funds from any source (Lusardi et al., 2011). Lusardi et al. (2011) defined financial vulnerability as "the ability to obtain funds for an unexpected expense of 2,000 USD in one month regardless of the source of financing", which is supposed to indicate an individual's ability to cope with an unfavorable financial situation. This approach constitutes a kind of "index of the resourcefulness" of households in coping with shocks, taking into account not only their wealth, but also, for example, the ability to rely on a network of family and friends, or to seek and take up additional work (Demertzis et al., 2020), which may result from and be related to cultural conditions (Azzopardi et al., 2019). In this case, attention is also drawn to the fact that financially vulnerable households are not necessarily poor (Hasler et al., 2019), which means that the problem of financial fragility may also concern well-off households with a stable

financial situation that have faced sudden, unforeseen events that dramatically change their life and material situation. O'Connor et al. (2019) noted that also wealthy households may find themselves in such a situation due to poor financial management of the household, excessive consumerism or unsuccessful investments. The problem of financial fragility is raised here to the risk that a given person will not be able to maintain current standard of living, which does not have to, but may be directly related to falling into poverty or being unable to meet basic needs (O'Connor et al., 2019).

Short-term financial security (financial fragility) is shaped by a number of diverse microeconomic factors, that can be divided into three main groups: socio-demographic (e.g. age, gender, level of education), economic (e.g. level of debt, income, accumulated assets) and behavioral (financial knowledge and behavioral aspects of individuals' behaviors and decisions regarding how to make decisions under conditions of risk and uncertainty) (Fernandez et al., 2024). It is worth noting that the level of financial knowledge and the possibilities of using it in managing personal finances, are increasingly being considered as a factor reducing the risk of losing short-term financial security by a household (Wittmann, Paulus, 2008; Anderloni et al., 2012; Giarda, 2013; Ksendzova et al., 2017; Meriküll, Rõõm, 2017; Hasler et al., 2018, 2023; Azzopardi et al., 2019; Hasler, Lusardi 2019; Clark et al., 2021; Sekita et al., 2022). While such financial knowledge may be necessary for making good financial decisions, knowledge alone does not necessarily lead to good decisions. This is because the use of financial knowledge may be limited not only by the lack of practical skills necessary to use it, but also by behavioral factors such as impulsiveness and lack of self-control, or lack of trust in financial institutions and the environment in which decisions are made (Kempson et al., 2013). For this reason, the concept of financial knowledge has been extended to financial literacy, which is accompanied by the ability to use it. The movement towards an expanded concept of financial literacy, which includes behavior and the interaction of knowledge, skills, and attitudes, but also takes into account the influence of the surrounding environment on people's ability to achieve positive outcomes in managing household finances. In this context, the term "financial capability" is increasingly used, which better captures the complexity of decision-making processes and financial management (Kempson et al., 2013).

In summary, there is no commonly accepted concept in the literature regarding short-term financial security expressed in the concept of financial fragility (Fernández-López et al., 2024), which is why this problem is considered multifaceted, complex, dynamic, and above all ambiguous (Ali et al., 2020). At the same time, understanding this phenomenon is crucial due to its broad social and economic consequences at the micro and macro levels. Short-term financial security is associated with a lack of savings and liquid assets, and hence excessive exposure to external risk and a focus on short-term "survival". A number of factors may underlie good personal financial management, the most important of which seem to be those related to knowledge and behavioral aspects of individual activity.

2. Methods

Factor analysis was used in the paper. It is the group of methods that allows for reducing a group of diagnostic features into the smallest possible number of sets that are consistent within groups but different between groups. Factor analysis also includes the related analysis of principal components, which is referred to as factor analysis in the narrow sense or factor analysis (Balicki, 2013). Additionally, this type of factor analysis used to describe and explain the complexity of phenomena and variables is called exploratory factor analysis (Balicki, 2013). It is used to analyze data without prior assumptions as to the number or nature of factors.

The factor analysis procedure has been comprehensively described in the literature (e.g. Czopek, 2013; Balicki, 2013; Gatnar, Walesiak, 2004). The main stages of the analysis are outlined below. At the first stage, the available data was subjected to diagnostics in order to check the possibility of conducting factor analysis. For this purpose, the Kaiser-Mayer-Olkin tests and the Bartlett test were used. Within the first criterion, the test value was checked, the results of which are in the range from 0 to 1. It is suggested that this measure should not be lower than 0.5 (Malarska, 2005). The closer the value to 1, the more justified it is to conduct factor analysis. Bartlett's test is a statistical test checking the assumption of no correlation between variables (<0.05).

Then, two criteria were used to extract the component variables. The first is the Kaiser criterion, which suggests extracting as many factors as the eigenvalues greater than 1 suggest for a given factor solution. The second criterion is the shape of the scree plot (based on the eigenvalues).

In the next step, a decision is made about the method of factor rotation. Rotation of the reference frame is used to determine its position that will provide the best interpretation of factor loadings from the point of view of the issue under study (Balicki, 2013). The factor matrix that we obtain as a result of the factor extraction process is called the unrotated factor matrix, while the matrix obtained as a result of the rotation procedure is called the rotated matrix. The last step is the interpretation of the obtained results. The Statistical Package for the Social Sciences (SPSS) software was used to conduct factor analysis (principal components).

Based on the literature review and substantive criteria, a set of publicly available indicators covering the year 2023, published in the European Union databases (Eurostat), was adopted for the analysis. These indicators are included in a Table 1. The analysis was limited by the availability of data. For this reason, the analysis included the following EU countries: Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Spain, Sweden.

Table 1.*List of diagnostic variables determining the financial situation of the household*

Number	Variable
X_1	Households making ends meet with great difficulty
X_2	Liabilities divided by currency and deposits
X_3	Gross debt-to-income ratio of households
X_4	Households heavy financial burden of the repayment of debts from hire purchases or loans
X_5	Arrears (mortgage or rent, utility bills or hire purchase)
X_6	Inability to face unexpected financial expenses
X_7	Overall Financial Literacy Score (out of 100)
X_8	Minimum target financial literacy (70 points or more)
X_9	Financial behaviour Average financial behavior scores (out of 100)
X_{10}	Minimum target financial behaviour (at least 6 out of 9 financially savvy behaviours)
X_{11}	Financial Knowledge Scores (out of 100)
X_{12}	Minimum target financial knowledge (5 out of 7 financial knowledge question)
X_{13}	Financial Resilience score (out of 100)
X_{14}	Financial Attitudes Scores (out of 100)

Source: Eurostat database.

3. Results

The results of the K-M-O test and Bartlett's test are presented in Table 2. The values of the measures allow to conclude that it is possible to conduct exploratory factor analysis.

Table 2.*Kaiser-Mayer-Olkin test and Bartlett's test*

KMO measure		0,512
Bartlett's Sphericity Test	approximate chi-square	327,032
	df	91
	significance	< 0,001

Source: Own calculations.

As a next step, actions were taken to isolate factors (components) using an exploratory factor analysis procedure known as the principal components method.

Using the principal components method, it was possible to isolate four uncorrelated factors (Table 3), rank them according to the variance they explained, and obtain information on the percentage of variance explained by the four factors whose eigenvalue was greater than 1 (Kaiser criterion).

The designation of newly extracted factors (components), that are characterized by eigenvalues higher than 1, means that they explain more variance than a single variable from the original set of variables. This criterion is commonly used due to its simplicity. At the same time, the second criterion in the form of a scree plot (Cattell's) allowed us to confirm the number of synthetic variables at the level of four. This plot was not included in the study due to the unambiguous confirmation of Cattell's criterion, as well as the requirements regarding the volume. According to the Kaiser criterion, four factors (components) are taken into account in further analysis.

Table 3.*Total explained variance before extraction*

Component	Initial eigenvalues		
	total	% variance	% cumulative
1	6,026	43,040	43,040
2	2,085	14,896	57,937
3	1,994	14,243	72,179
4	1,311	9,364	81,543
5	0,899	6,422	87,965
6	0,627	4,481	92,446
7	0,506	3,616	96,062
8	0,258	1,841	97,903
9	0,177	1,261	99,165
10	0,074	0,525	99,690
11	0,029	0,208	99,898
12	0,011	0,076	99,975
13	0,002	0,015	99,989
14	0,001	0,011	100,000

Source: Own calculations.

In the next step, the orthogonal Quartimax rotation (Table 4) was used, which is used in factor analysis and principal component analysis to simplify the interpretation of factors by rotating them. Table 4 contains the strength of the factors, i.e. the percentage of variability of all factors (components) explained by the cumulative percentage. These factors (components) can explain 81.5% of the variability of all diagnostic features.

Table 4.*Total explained variance after extraction, before and after rotation*

Component	Sums of squared charges after extraction			Sums of squares of charges after rotation		
	total	% variance	% cumulative	total	% variance	% cumulative
1	6,026	43,040	43,040	4,397	31,407	31,407
2	2,085	14,896	57,937	2,479	17,705	49,113
3	1,994	14,243	72,179	2,329	16,637	65,750
4	1,311	9,364	81,543	2,211	15,794	81,543

Source: Own calculations.

Thanks to rotation and calculation of factor loadings, it is possible to determine to what extent a given variable represents the extracted factor (component). The interpretation is as follows: the higher the factor loading value, the more it represents the new factor (component) and shows a stronger relationship with the new factor. The cut-off point was assumed to be 0.5. The matrix of rotated components is presented in a Table 5.

Table 5.*Rotated matrix*

Variable	Component			
	1	2	3	4
X_9	0,980	-0,012	-0,089	0,031
X_{10}	0,980	-0,011	-0,088	-0,019
X_8	0,849	0,228	0,432	-0,045
X_7	0,734	0,413	0,302	0,075
X_4	-0,594	-0,240	0,149	0,261
X_{13}	0,582	0,130	0,315	-0,389

Cont. table 5.

X_3	0,326	0,842	0,117	-0,046
X_2	-0,100	-0,834	-0,070	0,122
X_6	-0,304	-0,643	-0,055	0,395
X_{14}	0,484	0,518	0,116	-0,022
X_{11}	0,190	0,141	0,965	-0,013
X_{12}	0,081	0,132	0,965	-0,079
X_5	-0,158	-0,145	0,040	0,961
X_1	-0,126	-0,192	-0,120	0,938

Source: Own calculations.

Based on the factor loadings determined in the rotated matrix (Table 5), the results were interpreted. The first factor is defined by the variables: Financial behavior (X_9 and X_{10}), Financial Literacy (X_7 and X_8), Households heavy financial burden of the repayment of debts from hire purchases or loans (X_4) and Financial Resilience (X_{13}). This factor can be defined as "Financial behavior and competences". The second factor is defined by the variables: Gross debt-to-income ratio of households (X_3), Liabilities/Currency and deposits (X_2), Inability to face unexpected financial expenses (X_6), Financial Attitudes Scores (X_{14}). This factor can be captured as "Financial situation". The third factor is defined by the variables: Financial Knowledge Scores (X_{11}) and Minimum target financial knowledge (X_{12}). This factor is defined as "Financial knowledge". The fourth factor can be termed "Financial difficulties" and is defined by Arrears (mortgage or rent, utility bills or hire purchase) (X_5) and Households making ends meet with great difficulty (X_1).

4. Discussion

What is noteworthy in the obtained results is the fact that they are consistent with the theoretical achievements to date in the field of analyses of short-term financial security of households. This concept is based on the entirety of household behaviors and decisions in the area of broadly understood household financial management (see: Lusardi, 2019; Hasler, Lusardi, 2019; Lusardi, Hasler, 2020), which in turn are based not only on financial knowledge, but above all on the ability to use it, awareness of one's own financial situation and the consequences of decisions made (see: Graham, Isaac, 2002; Clark, 2021). It is financial education (see: Lusardi, Mitchell, 2014; Allgood, Walstad, 2016) that translates into the possibility of maintaining short-term financial resilience, including through the use of available institutional and legal solutions.

5. Summary

Practical understanding of financial dependencies, together with the ability to use the knowledge contained in the concept of financial literacy and awareness of the consequences of financial decisions made, seems to be crucial in the process of explaining the short-term financial security of a household. The obtained results encourage further in-depth research and discussions, but also emphasize the importance of behaviors based on financial literacy in managing household finances. This in turn encourages the creation of programs and trainings supporting this process and increasing the financial knowledge and awareness of individuals, which can increase the financial security of the entire household sector. At the same time, attention was drawn to the basic limitation in the analysis of the discussed phenomenon resulting from the availability of detailed and longitudinal data. The fact that the problem of financial fragility of households is considered a complex and multi-faceted problem also does not facilitate the analysis.

References

1. Ali, L., Khan, M.K.N., Ahmad, H. (2020). Financial fragility of Pakistani household. *Journal of Family and Economic Issues*, Vol. 41, Iss. 3, pp. 572-590. Retrieved from: <https://doi.org/10.1007/s10834-020-09683-y>
2. Allgood, S., Walstad, W.B. (2016). The effects of perceived and actual financial literacy on financial behaviors. *Economic Inquiry*, Vol. 54, Iss. 1, pp. 675-697. Retrieved from: <https://doi.org/10.1111/ecin.12255>
3. Ampudia, M., Vlokhoven, H., Żochowski, D. (2016). Financial Fragility of Euro Area Households. *Journal of Financial Stability*, Vol. 27, pp. 250-261. Retrieved from: <http://dx.doi.org/10.1016/j.jfs.2016.02.003>
4. Anderloni, L., Bacchiocchi, E., Vandone, D. (2012). Household financial vulnerability: An empirical analysis. *Research in Economics*, Vol. 66, Iss. 3, pp. 284-296. Retrieved from: <https://dx.doi.org/10.1016/j.rie.2012.03.001>
5. Angrisani, M., Burke, J., Lusardi, A., Mottola, G. (2023). The evolution of financial literacy over time and its predictive power for financial outcomes: evidence from longitudinal data. *Journal of Pension Economics and Finance*, Vol. 22, pp. 640-657. Retrieved from: [doi:10.1017/S1474747222000154](https://doi.org/10.1017/S1474747222000154)
6. Azzopardi, D., Fareed, F., Lenain, P., Sutherland, D. (2019). Assessing household financial vulnerability: Empirical evidence from the US using machine learning. In: D. Sutherland

- (Ed.), *OECD economic survey of the United States: Key research findings* (pp. 121-142). OECD Publishing. Retrieved from: <https://www.researchgate.net/publication/332398455>
7. Balicki, A. (2013). *Statystyczna analiza wielowymiarowa i jej zastosowania społeczno-ekonomiczne*. Gdańsk: Wyd. UG, pp. 1-357.
 8. Brunetti, M., Giarda, E., Torricelli, C. (2016). Is financial fragility a matter of illiquidity? An appraisal for Italian households. *Review of Income and Wealth, Vol. 62, No. 4*, pp. 628-649. Retrieved from: <http://www.roiw.org/2016/n4/2.pdf>
 9. Clark, R.L., Lusardi, A., Mitchell, O.S. (2021). Financial Fragility during the COVID-19 Pandemic. *AEA Papers and Proceedings, Vol. 111*, pp. 292-296. Retrieved from: <https://www.aeaweb.org/articles?id=10.1257/pandp.20211000>
 10. Czopek, A. (2013). Analiza porównawcza efektywności metod redukcji zmiennych – analiza składowych głównych i analiza czynnikowa. *Studia Ekonomiczne, No. 132*. Uniwersytet Ekonomiczny w Katowicach, pp. 7-23. Retrieved from: https://www.ue.katowice.pl/fileadmin/_migrated/content_uploads/1_A.Czopek_Analiza_Porownawcza_Efektywnosci....pdf
 11. Daud, S.N.M., Marzuki, A., Ahmad, N., Kefeli, Z. (2018). Financial Vulnerability and Its Determinants: Survey Evidence from Malaysian Households. *Emerging Markets Finance and Trade, Vol. 55, Iss. 9*, pp. 1991-2003. Retrieved from: <https://ideas.repec.org/a/mes/emfitr/v55y2019i9p1991-2003.html>
 12. Demertzis, M., Domínguez-Jiménez, M., Lusardi, A. (2020). The financial fragility of European households in the time of COVID-19. *Bruegel Policy Contribution, Iss. 15*, pp. 1-16. Retrieved from: <https://aei.pitt.edu/103258/>
 13. Fernández-López, S., Álvarez-Espino, M., Rey-Ares, L., Castro-González, S. (2024). Consumer financial vulnerability: review, synthesis, and future research agenda. *Journal of Economic Surveys, Vol. 38, Iss. 4*, pp. 1045-1084
 14. Gatnar, E., Walesiak, M. (Eds.) (2004). *Metody statystycznej analizy wielowymiarowej w badaniach marketingowych*. Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu, pp. 1-393.
 15. Giarda, E. (2013). Persistency of financial distress amongst Italian households: Evidence from dynamic models for binary panel data. *Journal of Banking & Finance, Vol. 37, Iss. 9*, pp. 3425-3434. Retrieved from: <https://ideas.repec.org/a/eee/jbfin/v37y2013i9p3425-3434.html>
 16. Graham, F., Isaac, A.G. (2002). The behavioral life-cycle theory of consumer behavior: survey evidence. *Journal of Economic Behavior & Organization, Vol. 48, Iss. 4*, pp. 391-401. Retrieved from: [https://doi.org/10.1016/S0167-2681\(01\)00242-6](https://doi.org/10.1016/S0167-2681(01)00242-6)
 17. Hasler, A., Lusardi, A. (2019). Financial Fragility among Middle-Income Households: Evidence Beyond Asset Building. *Global Financial Literacy Excellence Center*. The George Washington University School of Business, WP 2019-1, pp. 1-34.

18. Hasler, A., Lusardi, A., Oggero, N. (2018). Financial Fragility in the US: Evidence and Implications. *Global Financial Literacy Excellence Center*. The George Washington University School of Business, pp. 1-51. Retrieved from: <https://gflrec.org/wp-content/uploads/2018/04/Financial-Fragility-Research-Paper-04-16-2018-Final.pdf>
19. Hasler, A., Lusardi, A., Yagnik, N., Yakoboski, P. (2023). Resilience and wellbeing in the midst of the COVID-19 pandemic: The role of financial literacy. *Journal of Accounting and Public Policy*, Vol. 42, Iss. 2, pp. 1-17. Retrieved from: <https://doi.org/10.1016/j.jaccpubpol.2023.107079>
20. Jappelli, T., Pagano, M., Maggio, M.D. (2013). Households' indebtedness and financial fragility. *Journal of Financial Management Markets and Institutions*, Vol. 1, Iss. 1, pp. 23-46.
21. Kempson, E., Perotti, V., Scott, K.M. (2013). Measuring financial capability: a new instrument and results from low- and middle-income countries. *International Bank for Reconstruction and Development, The World Bank*, Vol. 2, No. 79806, Retrieved from: <http://documents.worldbank.org/curated/en/169421482489837037>
22. Ksendzova, M., Donnelly, G.E., Howell, R.T. (2017). A Brief Money Management Scale and Its Associations With Personality, Financial Health, and Hypothetical Debt Repayment. *Journal of Financial Counseling and Planning*, Vol. 28, Iss. 1, pp. 62-7. Retrieved from: <https://eric.ed.gov/?id=EJ1185314>
23. Lusardi, A. (2019). Financial literacy and the need for financial education: evidence and implications. *Swiss Journal of Economics and Statistics*, Vol. 155, Iss. 1. Retrieved from: <https://sjes.springeropen.com/articles/10.1186/s41937-019-0027-5>
24. Lusardi, A., Hasler, A. (2020). Financial Literacy and Wellness among African-Americans: New Insights from the Personal Finance (P-Fin) Index. *The Journal of Retirement*, Vol. 8, Iss. 1, pp. 22-31. Retrieved from: 10.3905/jor.2020.1.070
25. Lusardi, A., Mitchell, O.S. (2014). The Economic Importance of Financial Literacy: Theory and Evidence. *Journal of Economic Literature*, Vol. 52, Iss. 1, pp. 5-44. Retrieved from: <https://www.aeaweb.org/articles?id=10.1257/jel.52.1.5>.
26. Lusardi, A., Schneider, D.J., Tufano, P. (2011). Financially Fragile Households: Evidence and Implications. *National Bureau of Economic Research*, No. 17072. Massachusetts Avenue Cambridge. Retrieved from: <https://ideas.repec.org/p/nbr/nberwo/17072.html>
27. Malarska, A. (2005). *Statystyczna analiza danych wspomagana programem SPSS*. SPSS Polska, pp. 1-439.
28. Meriküll, J., Rõõm, T. (2017). The financial fragility of Estonian households: Evidence from stress tests on the HFCS microdata. *Bank of Estonia Working Papers*, Vol. 4, pp. 1-51. Retrieved from: 10.23656/25045520/42017/0142
29. Sekita, S., Kakkar, V., Ogaki, M. (2022). Wealth, Financial Literacy and Behavioral Biases in Japan: the Effects of Various Types of Financial Literacy. *Journal of The Japanese and International Economies*, Vol. 64, 101190. Retrieved from: 10.1016/j.jjie.2021.101190

30. Torricelli, C., Brunetti, M., Elena, G. (2012). Is Financial Fragility a Matter of Illiquidity? An Appraisal for Italian Households. *CEIS Working Paper, Vol. 10, Iss. 9, No. 242*. Retrieved from: 10.1016/j.tics.2007.10.004 12035
31. Wittmann, M., Paulus, M.P. (2008). Decision making, impulsivity and time perception. *Trends in Cognitive Sciences, Vol. 12, Iss. 1, pp. 7-12*. Retrieved from: 10.1016/j.tics.2007.10.004

EMPLOYMENT SURVIVAL CRITERIA FROM THE PERSPECTIVE OF EMPLOYEES

Katarzyna WOJCIECHOWSKA

Doctoral college of WSB Merito University in Gdansk; katarzyna.wojciechowska@op.pl,
ORCID: 0009-0005-1851-8769

Purpose: This article discusses the issue of employment survival, which is the employee's ability to keep the current job. The study aimed to identify the criteria of survival, establish the order and levels of said criteria according to employees, and examine the relation between the sociodemographic factors and survival criteria.

Design/methodology/approach: The diagnostic survey involved the CAWI method and an original questionnaire. Multiple statistical analysis tools were applied, including Spearman and Pearson rank correlations, the ANOVA analysis, and a regression analysis.

Findings: The most significant group of factors, which impact the decision on continuing employment at the given position is made up of the following in order: prestige, work-life balance, regulations, employee performance, and physical working conditions. The regression analysis revealed that only two sociodemographic variables - gender and education - had a generally significant overall impact on the selection of the criteria. The results reveal a completely opposite trend in the significance of organisational factors compared to that presented in macro-social research.

Research limitations/implications: This is a one-off study and its results reflect the current status. Continuous monitoring of the situation would require longitudinal studies. The results reflect primarily the opinions of Generation Z. Therefore, it would be reasonable to expand the research, specifically to include other age groups.

Practical implications: The results may be recognised in organisational business management as the basis for human resources decisions in the scope of retaining employees and selecting work and employment standards.

Social implications: The results may help raise compliance in the scope of mutual expectations and obligations between the employee and the employer and thus increase job stability for employees.

Originality/value: The research demonstrates the significance of individual work factors in the context of employment at the given job and indicates the determinants for maintaining certain, stable, and most importantly continuous employment at the given job. Answering the presented questions will make it easier to further study the problem of employment survival as a new research category and conduct more specific empirical studies.

Keywords: employment survival, employment survival criteria, employment retention, job adaptation.

Category of the paper: Research paper.

1. Introduction

Professional literature offers plenty of studies covering the numerous aspects of employment. Recent experiences, including the COVID-19 pandemic, have forced intensive development of theoretical research in this area. The observations of contemporary labour transformations have encouraged researchers to revise this category, which led to the modification of the current and creation of new job categories, including nomadic, remote, hybrid, or platform-based (Davidavičiene, Rymaniak, Lis, 2023; Sidor-Rządkowska, 2022; Król, 2022; Mączyńska, 2020; Penc-Pietrzak, 2023; Stoian et al., 2022; Łukasiński, Wójcik, 2023; Dobrzyńska, 2020; Niebler, Altenried, Macannuco, 2020; Ostój, 2024; Piasna, Drahokoupil, 2020). Businesses looking for solutions to reduce their employment costs are eager to establish cooperation with temporary job agencies, offer B2B contracts, and work with people who are self-employed (Weil, 2014). Such practices and the intensification of the GIG Economy (Janadari, Prena, 2020), which maximally reduces the time of jobs and contracts, have contributed to the deterioration of the conditions of employment and the social situation of employees. The digital revolution has forced employees to depend on advanced technologies and artificial intelligence, presenting numerous limitations and opportunities for their coexistence on the labour market. Other factors changing the working conditions include digitalisation and automation (Parker, Grote, 2022).

Although literature discusses the issue of adapting to the job and presents analyses of organisational behaviour elements such as employee engagement, employee motivation, employee satisfaction, working conditions, or employment rotation (Hauk, 2019; Biriowu, 2020; Wudarczyński, 2013; Cynk, 2016), there are no empirical studies or analysis results concerning all factors determining employment survival.¹ This research gap justifies the need to evaluate the meaning and system of values of the individual criteria for the employee to keep the given job. The priority here is to identify the individual criteria, especially in the context of the variety of the theoretical employment and job constructs. This scientific need establishes the research problem presented below, which serves as the basis for two research questions.

Research problem: Significance of criteria to survive employment at the current job.

Research questions:

1. What are the levels and order of the criteria to survive at the current job according to employees?
2. What are the relations between the sociodemographic factors and the criteria for the employee to survive at the current job?

¹ For the purposes of this study, *employment survival* is understood as keeping the current job due to the decision of the supervisor or the employee. This is not about maintaining employment at the company, but about keeping the specific job. Employment survival is subject to determinants conditioning continuation of employment at the given job.

This analysis will help establish the significance of individual work factors in the context of employment at the given job and indicate the determinants for maintaining certain, stable, and most importantly continuous employment. Answering the presented research questions will make it easier to further study the problem of employment survival as a new research category and conduct more specific empirical studies.

The researched problems are covered further in the article. They follow the review of professional literature covering employment statuses, establishment of the survival criteria verified in the pilot study, and presentation of the research methodology. Subsequent chapters are dedicated to presentation of the research results, discussion of said results and the conclusions drawn from them, and establishment of the future directions of research.

The originality of the presented material is demonstrated in the following aspects. The results show a completely opposite trend in the importance of factors at the organizational level than in macrosocial studies. Two groups of factors influence the decision to continue employment in a given position. The group with a high level of significance consists of, in the following order: prestige associated with the job position, work-life balance, regulations, employee performance, and physical working conditions. The results have been presented a structure of importance, where criteria previously perceived as important elements in human resources management (e.g., competences and qualifications, professional development, and personal characteristics) are of little importance. At the same time, this structure demonstrates a significant increase in the importance of prestige as a social evaluation of one's job position. The high ranking of Work-Life Balance confirms that work-life balance is also important for the new generation of employees.

2. Literature review

2.1. Employment and work theories

This literature review focuses on the aspects impacting employment survival at the given job. The impact categories selected for research are presented in Figure 1.

The labour market structure and nature of employment have never been as dynamic as they are today. The new job categories mean changes in not just the modes of work, but also in the perception of regular jobs. In order to survive and grow on the job, employees need to learn how to navigate a flexible world where careers are determined mainly by the ability to adapt. From this perspective, the dependency of the impact of the new working models on the stability of employment at the given job is clear. In recent years, the challenge of relocating work outside of the company's location emerged. The research on nomadic, remote, and hybrid work conducted during that time collectively demonstrated that the most desired way to work is the

hybrid model (Sidor-Rządkowska, 2022; Król, 2022; Mączyńska, 2020; Penc-Pietrzak, 2023; Stoian et al., 2022; Łukasiński, Wójcik, 2023; PARP, 2021) , which fulfils the need for direct contact with colleagues, makes it easier to balance work and home responsibilities, saves the time needed to commute to work, and offers flexibility in terms of working hours and locations.

Unfortunately, these work models also entail some negative impact, as they reduce employee motivation and self-discipline. This, in turn, reduces efficiency. There is also the problem of balancing professional and personal life.

Platform-based work involves the problem of providing employees with occupational health and safety standards and social basics like vacations or insurance (Dobrzyńska, 2020). The business and social risks are transferred to platform workers (Niebler, Altenried, Macannuco, 2020). The high level of work fragmentation entails low earning potential and the need to explore alternative or additional sources of income (Ostój, 2024; Piasna, Drahokoupil, 2020).

NEW JOB CATEGORIES	EMPLOYEE RETENTION	ORGANISATIONAL BEHAVIOURS
• Rising short employment model trend • Rising hybrid job model popularity • Position of employees weakened by employment outsourcing • Job sharing & employee as a solution to retain the job • Work digitisation and automation as a determinant of the direction and pace of employee competence adaptation	• Job-specific adaptation as an indirect employment retention tool • Positive impact of job crafting on employment stability • Job hopping as a generation Z trend • High employability is desired • Complementary resources in labour migration • Strategies of employing and retaining employees as an element of the retention strategy	• Positive relation between satisfaction and employment retention • Motivation as a building block of employee engagement • Engagement as the results of organisational culture transparency • Maintaining bonds as a challenge in interpersonal relations • Satisfaction acting as a mediator between work-life balance and employee rotation

Figure 1. Selected categories of impact on maintaining employment at the given job.

Source: Original work.

As platform workers have less education, there is also the risk of escalating social dysfunctions like stigmatisation (Ostój, 2024). Nevertheless, this is an easily accessible form of work, which offers financial independence from specific employers (Bakalarz, 2019).

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The results of work digitalisation and automation research indicate the need to quickly elevate employee competences in order to adapt everyone to the dynamic changes in the virtual labour world (Parker, Grote, 2020) and the need of an individual approach to employing so-called knowledge workers (Mirowski, 2021). As it is rather hard to provide autonomy, a sense of independence, and motivation, such people are hard to retain for extensive time.

There are also other work models – which offer employees a much safer alternative than temporary job agencies – being taken into consideration: employee sharing and job sharing. In the first instance, the main advantage is a full time contract guaranteeing a full time workload (Marica, 2020). Meanwhile, the benefits of sharing a job include more free time without the need to sacrifice career development at the employer company. Despite the part time hours, the employees retain the right to employee benefits for full time jobs (Crampton et al., 2023).

The length of employment at the given job is also determined by employment retention. The studies point to the job of line manager, who – due to regular communication with employees – has the best chance to learn their expectations and assess potential intentions to quit the job (Lipka, 2011). What is important here is three-way marketing impact, where the efforts are not limited to attract new and regain former employees, but mainly aimed to appease current ones. It is believed that the most important factor in developing emotional attachment to the company among employees is based on interpersonal relations (Spychała, Bartecki, Brzóska, 2019). The tendency to change jobs has been demonstrated to be diverse for different groups of employees (Kielczewska, Rozbicka, 2023). One trend is dangerous: job hopping, which is the domain of millennials and Generation Z (Lake, Highhouse, Shrift, 2018). It is established that the factor with the greatest impact on quitting a job is the salary (Pelczewski, 2023). This is followed by no promotion potential and a poor atmosphere in the workplace. Characteristics in the workplace persuading employees to keep their jobs include the following: sense of belonging in the workplace, satisfaction from work, benefits and rewards, attachment to the professional community, and quality leadership (Rubenstein et al., 2018). Furthermore, rotation has been established to have a negative impact on employee productiveness (De Winne et al., 2018). When it comes to labour migration, domestic workers are less attractive, because they expect higher salaries (Kruhlaya, Molenda, 2020). While migrants may be competition for domestic workers, it is important to note that the skills and abilities of both worker groups complement each other (Rolfe et al., 2013).

The ways companies attract and retain employees determine not just their operating efficiency, but also stability of employment. On the other hand, employees aware of the uncertain situation on the labour market are trying to raise their employability. Both of these aspects have considerable impact on the dynamics of changes in the scope of job employment. Literature distinguishes two leading employee selection and retention strategies: the human capital model and the sieve model. In the scope of the human capital strategy, deliberate investment in employees and development of their competences does not just shape personal selection methods; it is also one of the main determinants of long-term cooperation between the organisation and the employee. The objective is to tie the employee emotionally to the company while providing the best available development opportunities (Sobocka-Szczapa, 2014). When it comes to the sieve model, employee attractiveness is measured with the quality and quantity of competences. The qualification sieve may lower organisational expenses², but it requires endless rivalry and companies enforcing such practices may be perceived as having hostile working environments. The impact of outsourcing work on employment stability is also studied (Iheriohanma, Austin-Egole, 2020). Saving costs entails changes in the professional relations between the organisation and its employees to shorten the employment time and reduce administrative control over employees. There are also certain problems in the scope of motivation and engagement in work, which concern mainly external workers employed at lower positions (Grześ, 2017). Due to the dynamics of the organisational environment and the labour market, employers are looking for highly employable people, i.e. those with extensive competences, especially transferrable ones (Marzec, 2010). It is the uncertainty of long-term employment that forces people to develop skills and adapt to the requirements of numerous potential employers instead of just one. Despite a high degree of adaptability and presentation of the skills in question, the attractiveness of the candidate for the job is determined by the combination of general and technical skills, but also those required for the given job (Dasgupta, 2020) or adopted in work models (Rymaniak, 2015). Employability skills are also categorised in various ways, which include SS, a set of 10 skill groups covering 97 specific skills with a high index of professional and sector-specific universalisation (Sarfraz et al., 2018). The two groups of employability determinants – i.e. individual (e.g. competences, experience, predispositions, or psychophysical characteristics) and organisational (e.g. motivation system, employee competence development plan, or organisational structure and culture) factors – have been proven to be complementary (Wiśniewska, 2015). This is particularly obvious when it comes to employees demonstrating unique abilities who can be retained when they are provided with extremely individualised conditions for development and work (Cynk, 2016).

² The entire effort and cost of development and growth falls to the employee. As far as the organisation is concerned, the employee should be a full value asset up front to add value from the very start of cooperation.

Analyses of organisational and job-specific adaptation demonstrate that their overlapping nature seems to indirectly determine the time of employment. The impact of the supplementary and complementary Employee-Organisation adaptation on job satisfaction and consequential positive emotions has been established (Terelak, Jankowska, 2009), along with a high significance of the evaluation of candidate suitability for the given job in the scope of predispositions and qualifications, comparison of professional profiles, and utilisation of the tools used to survey professional usefulness. Adaptation to the job also involves the roles of temperament and working style of the employee (Gajda, 2013). In the context of supporting employee adaptation, the roles of leaders are considered prominent, especially in the scope of self-agency and task-based productivity (Wojczuk-Turek, 2018). Superiors can also affect the attitudes and beliefs of their subordinates by modifying the working environment, i.e. creating pro-development conditions and providing the resources necessary to perform. According to research, the degree of adaptation to the job is the main determinant of employee engagement (Chirkowska-Smolak, 2012; Lipińska-Grobelny, Głowacka, 2009). The correlation between general appreciation of the job and sensitivity to organisational and job-specific adaptation was also examined. The conclusion is that the more important the job is to the employee, the more the employee in question will want to adapt to it (Czerw, Czarnota-Bojarska, 2016). One of the solutions in the scope of job-specific adaptation, which indirectly determines job retention is job crafting. It has been established that crafting the job makes employees more productive and internally motivated and makes them tend to believe that their jobs have meaning (Van Dam, Nikolova, Ruysseveldt, 2013). This proactive approach develops confidence and increases engagement. Job crafting has also been confirmed to influence employee satisfaction (Jatav, Kuriakose, Dixit, 2023). Task and relational job crafting have also been established to have a positive impact on employment stability (Zuma, 2020). Job crafting also helps retain talents by adapting the job to the potential and priorities of the key employees (Abuzaid, 2024).

2.2. Organisational behaviours

The key organisational behaviour elements in determination of long-term employment stability include motivation, engagement, work-life balance, and interpersonal relations. These are important determinants of job satisfaction, although certain ones – like engagement – can be enforced with satisfaction through feedback.

The satisfaction survey confirmed a positive relation between satisfaction and employment retention (Biason, 2020). A satisfied employee demonstrates a greater desire to stay at the given company for a longer time. Five factors determining whether employees decide to stay at the current job have been established (Htun, 2022). In order from most to least significant, they are as follows: regular salary raises, recognition and rewards, retirement benefits, promotion potential, and conditions for self-fulfilment (taking advantage of education, skills, and experience). Retirement benefits are very important as only approximately 20% of the respondents were aged 41-50 years old. However, the survey conducted in the IT industry

established that remuneration was the only one of the elements developing job satisfaction, which had a positive correlation with employee retention. Two of the satisfaction determinants – motivation and engagement – demonstrate a strong interdependence (Steil et al., 2022).

Motivation is a factor in development of engagement, but not all motivated employees will engage in their work. Both internal and external motivation have a positive impact on retention (Shah, Asad, 2018). Motivation is built by material, formal, but also intrinsic rewards. It is also noted that the potential of rewards is not determined by their value (Chama, Matafwali, 2024). When the salary is sometimes unsatisfactory, intangible motivation factors become more important. Such factors include recognition, the opportunity to develop professionally, self-fulfilment, work-life balance, justice, good communication and trust in the workplace, and performance flexibility (Mazur, 2013; Saidi, 2024; Mamkhumbi, 2023).

Scientific studies associate the concept of engagement with organisational culture, which is innovative, transparent, and cooperative. Organisational culture raises engagement as it offers conditions benefiting a sense of recognition and the motivation to perform (Siswanto, 2024). Meanwhile, companies enforcing a rigid and excessive hierarchisation reluctant to change limit the developmental potential of their employees stifle their creativity and develop unnecessary relational barriers, which does not help to retain employees at their current jobs. Other studies demonstrate the key roles of communication, personal development, emotional affiliation, and recognition in building engagement (Dhanya, 2024; Bhakuni, Saxena, 2023). According to the Leader-Member Exchange theory, an individual approach to employees will strengthen their engagement (Presitero, Fujimoto, Lim, 2025).

Interpersonal relations have a similar impact. It is demonstrated that the strongest factor of engagement building involves preservation of relations based on support and understanding (Kulikowski, 2015). The association between relations at work and engagement is moderated by the requirements of the job. The higher the stressfulness, the greater the impact on engagement. There is also the matter of taking advantage of digital technologies at work, which makes it harder to maintain human relations due to the considerably limited possibility to show and receive natural emotional reactions (Robak, 2022). Relations also involve a relation mechanism in the form of the human ability to maintain positive images of each other, one of the most prominent predictors of satisfaction (Seppala, McNichols, 2022). Inspiring superiors or colleagues creates a personal need and willingness to grow. This kind of interaction increases productiveness. Furthermore, teams made up of people demonstrating similar mental models tend to be more efficient.

The next satisfaction determinant with impact on employees deciding whether to stay or quit the job is the balance between personal and professional life. Satisfaction is defined as a mediator between work-life balance and employee rotation (Kuancintami, Heryjanto, 2023). When the working conditions and the quality of personal life are satisfactory, the level of satisfaction with the job rises and consequentially increases employment retention. An imbalance between professional activity and personal life tends to generate stress and

professional burnout, which reduces satisfaction from work and may cause the employee to decide to quit. When the time dedicated to personal and private matters is balanced appropriately, individual productiveness rises. Excessive overlapping of personal and professional matters creates mental discomfort among employees (Susanto et al., 2022).

According to literature, an employee's ability to stay employed at the given job results from an interaction of both individual and organisational factors. Considering the multitude of variables in the employment and work processes, it is important to remember to continuously adapt to the transforming professional reality. Another important factor is the level of conformity in the scope of mutual expectations and obligations in the relation between the employee and the employer and the ability to effectively convey said expectations and obligations into the effects of cooperation. Available studies confirm that the current employment survival form trends and numerous organisational behaviour elements have an impact on employment survival at the current job. However, this impact has been studied selectively and often indirectly and no complete image of the impact of said aspects on the ability to keep the job is available. This proves that this area should be examined in a comprehensive manner in accordance with the premises of the research in question.

3. Materials and methods

3.1. Research subject

The research focuses on the criteria for employees to keep their current jobs. There are ten such criteria established, which are presented in the second column of Table 1.

The *competences and qualifications* criterion covers knowledge, skills, and professional experience. *Knowledge* is understood as that obtained in the scope of formal education and confirmed with diplomas and certificates (e.g. college degree) and the professional kind obtained in the scope of the performed job. *Skills* are the employee's ability to perform specific tasks in an effective manner – in this case, in the scope of professional responsibilities.

Professional experience is the time employed at the given job or given role or given industry and professional progress. The next group is *development*, which is understood as continuous professional improvement. This includes not only the opportunities provided by the employer, but also the employee's desire to continue education and attend training courses. This is the opportunity or readiness to expand skills and competences. *Personal traits* constitute the next moderator of employee attitude. These are the personal traits and individual predispositions of employees, which determine engagement in work, punctual delivery of tasks, and initiative. They include resistance to stress and empathy. The workplace also involves *interpersonal relations*, which define how the employee interacts with colleagues, superiors, subordinates,

or the company's clients and business partners. Such relations include communication, resolving conflicts, cooperation, trust, support, and respect. The next part concerns the *financial benefits* of employment, mainly the basic salary and financial supplements like bonuses. This also includes non-wage benefits, which indirectly help the employee save money. These may include sports cards, medical plans, or discounts for the company's products or services. The next factor group is *work-life balance*, which is the ability to maintain balance between personal and professional life. This balance may be disturbed by having to work overtime, having to be available outside of working hours, or having to work at home because there is not enough time at work to do everything. This is particularly important when it comes to professional burnout. *Physical working conditions* define the external factors of the working environment, which include not just the working premises or job equipment, but also amenities for employees like a cafeteria or leisure zone. Physical working conditions also include the location of the workplace. *Productiveness* is a measure of the employee's effectiveness at work. This is an element of the employee's evaluation, which may serve as cause for termination. Productiveness is associated with results at work, assignment of tasks, and the level of workload.

Table 1.
Employment survival criteria

CRITERION	SPECIFIC FACTORS
Competences and qualifications	• knowledge, • skills, • professional experience
Development	• continuing education, • attending training courses
Personal traits	• engagement in work, • punctuality, • initiative, • resistance to stress, • empathy
Interpersonal relations	• relations with colleagues, • relations with superiors, • relations with clients
Financial benefits	• salary value, • financial supplements, • benefits
Work-life balance	• working overtime, • being available outside of working hours, • bringing work home
Physical working conditions	• location, • working premises, • workstation equipment, • amenities, e.g. cafeteria, leisure zone
Productiveness	• workload, • productiveness, • task assignment

Cont. table 1.

Regulations	• work discipline, e.g. arrivals, departures, absences, • obeying regulations
Prestige	• approval from friends and family, • social esteem of the given job

Source: Original work.

The factor named *regulations* concerns obedience of the policies and formal standards enforced by the organisation. It also applies to working discipline, mainly arrivals to work, departures from work, and absence from work, which are the main determinants in the context of continuing employment. Having the natural need for approval, employees also hold *prestige* in high regard. This criterion covers the social esteem towards the job and the opinions of family and friends concerning the job.

3.2. Research methods

The surveying methods were selected with consideration of the research problem and with the aim to answer the specific research questions. A quantitative study involving a diagnostic survey in the form of an original questionnaire was carried out. The questionnaire presented closed-ended questions. The respondents graded the individual criteria on a scale of 1 to 10 with 1 being the lowest and 10 being the highest. The survey was conducted in the spring of 2025 and was based on the CAWI method. It was an open survey and the link was provided to college students, local government representatives, and employees of the education, administration, and health care sectors. 746 responses were recorded, 460 of which were verified positively as satisfying the requirements established in the questionnaire.

The survey involved various statistical methods and techniques, including certain structural measures, Spearman and Pearson rank correlations, selected nonparametric tests, the ANOVA analysis, and a regression analysis as the main tool to establish the correlations between sociodemographic characteristics and the criteria of survival. The relational studies involved a multivariate regression analysis, which means that the results do not focus strictly on impact or determination. In this method, the significant dependence between the predictors and the dependent variable may concern only the co-occurrence of the variables and not the actual impact of one variable on the other.

The survey of relations between sociodemographic characteristics and survival involved analysis of such demographic characteristics as sex, age, education, tenure, and place of residence. In the scope of sex, a classic demographic depiction of said research characteristic was assumed.

Table 2.
Sociodemographic characteristics

CHARACTERISTIC	CHARACTERISTIC VALUES
Sex	• female, • male
Age	• < 20, • 21-30, • 31-40, • 41-50, • > 50
Education	• Elementary. • Middle school. • Basic vocational. • Secondary vocational. • Secondary. • Post-secondary. • Higher
Tenure	• < 1 year, • 1-5 years, • 6-10 years, • > 10 years
Residence	• urban, • rural

Source: Original work.

The surveyed sample was made up of 68% women and 32% men. The majority, 80%, were aged 21-30, followed by 31-40 (11%), 41-50 (8%), and over 50 (1%). 95% of the respondents have a college education, 2.5% have a secondary education, 1.5% a secondary vocational education, and 1% post-secondary education. 80% resided in urban areas and 20% in rural areas. More than half (53%) had a tenure between 1 and 5 years, and almost the same amount (21% and 20%) had the tenure of respectively 6-10 years and over 10 years. 7% of the respondents had been working for less than one year.

4. Results

4.1. Survival criteria significance system

The first research problem involved establishment of the order and levels of the criteria for retaining the given job according to employees. These results are presented in Figure 2.

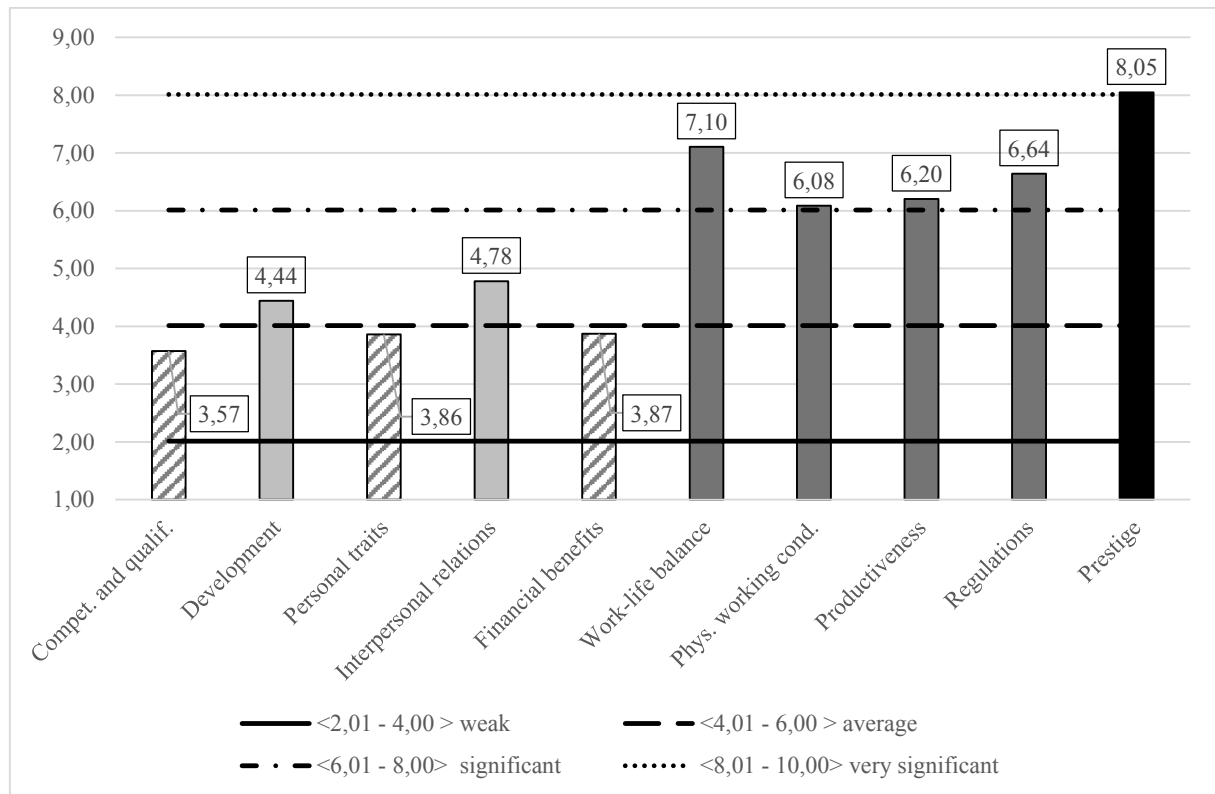


Figure 2. Average values of significance of the criteria of keeping the job in the opinion of employees.
Source: research results.

The most important criterion in the context of deciding to continue employment is the prestige associated with the given job. Next in order the respondents indicated maintenance of balance between personal and professional life. Regulations, i.e. obedience of the standards and discipline enforced at work, were third. This was followed by employee productiveness and physical working conditions. Interpersonal relations came in sixth and were followed by personal development. Financial benefits were seventh, personal traits – the individual employee characteristics and predispositions – were second-to-last, and the least significant determinant chosen by the respondents was competences and qualifications.

The survey results were used to establish four average significance value ranges, which are very significant, significant, average, and weak. Only prestige was deemed as a very significant criterion. Significant criteria include work-life balance, regulations, productiveness, and physical working conditions. Respondents feel that interpersonal relations and personal development have average significance and deemed the significance of financial benefits, personal traits, and competences and qualifications as weak. Interpersonal relations and personal development were deemed average. The factors falling under the low impact range are ranked the lowest. They include financial benefits, personal traits, and competences and qualifications.

The results presented above served to establish the order of significance of the individual criteria in the context of their impact on keeping the given job according to employees and to establish the ranges of significance for said criteria. This part of the research made it possible

to establish the hierarchy and force of impact of the factors determining whether to remain employed at the given job.

4.2. Relations between sociodemographic characteristics and criteria of survival

The analysis of sociodemographic characteristic regression demonstrated that only two characteristics – sex and education – have comprehensive impact on the selection of criteria. This impact is limited to five of them. Significant criteria include regulations, productiveness, and physical working conditions, development is average, while financial benefits are weak. Education seems significant only for physical working conditions, while sex is significant for the four other ones: development, financial benefits, productiveness, and regulations.

Table 3 does not highlight the collective impact of education in relation with professional development as significant as the value of this parameter – 0.054 – exceeded the value of $p < 0.05$ and was therefore not statistically significant. Each of the five criteria established in relation with characteristics is assigned just one sociodemographic characteristic, which means that the relation is highly oriented. Prestige, which was graded by the respondents the highest, has no relations with any of the characteristics. Sex was closest to being significant, but it failed to reach the bar to qualify as statistically significant ($0.07 > 0.05$).

Cross-sectional studies demonstrate that the impact of sex has a specific regularity. The first five criteria deemed weak and average are dominated by the opinions of males. In turn, the relatively high level of the other characteristics is established mainly by the opinions of women. In this context, it is possible to say that the results concerning the more prospective matters of the essence of work (productiveness, regulations, physical working conditions), the balance between personal and professional life, and prestige are determined mainly by women.

Meanwhile, the classic employee matters (outside of productiveness) ranked lower in the surveys continue to be dominated by men. The second characteristic – age – is statistically significant only in one age group. Only employees aged 31-40 demonstrate a statistically significant correlation with financial benefits. The third characteristic – education – clearly demonstrates the sectional significance of the qualifying groups as the specific types of education are significant together with various criteria. Secondary vocational education demonstrates significance together with two criteria: competences and qualifications as well as physical working conditions. There are significant correlations between post-secondary education and two of the criteria, which are personal traits and interpersonal relations. General secondary education does not demonstrate any significant relations with any criteria. The result concerning development and regulations is impacted by the group of employees with a higher education. The structural surveys of individual characteristics demonstrate that tenure and residence are insignificant in the clarification of the significance ranking.

Table 3.

Results of the regression analysis for significance of sociodemographic characteristics in establishment of the opinion on employment survival criteria

Cechy	Kryteria przetrwania na stanowisku																								
	Kompetencje i kwalifikacje					Rozwój zawodowy					Cechy osobnicze					Relacje interpersonalne					Korzyści finansowe				
Efekt	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p
Wyraz wolny	72,43	1	72,43	9,48	0,00	342,50	1	342,50	57,12	0,00	248,90	1	248,90	40,37	0,00	178,93	1	178,93	39,08	0,00	73,32	1	73,32	11,62	0,00
pleć	0,07	1	0,07	0,01	0,92	23,61	1	23,61	3,94	0,05	15,26	1	15,26	2,47	0,12	3,50	1	3,50	0,76	0,38	40,67	1	40,67	6,44	0,01
wiek	16,59	4	4,15	0,54	0,70	4,85	4	1,21	0,20	0,94	27,34	4	6,84	1,11	0,35	11,90	4	2,97	0,65	0,63	19,33	4	4,83	0,77	0,55
wykształcenie	54,44	4	13,61	1,78	0,13	56,23	4	14,06	2,34	0,05	48,14	4	12,03	1,95	0,10	28,39	4	7,10	1,55	0,19	17,23	4	4,31	0,68	0,60
staż	5,88	3	1,96	0,26	0,86	32,03	3	10,68	1,78	0,15	2,03	3	0,68	0,11	0,95	7,73	3	2,58	0,56	0,64	0,37	3	0,12	0,02	1,00
miejsce zamieszkania	1,75	1	1,75	0,23	0,63	0,01	1	0,01	0,00	0,98	0,47	1	0,47	0,08	0,78	12,37	1	12,37	2,70	0,10	5,99	1	5,99	0,95	0,33
Błąd	3406,42	446	7,64			2674,25	446	6,00			2750,03	446	6,17			2041,82	446	4,58			2814,87	446	6,31		

Cechy	Kryteria przetrwania na stanowisku																								
	Work-Life Balance					Warunki fizyczne pracy					Wydajność					Regulacje					Prestiż				
Efekt	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p	SS	Stopnie	MS	F	p
Wyraz wolny	571,64	1	571,64	87,50	0,00	449,44	1	449,44	101,64	0,00	329,53	1	329,53	64,02	1,08	278,28	1	278,28	56,73	2,8	586,75	1	586,75	70,32	6,66
pleć	19,65	1	19,65	3,01	0,08	4,55	1	4,55	1,03	0,31	22,70	1	22,70	4,41	0,04	19,16	1	19,16	3,91	0,05	28,10	1	28,10	3,37	0,07
wiek	16,48	4	4,12	0,63	0,64	32,35	4	8,09	1,83	0,12	14,82	4	3,70	0,72	0,58	18,99	4	4,75	0,97	0,42	27,88	4	6,97	0,84	0,50
wykształcenie	20,62	4	5,16	0,79	0,53	49,05	4	12,26	2,77	0,03	33,74	4	8,44	1,64	0,16	37,40	4	9,35	1,91	0,11	24,91	4	6,23	0,75	0,56
staż	2,47	3	0,82	0,13	0,94	11,98	3	3,99	0,90	0,44	20,11	3	6,70	1,30	0,27	6,29	3	2,10	0,43	0,73	40,24	3	13,41	1,61	0,19
miejsce zamieszkania	6,32	1	6,32	0,97	0,33	0,36	1	0,36	0,08	0,78	0,11	1	0,11	0,02	0,89	9,87	1	9,87	2,01	0,16	2,37	1	2,37	0,28	0,59
Błąd	2913,66	446	6,53			1972,05	446	4,42			2295,62	446	5,15			2187,61	446	4,90			3721,46	446	8,34		

Attention: shaded fields ■ designate statistically significant dependencies. Statistically significant items $p < 0.05$.

Source: research results.

The survey of relations between sociodemographic characteristics and the criteria of survival demonstrated a general significant impact on said criteria for two characteristics only, i.e. sex and education. Extensive analysis demonstrated the dominance of women in establishment of the most significant criteria. The level of employee education determined the relation of this characteristic with individual criteria.

5. Discussion

The criteria presented in this study have thus far not been subject to research in the context of impact on retaining employment, including retaining employment at the given job. According to the results, employees believe that the factor with the greatest (very significant) impact is just the prestige associated with having the given job. Previously, prestige had been researched in the context of social transformations (Domański, Sawiński, Słomczyński, 2010) and categorisation of vocations, where the vocation was established as the most credible differentiator of prestige (Wyrzykowska, Zawadzka, 2018; Pokropek, 2008). It also appeared in research as an element of employee motivation (Paszkievicz, Wasiluk, 2022) and the results indicated that it is not a significant determinant, which makes the high ranking of said parameter rather surprising. The leading factor with significant impact is work-life balance. The studies of the impact of work-life balance on employee satisfaction (Kuancintami, Heryjanto, 2023) and of professional burnout (Susanto et al., 2022; Gembalska-Kwiecień, Żurkowski, 2016; Kaczmarek, 2019) seem to confirm the significance of said parameter in the context of employee wellness. Being able to keep a balance between professional and personal life makes it easier to decide whether to stay or quit the given job. Indirectly, this impacts the comfort, attitude, and behaviour of the employee. For regulations, the criterion with the second most significant impact on employment retention, the high ranking is justified by factors including effective provisions of the law and occupational health and safety standards, which normatively regulate employment. In this instance, it is mostly about the decisions made by the employer. Work discipline also involves disciplinary measures, which the research shows to have a negative impact on employee motivation and satisfaction (Pokrzywa, 2024). The sense of injustice caused by disciplinary measures may incline the employee to quit the job, which confirms the significance of said criterion. The next significant factor is productiveness. As basic employee evaluation parameters, workload and efficiency are not just elements of adapting to the job (Chirkowska-Smolak, 2016), but also a measurable determinant of employment decisions. Physical working conditions are the final very significant factor. Previously perceived as neutral, they were considered an acceptable condition of the working environment, modified irregularly and only due to the good will of the employer (Rymaniak,

Lis, 2016). Establishment of this parameter by the respondents as significant is opposite to the previously presented trends.

There is a considerable difference in the average values between the first five and last five criteria. In light of the research, the five highest-graded criteria are the basic ones. The remaining ones can be defined as supplementary and rather insignificant to the employee in the context of continuing employment at the given job. The average impact group includes interpersonal relations and development. The low ranking of the latter is rather surprising because literature indicates it as one of the main organisational behaviour factors (Robbins, Judge, 2012). It is noted that it is very significant in the context of nomadic workers having problems maintaining relations (Robak, 2022). It is also believed to be a significant determinant of emotional attachment to the organisation (Spychała, Bartecki, Brzóska, 2019). Meanwhile, despite the efforts of HR departments carrying out their human capital strategies in support of employees, development seems to have no significant impact to the respondents. The following parameters were graded as rather insignificant: financial benefits, personal traits, and competences and qualifications. The low grade of the latter may indicate that employees do not believe that competences and qualifications can effectively raise their value in the eyes of the employer. The same may apply to personal traits. Financial benefits surprisingly came in eighth, although literature demonstrates rather diverse results in the scope of this parameter. Some studies establish it as the main factor of employee satisfaction (Htun, 2022; Robak, 2013) and employee efficiency (Ciekanowski, 2010), while others claim it has little impact in this scope (Robbins, Judge, 2012). The low impact of remuneration on employee satisfaction may confirm the low significance of financial benefits in the context of retaining employment at the given job.

The analysis of relations between sociodemographic characteristics and survival criteria helped produce interesting conclusions. The statistically significant dependency of the group aged 31-40 on financial benefits confirms the sensitivity of younger employees to basic employment issues that make it possible to secure the means of existence for themselves and their families. This survey studied age from the perspective of demographics, i.e. age groups. Its impact turned out to be very limited. Researchers are Researchers advocate for introduction of multidimensional studies to conceptualise measures ranging from generational cohort to physical appearance in order to capture a social representation of age (Johfre, Saperstein, 2023). The survey confirms the statistical significance of the impact of education. This is particularly important due to the current problems on the labour market in the scope of hiring people to perform simple work. Meanwhile, the significance of secondary vocational education together with physical working conditions evidences that operational staff (mainly production workers) sees the physical aspects of the workplace as equally significant to financial gratifications (Rymaniak, Lis, 2016). The specific result demonstrates significant correlations between post-secondary education and two criteria: personal characteristics and interpersonal relations. Post-secondary education in Poland usually involves learning practical and professional skills.

Therefore, this survey seems to statistically confirm the fact that gaining professional knowledge may be accompanied by development of personal characteristics and social skills. Previous results have confirmed the common drive to obtain a college degree to gain professional (Piotrowska-Marczak, 2013) and social (Kokocińska, 2016) prestige, thus the established significance of higher education together with professional development characteristics is not a surprising result.

The studies of the impact of sociodemographic factors demonstrate a completely different system of correlations than macrosocial research, where the significant factors included age, place of residence, and education (Szubert, 2015). The criteria of age or residence are completely irrelevant in research of employment survival. This creates completely different research and practical perspectives in the scope of management decisions concerning employee survival at the given job and in the organisation.

6. Conclusions

The research aimed to create the category of employment survival attempted to identify the criteria for employees to retain employment at their current jobs. It surveyed the order and significance of the individual criteria according to the opinions of employees. It also analysed the relations between said criteria and the sociodemographic characteristics of the respondents.

The results demonstrate significantly diverse criteria, which are divided into two groups. The first includes the five criteria deemed by the respondents as significant. The criterion deemed most significant is prestige, which is followed by productiveness, regulations, physical working conditions, and work-life balance. The second group includes criteria graded much less significant (13% of the scale value and up). These are interpersonal relations, professional development, competences and qualifications, personal traits, and financial benefits. This creates a structure of significance, where the criteria previously perceived as significant elements in human resources management (e.g. competences and qualifications, professional development, or personal traits) are rather insignificant. Simultaneously, this structure demonstrates the considerable growth of prestige as a form of social evaluation of the occupied job. The high ranking of work-life balance confirms that this balance is important to the new generation of employees as well.

Women played an important role in the development of the presented structure of significance. According to the regression analysis, they had a dominating impact on the development of the five key criteria of survival. Meanwhile, men demonstrated dominance in the scope of less significant criteria. Sex appears in relation with four of the ten criteria, which are professional development, financial benefits, productiveness, and regulations. Generally speaking, education is significant only together with physical working conditions.

However, it should be noted that its individual levels already correlate with six different criteria. This does not include general secondary education, which does not demonstrate significant dependencies. Age is similar, as it does not have general impact on any of the criteria, but employees aged 31-40 demonstrate a significant impact on the criterion of financial benefits. Tenure and residence do not demonstrate any statistical significance with the criteria to keep employment at the given job.

The presented results establish new theoretical foundations for the category of survival and may serve as a database of practical information for management in the scope of maintaining employment. As this was a one-off survey, ongoing monitoring of the situation would require longitudinal studies. 80% of the respondents in the research sample are aged 21-30, the so-called generation Z, which means it would be beneficial to expand the research over a more representative segment of the other age groups.

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References

1. Abuzaid, A.N. (2024). Examining the mediating role of job involvement in the relationship between job crafting and talent retention. *Global Business & Finance Review*, 29(1), 18-30.
2. Bakalarz, T. (2019). Zatrudnienie za pośrednictwem platformy internetowej jako przejaw „uberyzacji” pracy. *Przegląd Prawa i Administracji*, 117, 9-20.
3. Bhakuni, S., Saxena, S. (2023). Exploring the link between training and development: employee engagement and employee retention. *Journal of Business and Management Studies*, 5(1), Article 17.
4. Biason, R.S. (2020). The effect of job satisfaction on employee retention. *International Journal of Economics, Commerce and Management*, 8(3), 405-413.

5. Biriowu, C. (2020). Employee engagement and organizational survival. *World Journal of Innovative Research*, 79-92. https://www.researchgate.net/publication/347954443_Employee_Engagement_and_Organizational_Survival
6. Chama, M., Matafwali, M. (2024). Exploring the influence of motivation on employee performance and retention: A case of one chain store in Zambia. *American Research Journal of Humanities & Social Science*, 7(1), 93-107.
7. Chirkowska-Smolak, T. (2012). Zaangażowanie w pracę w kontekście dopasowania człowieka do pracy. *Czasopismo Psychologiczne*, 18(2), 185-194.
8. Ciekanski, Z. (2010). Motywacja a kształtowanie płac. *Bezpieczeństwo i Technika Pożarnicza*, 3, 25-34.
9. Crampton, S., Douglas, C., Hodge, J., Mishra, J. (2003). Job sharing: Challenges and opportunities. *Seidman Business Review*, 9(1), 11-13.
10. Cynk, R. (2016). Metody utrzymywania kluczowych pracowników w organizacji. *Journal of Modern Management Process*, 1(1), 71-79.
11. Czerw, A., Czarnota-Bojarska, J. (2016). Dopasowanie człowiek–środowisko i postawa wobec pracy jako motywatory zachowań organizacyjnych. *Psychologia Społeczna*, 11(1[36]), 8-19.
12. Dasgupta, S. (2020). Identifying the key employability skills: Evidence from literature review. *IOSR Journal of Humanities and Social Science*, 25(6), 85-90.
13. Davidavičienė, V., Rymaniak, J., Lis, K. (2023). Remote workplaces as a determinant of working conditions in education during COVID-19. *Economics and Sociology*, 16(1), 123-138. <https://doi.org/10.14254/2071-789X.2023/16-2/8>
14. De Winne, S., Marescaux, E., Sels, L., Van Beurden, P., Vanormelingen, S. (2018). The impact of employee turnover and turnover volatility on labor productivity: A flexible non-linear approach. *The International Journal of Human Resource Management*, 29(22), 3108-3131.
15. Dhanya, R. (2024). Employee engagement: A smart way to employee retention with reference to corporate sector, Chennai City Corporation. *International Journal of Business Management & Research*, 14(1), 23-30.
16. Dobrzyńska, M. (2020). Praca platformowa. Wyzwania dla bezpieczeństwa i higieny pracy w Polsce. *Praca i Zabezpieczenie Społeczne*, 6, 16-22.
17. Domański, H., Sawiński, Z., Słomczyński, K.M. (2010). Prestiż zawodów w obliczu zmian społecznych: 1958-2008. *Studia Socjologiczne*, 4(199), 79-119.
18. Fugate, M., Kinicki, A., Ashforth, B. (2004). Employability: A psycho-social construct, its dimensions, and applications. *Journal of Vocational Behaviour*, 65, 14-38.
19. Gajda, J. (2013). Pozyskiwanie i dobór odpowiednich pracowników do organizacji. *Trendy ve vzdělávání*, 6(1), 422-426.

20. Gembalska-Kwiecień, A., Żurkowski, Z. (2016). Przyczyny i skutki wypalenia zawodowego. *Zeszyty Naukowe Politechniki Śląskiej. Seria: Organizacja i Zarządzanie*, 92, 73-83.
21. Grześ, A. (2017). *Outsourcing w kształtowaniu zatrudnienia oraz kosztów i produktywności pracy w przedsiębiorstwach*. Białystok: Wydawnictwo Uniwersytetu w Białymstoku.
22. Hauk, M. (2019). Cechy pracy a zadowolenie z pracy. *Acta Universitatis Lodziensis. Folia Psychologica*, 22, 17-32.
23. Herzog, L., Zimmermann, B. (Eds.) (2022). *Shifting categories of work: Unsettling the ways we think about jobs, labor, and activities* (1st ed.). Routledge. <https://doi.org/10.4324/9781003341321>
24. Htun, W.T. (2022). Employees' job satisfaction and retention at workplace. *Journal of Positive School Psychology*, 6(3), 4342-4346.
25. Iheriohanma, E.B.J., Austin-Egole, I.S. (2020). Outsourcing and employment trends: An exploratory discourse. *Issues in Business Management and Economics*, 8(3), 48-56.
26. Janadari, N., Preena, G.R. (2020). The gig economy and workforce. In: *Contemporary Developments in Human Resource Management* (pp. 1-14). Department of Human Resource Management, University of Kelaniya.
27. Jatav, S., Kuriakose, V., Dixit, A. (2023). Job crafting and intention to stay in an organization: The mediating role of job satisfaction. In: *Effective Human Resources Management in the Multigenerational Workplace* (pp. 142-152). IGI Global.
28. Johfre, S., Saperstein, A. (2023). The social construction of age: Concepts and measurement. *The Annual Review of Sociology*, 49, 339-358.
29. Kaczmarek, A. (2019). Wypalenie zawodowe – następstwo stresu zawodowego. *Nowoczesne Systemy Zarządzania*, 14(1), 65-77.
30. Kielczewska, A., Rozbicka, I. (2023). Rotacja pracowników w Polsce. *Polski Instytut Ekonomiczny, Working Paper*, 6.
31. Kokocińska, A. (2016). Społeczna wartość wyższego wykształcenia. *Seria Socjologia*, 78, Uniwersytet im. Adama Mickiewicza w Poznaniu.
32. Król, M. (2022). *Praca zdalna – cechy, uwarunkowania, implikacje dla procesu pracy*. Katowice: Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.
33. Kruhlaya, M., Molenda, M. (2020). Migracje zarobkowe jako sposób na pozyskanie pracowników w latach 2009-2020. *Przegląd Prawno-Ekonomiczny*, 2, 55-70.
34. Kuancintami, A., Heryjanto, A. (2023). Increase employee retention: Impact work-life balance, meaningful work, and job satisfaction towards turnover intention. *Jurnal Indonesia Sosial Sains*, 4(11), 1099-1111.
35. Kulikowski, K. (2015). Relacje interpersonalne z współpracownikami a zaangażowanie w pracę – analiza w ramach teorii wymagań i zasobów pracy. *Fides et Ratio*, 24, 128-137.

36. Lake, C.J., Highhouse, S., Shrift, A.G. (2018). Validation of the job-hopping motives scale. *Journal of Career Assessment*, 26(3).
37. Lipińska-Grobelny, A., Głowacka, K. (2009). Zadowolenie z pracy a stopień dopasowania do zawodu. *Przegląd Psychologiczny*, 52(2), 181-194.
38. Mączyńska, E. (2020). Praca zdalna – dobrodziejstwo warunkowe. In: *Praca zdalna – rewolucja, która się przyjęła, teraz czas na zmiany* (Raport Future Business Institute). Polskie Towarzystwo Ekonomiczne.
39. Mamkhumbi, G. (2023). The influence of motivation strategies on employee's retention in private universities in Tanzania: Experiences from Catholic University College of Mbeya. *International Journal of Business Management and Economic Review*, 6(6), 147-159.
40. Marica, M.E. (2020). Employee sharing – a new type of employment, opportune in a globalized context. *Annals of the Constantin Brâncuși University of Târgu Jiu, Economy Series*, 1, 77-81.
41. Marzec, I. (2010). Zatrudnialność jako czynnik bezpieczeństwa zatrudnienia i sukcesu na współczesnym rynku pracy. *Zeszyty Naukowe Wyższej Szkoły Zarządzania Ochroną Pracy w Katowicach*, 1(6), 127-138.
42. Mazur, M. (2013). Motywowanie pracowników jako istotny element zarządzania organizacją. *Nauki Społeczne*, 2(8), 75-85.
43. McQuaid, R., Lindsay, C. (2005). The concept of employability. *Urban Studies*, 42(2), 197-219.
44. Mirowski, M. (2011). Organizacja wirtualna jako odpowiedź na realia gospodarcze XXI wieku. *Studenckie Prace Prawnicze, Administratywistyczne i Ekonomiczne*, 10, 57-68. <https://wuwr.pl/sppae/article/view/8796>
45. Niebler, V., Altenried, M., Macannuco, J. (2020). Platform labour: Contingent histories and new technologies. *Soft Power: Revista Euro-Americana de Teoria e Historia de la Política*, 7(1), 255-265.
46. Ostoj, I. (2024). Praca platformowa z wykorzystaniem aplikacji mobilnych jako przejaw fragmentacji pracy. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 68(1), 88-95.
47. Parker, S.K., Grote, G. (2022). Automation, algorithms, and beyond: Why work design matters more than ever in a digital world. *Applied Psychology*, 71(4), 1171-1204. <https://doi.org/10.1111/apps.12241>
48. Paszkiewicz, A.J., Wasiluk, A. (2022). Motywacja do pracy osób z pokolenia Z. *Akademia Zarządzania*, 6(3), 240-260.
49. Pelczewski, M. (2023). *Odejścia pracowników z firmy. Przyczyny, skutki i sposoby przeciwdziałania* [Rozprawa doktorska]. Repozytorium Uniwersytetu Łódzkiego. Uniwersytet Łódzki.
50. Piasna, A., Drahokoupil, J. (2020). Praca platformowa w Polsce: wyniki badania pracy internetowej i platformowej przeprowadzonego przez ETUI. *Europejski Instytut Związków*

- Zawodowych*. <https://www.etui.org/sites/default/files/2020-08/Summary%20PL%20Digital%20labour%20platform%20WP%202019.12.pdf>
51. Piotrowska-Marczak, K. (2013). Kontrowersje wokół systemu szkolnictwa wyższego w Polsce. *Studia Ekonomiczne*, 131. Uniwersytet Ekonomiczny w Katowicach, 63-71.
 52. Pokropek, A. (2008). Wzory prestiżu zawodów. *Studia Socjologiczne*, 2(189), 29-64.
 53. Presbitero, A., Fujimoto, Y., Lim, W.M. (2025). Employee engagement and retention in multicultural work groups: The interplay of employee and supervisory cultural intelligence. *Journal of Business Research*, 186.
 54. Robak, E. (2013). Work-life balance factors in the small and medium-sized enterprises. *Management*, 17(1), 139-152.
 55. Robak, E. (2022). Znaczenie relacji pracowniczych w kształtowaniu atmosfery pracy. In: A. Bazan-Bulanda, A. Kwiatek, M. Skiba (Eds.), *Spoleczne, psychologiczne i prawne uwarunkowanie zarządzania współczesną organizacją* (pp. 55-66). Wydawnictwo Politechniki Częstochowskiej.
 56. Robbins, S.P., Judge, T.A. (2012). *Organizational behavior* (15th ed.). Pearson Education.
 57. Rolfe, H., Rienzo, C., Lalani, M., Portes, J. (2013). Migration and productivity: Employers' practices, public attitudes and statistical evidence. *National Institute of Economic and Social Research*.
 58. Rosenberg, S., Heimler, R., Morote, E. (2012). Basic employability skills: A triangular design approach. *Education and Training*, 54(1), 7-20.
 59. Rubenstein, A.L., Eberly, M.B., Lee, T.W., Mitchell, T.R. (2018). Surveying the forest: A meta-analysis, moderator investigation, and future-oriented discussion of the antecedents of voluntary employee turnover. *Personnel Psychology*, 71(1).
 60. Rymaniak, J. (2015). Współczesne cechy pracy: koncepcja teoretyczna i weryfikacja empiryczna. In: M. Makowiec (Ed.), *Wybrane problemy w kształtowaniu zachowań organizacyjnych* (pp. 15-22). Uniwersytet Ekonomiczny w Krakowie.
 61. Rymaniak, J., Lis, K. (2016). Fizyczne cechy pracy w perspektywie pracowników i pracodawców. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 31(3), 117-129.
 62. Saidi, L. (2024). Assessing the effect of motivation on employee retention in Zambian Microfinance Institutions: A case of EFC Zambia Financial Services. *International Journal of Finance*, 9(3).
 63. Sarfraz, I., Rajendran, D., Hewege, C., Mohan, M.D. (2018). An exploration of global employability skills: A systematic research review. *International Journal of Work Organisation and Emotion*, 9(1), 63-88.
 64. Seppälä, E., McNichols, N.K. (2022). The power of healthy relationships at work. *Harvard Business Review*, June 21. <https://hbr.org/2022/06/the-power-of-healthy-relationships-at-work>

65. Shah, M., Asad, M. (2018). Effect of motivation on employee retention: Mediating role of perceived organizational support. *European Online Journal of Natural and Social Sciences*, 7(2), 511-520.
66. Sidor-Rządkowska, M. (2022). Praca zdalna i hybrydowa a budowanie wizerunku pracodawcy w czasach postpandemicznych. *Marketing i Rynek*, 29(12), 28-37.
67. Siswanto, A. (2024). Employee engagement and retention: Analyzing the role of leadership styles and organizational culture. *Global International Journal of Innovative Research*, 2(6).
68. Skowron-Mielnik, B., Borb, M. (2015). Generacyjne uwarunkowania retencji pracowników w kontekście elastyczności organizacji. *Management Forum*, 3(3), 44-55.
69. Sobocka-Szczapa, H. (2014). Dobór pracowników – decyzja strategiczna firmy. *Zeszyty Naukowe Politechniki Śląskiej. Seria: Organizacja i Zarządzanie*, 68, 103-115.
70. Spychała, M., Bartecki, T., Brzóska, M. (2019). Employer branding – nowoczesne rozwiązanie problemu rotacji pracowników. *Zeszyty Naukowe Politechniki Poznańskiej. Organizacja i Zarządzanie*, 79, 163-179.
71. Steil, A.V., Bello, J. da S.A., de Cuffa, D., de Freitas, A.F. (2022). Job satisfaction and employee retention by public and private IT organizations. *Revista de Administração da UFSM*, 15(2), 354-369.
72. Stoian, C.-A., Caraiani, C., Anica-Popa, I.F., Dascălu, C., Lungu, C.I. (2022). Telework systematic model design for the future of work. *Sustainability*, 14, 7146.
73. Susanto, P., Hoque, M.E., Jannat, T., Emely, B., Zona, M.A., Islam, M.A. (2022). Work-life balance, job satisfaction, and job performance of SMEs employees: The moderating role of family-supportive supervisor behaviors. *Frontiers in Psychology*, 13, Article 906876.
74. Szubert, T. (2015). Demograficzno-społeczne determinanty określające subiektywny status jednostki w polskim społeczeństwie. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 207, 276-285.
75. Taylor, L. (2016). What is employability and what does it mean for you? In: L. Taylor (Ed.), *How to develop your healthcare career: A guide to employability and professional development* (pp. 1-20). John Wiley & Sons, Ltd.
76. Terelak, J.F., Jankowska, P. (2009). Dopasowanie jednostka – organizacja a zadowolenie z pracy. *Studia i Materiały. Miscellanea Oeconomicae*, 13(1), 229-254.
77. Van Dam, K., Nikolova, I., Van Ruysseveldt, J. (2013). The importance of “leader-member exchange” (LMX) and situational goal orientation as predictors of job crafting. *Gedrag & Organisatie*, 26.
78. Weil, D. (2014). *The fissured workplace: Why work became so bad for so many and what can be done to improve it*. Harvard University Press.
79. Wiśniewska, S. (2015). Zatrudnialność – pojęcie, wymiary, determinanty. *Edukacja Ekonomistów i Menedżerów*, 35(1), 11-24. <https://doi.org/10.5604/01.3001.0009.4583>

80. Wojtczuk-Turek, A. (2018). Rola liderów w dopasowaniu pracowników do organizacji, pracy i zespołu. *Edukacja Ekonomistów i Menedżerów*, 1(47), 25-41.
81. Wudarzewski, G. (2013). Satysfakcja z pracy – konceptualizacja pojęcia w świetle badań literaturowych. *Zeszyty Naukowe Wyższej Szkoły Bankowej we Wrocławiu*, 5(37), 323-344.
82. Wyrzykowska, K.M., Zawadzka, K. (2018). Wybrańcy czy ofiary losu? Kilka uwag o prestiżu zawodowym osób wykonujących profesje muzyczne w Polsce. *Pogranicze. Studia Społeczne*, 34, 149-169.
83. Zuma, S.K. (2020). The effects of job crafting on employee retention: The mediating role of proactive personality. *International Journal of Business and Management Review*, 8(6), 24-42.

FIELD STUDIES ON THE EFFICIENCY OF FIRE EVACUATION PROCEDURES IN BUILDINGS

Paweł WOLNY^{1*}, Mykola NALYSKO²

¹ Lodz University of Technology; pawel.wolny@p.lodz.pl, ORCID: 0000-0003-2161-4506

² Department of Labor Protection, Civil and Technogenic Safety, Ukrainian State University of Science and Technologies, ESI «Prydniprovsk State Academy of Civil Engineering and Architecture», Dnipro, Ukraine; nalisko.nikolay@pdaba.edu.ua, ORCID: 0000-0003-4039-1571

* Correspondence author

Purpose: The purpose of the study is to identify the human movement characteristics during fire evacuation in complex and unfamiliar topological conditions of evacuation routes.

Design/methodology/approach: The study uses the methods of observation, recording, and measurement of the evacuation process of people from a building. A survey method was used to identify the main motivational factors to make a decision under conditions of limited time and insufficient information. Analytical calculations were conducted to determine the normative evacuation parameters and predict conditions along evacuation routes in case of smoke resulting from fire.

Findings: The patterns in decision-making during evacuation from buildings in unfamiliar topological conditions, influenced by psychological factors, were found. They include the impact of light along the evacuation route, possible misinterpretation of information signs that resemble fire evacuation signs, and a high probability of indistinguishable evacuation signs when the background color matches the color of the sign's informational elements under certain lighting conditions.

Research limitations/implications: During field studies, it was not possible to fully simulate stressful conditions of evacuation due to some ethical considerations.

Practical implications: The findings of the research provide legislators and fire safety policy makers with evidence-based approaches, which they can use to improve the normative requirements for evacuation routes in fire emergencies in buildings of various types.

Social implications: Psychological patterns of people's behavior during evacuation will help reduce the risk of injury in fires due to the improved requirements for evacuation routes.

Originality/value: The research has revealed new psychological traits of human behavior in complex topological conditions along evacuation routes in buildings on fire. They arise due to the factors that were not previously considered in the design of evacuation routes, including unfamiliar (or less familiar) environments, varying light levels in different sections of evacuation paths, and information signs resembling standard fire safety ones.

Keywords: evacuation, building, fire, evacuation signs, limited information.

Category of the paper: Viewpoint.

1. Introduction

The evacuation of occupants from buildings during fire emergencies is a key priority of fire safety measures in the context of emergency response. In Ukraine, according to general regulatory requirements for evacuation, as outlined in the State Building Codes (DBN V.1.1-7:2016), it is necessary to ensure timely, unobstructed, and safe conditions for evacuation, which is considered to be evacuation efficiency.

In Ukraine, due to ongoing military actions, fires occur almost daily, particularly in cities near the frontline. Thus, the issue of ensuring safe and efficient evacuation from buildings is highly relevant.

The issue of efficient evacuation of people from buildings has been the subject of extensive scientific research both in Ukraine and in countries of the European Union and the Americas (see e.g., Goatin et al., 2009; Pan et al., 2020; Gerges al., 2021; Ahn et al., 2022; Fu et al., 2024; Tsvirkun et al., 2015; Maiboroda et al., 2023; Kovalishyn et al., 2022; Dotsenko, 2023). These studies examine the influence of various factors on the evacuation process, such as the presence of different mobility groups in evacuation flows, the impact of building height, and obstacles on evacuation parameters, etc.

This work is the result of joint research carried out by the scholars from Lodz University of Technology and REI 'Prydniprovsk State Academy of Civil Engineering and Architecture' of the Ukrainian State University of Science and Technologies. The study of the evacuation process was conducted according to the requirements of Ukrainian fire safety standards and regulations (State Standard of Ukraine DSTU ISO 23601:2019; State Standard of Ukraine DSTU 8828:2019; State Standard of Ukraine DSTU EN ISO 7010:2019).

2. Methods

Global practice shows that even when evacuation routes are properly arranged in buildings (especially intended for public use), people may get trapped or injured on these routes. This can occur due to violations of evacuation route design standards as well as psychological factors, such as human behavior patterns and misunderstanding of evacuation signs under stress.

To study the specific features of this process in detail, we conducted time-motion measurements to determine the actual evacuation time of people in case of fire from a five-storey academic building in various topological conditions of evacuation routes. The building has a complex layout due to multiple sections and wings, with corridor length up to 80 meters (Figure 1).

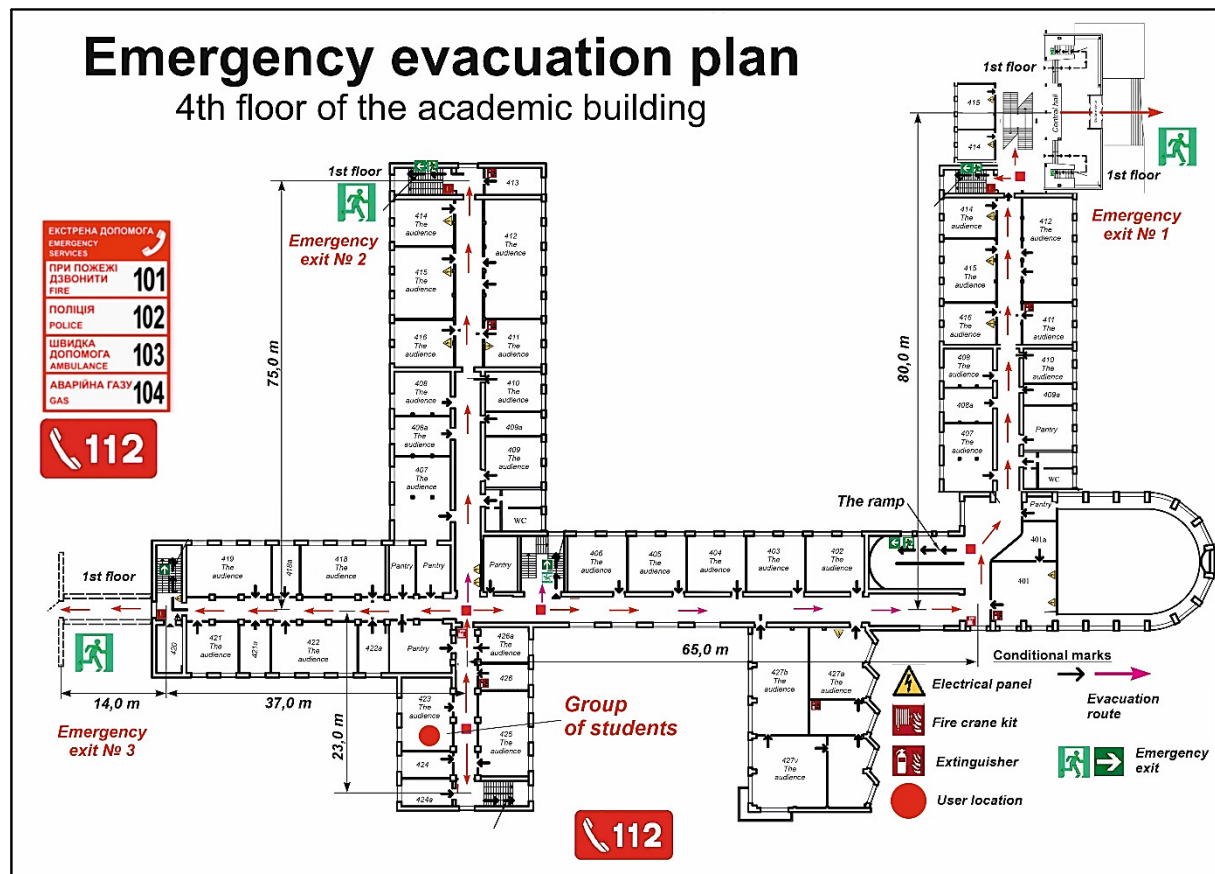


Figure 1. General layout of the experimental section of the evacuation route.

Source: Own research.

The study examined both psychological aspects of human behavior during evacuation and the ability of people to navigate unfamiliar buildings using evacuation signs, as well as technical factors related to the placement and visual perception of these signs.

Five groups of people participated in the study. The test groups consisted of young individuals (students) aged 18-25. They were divided into two categories: two groups were familiar (fully or partially) with the building and the location of the main evacuation exits, as they studied in the classrooms of this building; and three groups were students from other universities who were unfamiliar with the building and visited it for the first time. The students who were partially familiar with the building layout attended the university only during exam sessions (once a year) and no more than 3-4 times per month. The reason is the COVID-19 pandemic and the ongoing war since 2022, when all classes were conducted online.

During the research, the evacuation routes in the building were marked according to the minimum regulatory requirements of Ukrainian standards (State Standard of Ukraine EN ISO 7010:2019) (Figure 2).



Figure 2. Fire evacuation signs according to the evacuation plan.

Source: Own research.

It is not possible to fully simulate a state of stress in an evacuation drill. However, a certain level of psychological tension was felt during the experiment due to the overall threat environment in the city of Dnipro, the limited time for evacuation, and the complicated initial conditions, such as blocked exits that students normally use. The latter conditions were provided only to the groups familiar with the building.

The study used several methods: time-motion measurements, observation of the evacuation process (including video recording), statistical analysis of the measurement results, and participant surveys to assess psychological factors influencing evacuation behavior.

3. Results

During the time-motion measurements, the time when the students left the building was recorded for both the first and the last subgroups, which spontaneously separated in the evacuation process. Table 1 shows measurement results of the evacuation process.

Table 1.
Results of parameter measurements of evacuation process from the academic building

№ group / subgroup	Number of people	Ratio of men to women in the group, %	Number of subgroups	Average movement velocity, m/min	Actual evacuation time, minutes.
People familiar with the building layout					
1	9	45/55	4		
1.1	3			85	12,5
1.2	2			88	7,1
1.3	3			92	4,2
1.4	1			96	3,5
2	10	50/50	3		
	6			92	4,7
	4			95	3,6

Cont. table 1.

People unfamiliar with the building layout					
3	9	80/20	5		
3.1	2			87	2,3
3.2	1			92	5,3
3.3	3			92	6,3
3.4	1			95	9,4
3.5	2			82	12,1
4	12	50/50	2		
4.1	6			90	3,1
4.2	6			92	4,0
5	17	70/30	3		
5.1	10			92	2,5
5.2	3			95	3,2
5.3	4			90	4,1

Source: Own research.

The average movement time for each subgroup was calculated using coordinates obtained from video recordings. In each measurement, the coordinates of two different participants (x_1 and x_2) at a specific moment in time t_n were identified in pairs. Then, the distance between them was calculated using the following formula:

$$a(t_n) = x_1(t_n) - x_2(t_n) \quad (1)$$

For the next moment in time t_{n+1} , the data $x_1(t_{n+1})$, $x_2(t_{n+1})$ were recorded using the same method.

For each time interval between measurements, the average velocity was calculated using the formula:

$$V_{aver} = \frac{1}{2} \cdot \frac{(x_1(t_{n+1}) - x_1(t_n)) + (x_2(t_{n+1}) - x_2(t_n))}{(t_{n+1} - t_n)} \quad (2)$$

As shown in Table 1, the average movement velocity of the groups of people was 5-18% lower than the standard values (State Building Codes DBN V.1.1-7:2016) for conditions with minimum flow density of 0.01 m²/m².

Additionally, the actual evacuation time of people from the building was compared with the normative calculated evacuation time, according to the State Standard of Ukraine, using a simplified analytical model of flow movement (State Standard of Ukraine 8828:2019). The evacuation time was estimated for the farthest evacuation exit. The layout of this evacuation route included 8 horizontal sections and one downward staircase section (Figure 3).

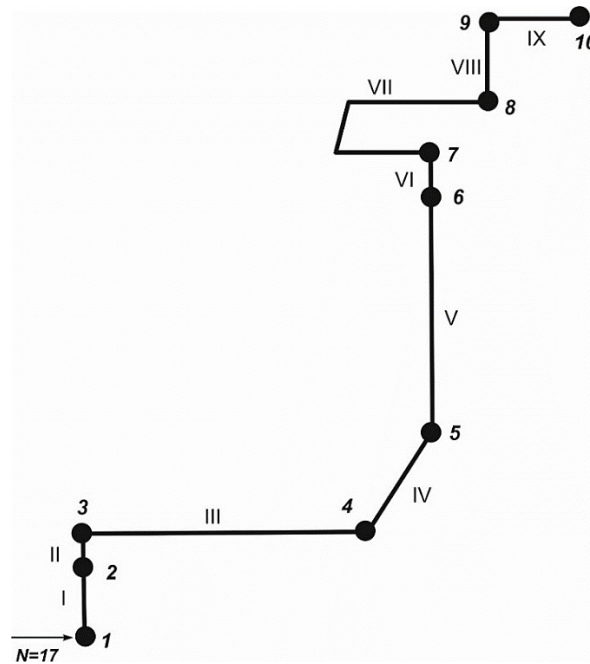


Figure 3. Estimated evacuation scheme of the longest route.

Source: Own research based on design.

Estimated evacuation time of people t_p is the total movement time of people flow in different sections of the route:

$$t_p = t_1 + t_2 + \dots + t_i, \quad (3)$$

where:

t_1 – movement time of people flow on the first (initial) section, min,

$t_2 \dots t_i$ – movement time people flow on the next sections, min.

The movement time of people flow along the route section was calculated using the formula:

$$t_1 = \frac{l_1}{V_1} \quad (4)$$

V_1 – velocity value of people flow depends on flow density D , m/min, as specified in Table A.1 (State Standard of Ukraine 8828:2019).

Density of people flow D on the route section with the length l_i and the width δ_i is calculated according to the following formula:

$$D_i = \frac{N_i f}{l_i \cdot \delta_i} \quad (5)$$

where:

D_i – density of people flow on the evacuation route m^2/m^2 ,

N_i – number of people on the first section,

f – average size of a person's horizontal projection, m^2 , according to State Standard of Ukraine 8828:2019.

Congestion depends on people flow intensity q , m/min, which must not exceed the established maximum values. The calculation results are presented in Table 2.

Table 2.

Calculations of the estimated evacuation time from the building according to the evacuation route presented in Figure 3

№ section	Type of premise	<i>N</i>	<i>b, m</i>	<i>l, m</i>	<i>D, m²/m²</i>	<i>q, m/min.</i>	<i>v, m/min.</i>	<i>t, min.</i>
I	corridor on the 4th floor	17	3,0	6,0	0,12	8,5	79	0,07
II	doors	17	2,5	–	–	8,9	–	–
III	corridor on the 4th floor	17	3,0	65	–	1,0	100	0,65
IV	corridor on the 4th floor	17	5,0	10	–	0,8	100	0,01
V	corridor on the 4th floor	17	3,0	80	–	1,0	100	0,8
VI	doors	17	2,5	–	–	1,3	–	–
VII	downstairs	17	2,0	40	–	2,8	100	0,4
VIII	corridor on the 1th floor	17	6,0	20	–	0,9	100	0,2
IX	lobby on the 1th floor	17	10	20	–	0,5	100	0,2
								Σ 2,3

Source: Own research.

The capacity of the sections (corridors, lobbies, foyers) along the evacuation routes significantly exceeded the calculated values, because a relatively small number of people participated in the experiment. Therefore, the velocity of people flow was not limited by flow density. It depended solely on human speed of perception and interpretation of fire evacuation signs, as well as the choice of a correct route at corridor intersections.

4. Discussion

The results of the calculations and time measurements showed that the actual evacuation time exceeded the estimated time in all cases. The groups familiar with the building exceeded the time of evacuation from 1.3 to 5.1 times, the unfamiliar groups - from 3.1 to 12.2 times. Only in two out of sixteen cases the time coincided.

The analysis of the calculation results and observations showed that the evacuation time was increased due to insufficient informational support in the organization of evacuation routes, especially for individuals who were unfamiliar with the building (e.g., first-time visitors) but not due to a reduced velocity.

In Ukraine, there are no clear regulatory requirements for the height and frequency of evacuation signage. As a result, there are cases where the signs are positioned higher than 3 meters.

Psychological aspects of human behavior and perception of information from evacuation signs and evacuation plans were recorded with the help of two methods: observation of student groups during the experiment and analysis of questionnaire responses from participants. The results revealed some new as well as well-known psychological factors influencing decision-making in the selection and alteration of evacuation routes. Among the well-known factors, it was found that in 100% of cases, people leaving the classroom (the initial evacuation

point) began moving in the same direction which they had entered the building despite of evacuation signs indicating an alternative route.

Among the new factors, we consider the fact that people will likely move towards better-lit parts of the building at corridor intersections (Figure 4).



Figure 4. Corridor entrances: a well-lit area ($E = 257$ lux) and a dimly lit area ($E = 17$ lux).

Source: Own research.

In our case, none of the nine groups chose to move through the dimly lit corridor under other equal conditions and evacuation signs. The actual illumination levels of the corridors were as follows: 17 lux (floor level) in the dimly lit section and 257 lux (floor level) in the well-lit section. Although, according to Ukrainian regulations, emergency corridor lighting may be reduced to 1 lux, we believe that these are not the absolute illuminance values but their ratio which influence the decision-making. Subjectively, it creates the perception that the better-lit area is a safer direction. At night, emergency lighting even at $E = 1$ lux gives a sense of a safe exit in the illuminated corridors compared to dark ones. However, during the day, similar conditions may arise due to the absence of windows in some corridors or partial smoke.

While observing the evacuation process, we have found that it was difficult to understand the evacuation signs, according to the State Standard of Ukraine EN ISO 7010:2019. They are placed on a green background in a darkened corridor, even in conditions when rays of natural light fall perpendicularly on the sign surface (Figure 5).



Figure 5. The sign of emergency exit from different distances - 5, 2.5, and 1.5 meters. The glare is on sign surface in a dark corridor from rays of natural light.

Source: Own research.

At a distance of 3-4 meters the emergency exit pictogram blends with the background due to glare. Smoke in premises can worsen the visibility. To take this factor into account, we performed a visibility assessment of evacuation signs with smoke under specific corridor conditions on the 4th floor, using the methodology developed by American researchers (see Klote et al., 2002).

The analysis considered the material type, mass, and smoke production characteristics of wall claddings and finishes, floor coverings, the size of the room, the sign type (retroreflective), and the combustion type. The calculation was performed using a functional dependency:

$$S = \frac{K}{\alpha_m \cdot m_p} \quad (6)$$

where:

S – visibility, fi (m),

K – proportionality constant (Table 3.3, [14]),

α_m – specific extinction coefficient, ft²/lb (m²/g),

m_p – mass concentration of particulate lb/fi³ (g/m³).

According to the calculation, the minimum recognition distance of the sign is 6 meters in conditions of white smoke, standard ambient lighting, and average visual acuity. However, in reduced lighting, this distance decreases to approximately 1 meter.

While observing people's movements along evacuation routes, instances of misinterpretation of information signs as fire evacuation ones were recorded in two subgroups (Figure 6).



Figure 6. Information sign design resembling the fire evacuation direction sign.

Source: Own research.

Such signs contain similar informational elements (in this case, an arrow), which resulted in the wrong choice of evacuation route. This issue is especially critical for individuals who lack knowledge of basic fire safety principles and standard design of fire evacuation signs.

5. Summary

As a result of the research, patterns in decision-making during evacuation from the building in unfamiliar topological conditions were identified, influenced by psychological factors. These include the impact of light along evacuation routes, potential misinterpretation of information signs resembling fire evacuation ones, and a high probability that evacuation signs cannot be distinguished. It occurs when the background color matches the color of the sign's informational elements in certain lighting conditions.

The study revealed new psychological characteristics of human behavior in complex topological environments during evacuation. They arise from factors that were previously overlooked in the design of evacuation routes. These factors include unfamiliar or poorly known spatial layouts, varying degrees of relative illumination along evacuation routes, and information signs similar to standard fire safety signs.

The practical findings provide legislators and fire safety policy makers with evidence-based approaches to improving the requirements for evacuation routes in buildings of various types. The psychological patterns of human behavior during evacuation can help reduce the risk of injury in fire emergencies by enhancing the regulatory requirements for evacuation routes.

Based on the analysis of relevant literature, the identified behavioral patterns are also applicable within the regulatory framework of the Republic of Poland, as the psychological factors examined in this study have not been addressed in existing European research.

References

1. Ahn, C., Kim, H., Choi, I., Rie, D. (2022). A study on the safety evaluation of escape routes for vulnerable populations in residential facilities. *Sustainability*, Vol. 14(10), 5998, doi: 10.3390/su14105998.
2. DBN V.1.1-7:2016. *Fire safety of construction sites. General requirements* (in Ukrainian).
3. Dotsenko, O.G. (2023). Method of experimental research of evacuation of mixed flows of people of different mobility groups. *Municipal Economy of Cities*, Vol. 6(180), pp. 154-159, <https://doi.org/10.33042/2522-1809-2023-6-180-154-159> (in Ukrainian).
4. DSTU 8828:2019. *Fire safety. General provisions* (in Ukrainian).
5. DSTU EN ISO 7010:2019. *Graphical symbols. Safety colors and signs. Registered safety signs* (in Ukrainian).
6. DSTU ISO 23601:2019. *Safety identification. Signs on evacuation plans* (in Ukrainian).
7. Fu, L., Qin, H., He, Y., Shi, Y. (2024). Application of the social force modeling method to evacuation dynamics involving pedestrians with disabilities. *Applied Mathematics and Computation*, Vol. 460, 1 January, 128297, doi: 10.1016/j.amc.2023.128297.
8. Gerges, M., Demian, P., Adamu, Z. (2021). Customizing evacuation instructions for high-rise residential occupants to expedite fire egress: results from agent-based simulation. *Fire*, Vol. 4(2), 21, doi: 10.3390/fire4020021.
9. Goatin, P., Colombo, R.M., Rosini, M.D. (2009). *A macroscopic model for pedestrian flows in panic situations*. 4th Polish-Japan Days, May 2009, Madralin, Poland, 32, pp. 255-272, <https://core.ac.uk/download/pdf/52786254.pdf>.
10. Klote, J.H., Milke, J.A. (2002). *Principles of smoke management*. 1791 Tullie Circle, NE Atlanta GA 30329, USA: American Society of Heating, Refrigerating and Air-conditioning Engineers.
11. Kovalishyn, V.V., Dotsenko, O.G., Khlevnoy, O.V., Dyven, V.I. (2022). Research on the evacuation of people of different mobility groups from a shopping and entertainment center. *Scientific Bulletin: Civil Protection and Fire Safety*, Vol. 2(14), pp. 99-107, doi: 10.33269/nvcz.2022.2(14).99-107 (in Ukrainian).
12. Maiboroda, R.I., Otrosh, Y.A., Rashkevych, N.V., Melezhik, R.S. (2023). Assessment of the fire resistance of buildings from fireproof reinforced concrete building structures. *Municipal Economy of Cities*, Vol. 4(178), pp. 219-231, <https://doi.org/10.33042/2522-1809-2023-4-178-219-231> (in Ukrainian).
13. Pan, H., Zhang, J., Ma, W. (2020). *Simulation of pedestrian flow mixed with wheelchair users in funnel-shaped bottlenecks based on Pathfinder*. RSVT'20: Proceedings of the 2020 2nd International Conference on Robotics Systems and Vehicle Technology, pp. 83-88, doi: 10.1145/3450292.3450306.

14. Tsvirkun, S.V., Berezovsky, A.I., Berezovska, Y.V. (2015). Calculation of evacuation time of people from the classroom during a fire. *Scientific Bulletin of Construction, No. 1*, pp. 214-219, http://irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Nvb_2015_1_49.pdf (in Ukrainian).

ANALYSIS OF THE TREND OF CHANGES IN THE ACCIDENT RATE IN THE POLISH MINING INDUSTRY IN COMPARISON TO OTHER INDUSTRIES AND EU COUNTRIES

Małgorzata WYGANOWSKA^{1*}, Piotr BAŃKA²

¹ Faculty of Mining, Safety Engineering and Industrial Automation, Department of Safety Engineering;
malgorzata.wyganowska@polsl.pl, ORCID: 0000 0002 2704 3188

² Faculty of Mining, Safety Engineering and Industrial Automation, Department of Geoengineering and Raw
Materials Extraction; piotr.bank@polsl.pl, ORCID: 0000 0002 5476 1716

* Correspondence author

Purpose: The main objective of the study was to analyse the trend of changes in accident rates in the Polish mining sector against the accident rates registered in other industries and EU countries.

Design/methodology/approach: The study used a three-stage comparative analysis of accident rates for fatal and non-fatal accidents at work occurring in the mining industry and the 20 most important industries defined by NACE (Statistical classification of economic activities in the European Community) in EU countries. The method of analysis was based on the principle: from the general to the specific, at the first stage analysing and averaging the accident rates occurring in EU countries among the 20 industries and comparing them with the same rates occurring in Poland. The second stage of the analysis compared accident rates in mining and construction in EU countries, and the third stage analysed average accident rates in mining and construction in Poland. Such studies were carried out in order to diagnose the accident rate and, on this basis, to diagnose the trend in this area.

Findings: The analysis carried out allowed us to establish that the negative trend of increasing accident rates in the Polish mining sector does not coincide with changes in accident rates occurring in the 20 most important sectors of the economy of the European Union countries under consideration. The increase in the accident rate and fatal accident rate recorded in Poland in recent years is not present in the same analysed period in other industries, including the mining sector in EU countries or the highly accident-prone construction sector. The analysis made it possible to conclude that the increase in accident rates is not a general trend, but only a feature of the Polish mining industry. Such results point in the direction of the necessary research to be carried out in further stages aimed at identifying the causes of the increase in accident rates in the Polish mining industry and seeking effective remedial measures.

Research limitations/implications: The research and analyses carried out have clearly indicated that the increase in the number of accidents in the mining industry is an isolated phenomenon in comparison with the number of accidents in other sectors and countries of the European Union, therefore further, in-depth research to be carried out in the Polish mining industry must focus on diagnosing the causes of this state of affairs, which should be sought within mining companies by analysing safety culture, carrying out in-depth analyses of accidents at work or examining the effectiveness of preventive health and safety measures.

Practical implications: The results of the conducted research and analysis can be used by entities such as universities, scientific and research institutes, as well as occupational health and safety supervisory institutions in the mining industry. The presented results diagnose the state of safety in the mining industry and indicate the direction of further research.

Social implications: Safety is one of the basic human needs, so any research and analysis in the field of occupational health and safety has a potentially positive impact on the increase of the quality of life of societies, public and industry policies. They therefore have high social implications.

Originality/value: The publication uses an original research method based on a three-stage analysis of the accident rates of industries and countries in the European Union.

Keywords: mining, accidents at work, incidence rate.

Category of the paper: research paper.

1. Introduction

Restructuring processes in the Polish mining industry have brought about many qualitative changes in the closer and further environment of the industry's enterprises (Bijańska, Wodarski, 2020; Smoliło, Chmiela, 2021). These changes are noticeable, among others, in the area of occupational safety, which has become a fundamental pillar forming modern mining (Chen, Zorigt, 2013; Cliff, Harris, Bofinger, Lynas, 2017). Occupational safety is an important social category (Johanson, Aboagye, Yao, 2022), but it is also an economic category (Simsek, 2024), because prevention and safety in general is a cost to be borne in the course of business (Cao, Zhou, Miao, 2025; Estudillo, Carretero-Gomez, Forteza, 2024). It needs to be managed in a rational and sustainable manner especially with regard to the production-safety relationship. How important this issue is can be seen from the fact that the most important Polish scientific and research institutions have been dealing with this problem for many years. Unfortunately, many issues remain unresolved. In this study, the authors decided to analyse trends in accident rates in the Polish mining industry against the background of other industries and countries in the European Union. They were prompted to do so by the negative trend of changes in accident rates in the Polish mining industry (WUG, 2025), which shows an upward trend from 2020 onwards. In their search for the reasons for this, the authors carried out a complex analysis of the accident rate, starting with an analysis of the accident rates determined for 20 branches of the economy of the European Union countries (Eurostat, 2025; ESAW, 2020). The authors then made a comparative analysis of the accident rate occurring in the Polish mining industry with the accident rate occurring in the mining industry of EU countries, and, in addition, they also made an in-depth comparative analysis of the accident rate occurring in the mining industry with the accident rate determined for the equally high accident rate construction industry (Woźniak, Hoła, 2024), both in Poland and in the European Union as a whole. The results of this analysis are intended to help diagnose the reasons for the increase in the accident rate in the Polish mining industry. To provide an answer to the question of whether this trend coincides

with a similar direction of changes in the accident rate in other sectors and in all countries of the European Union or whether it is a trend occurring only in the Polish mining sector. The results of the analysis are not only cognitive but also practical, as they indicate the direction of further diagnosis and analysis of the causes of the occupational safety situation in the Polish mining industry. In the specific period of restructuring of the Polish mining industry, requiring a reduction in production costs and the closure of mines, problems relating to work safety that are not well known and recognised are emerging. These are not just problems in the technical sphere, but also in the social sphere. Comprehensive solutions must therefore be sought in this area in order to reverse the negative trend of increasing accident rates in the Polish mining industry.

2. Description of the research method

The authors formulated the following research hypothesis: the increase in mining accidents observed in recent years is a characteristic of only the Polish mining industry in the EU. To verify the research hypothesis thus adopted, a three-stage comparative analysis method was used, based on source data obtained from Eurostat and the Higher Mining Authority. Looking for reasons for the increase in accident rates in recent years in the Polish mining industry (WUG2, 2025; Wyganowska, Tobór, 2022; Gajdzik, Małysa, Sujova, Bialy, 2022; Ogrodnik, Kęsek, 2022), the authors used accident rates in the 20 most relevant industries of the European Union economy for the period 2014-2022 in making a comparative analysis. This time range is due to the delay in updating the data - EUROSTAT does not have complete data for 2023-2024. For statistical analyses of data from different European countries, the authors used the overall rate of accidents at work as a ratio of the number of accidents (non-fatal or fatal in a given year) per 100,000 persons employed in a given industry.

Accident rates were analysed for the following industries:

- Agriculture; industry and construction (except mining); services of the business economy.
- Agriculture, forestry and fishing.
- Mining and quarrying.
- Manufacturing.
- Electricity, gas, steam and air conditioning supply.
- Water supply; sewerage, waste management and remediation activities.
- Construction.
- Wholesale and retail trade; repair of motor vehicles and motorcycles.
- Transportation and storage.

- Accommodation and food service activities.
- Information and communication.
- Financial and insurance activities.
- Real estate activities.
- Professional, scientific and technical activities.
- Administrative and support service activities.
- Public administration and defence; compulsory social security.
- Education.
- Human health and social work activities.
- Arts, entertainment and recreation.
- Other service activities.

Standardised data on accidents at work are collected as part of the administrative data “European Statistics on Accidents at Work (ESAW)”, based on a methodology first developed in 1990. European Statistics on Accidents at Work (ESAW) data are collected and disseminated on Eurostat's website on an annual basis. In addition to absolute accident numbers and percentages, Eurostat calculates accident rate values.

Accident rates are calculated as the ratio of the number of accidents (fatal and non-fatal) for a given year, country, sector, gender, age group or other breakdown, to the relevant number of persons employed (reference population) and multiplied by 100 000. The result of such calculations is the number of accidents per 100 000 employees (per age, sector or country - and this depends on the objectives of the analysis).

The paper uses a three-stage comparative analysis of the values of fatal and non-fatal accident rates occurring in the mining industry, construction and the 20 most important industries found in EU countries. The method of analysis was based on the principle: from the general to the specific. The following stages of research and analysis were planned and carried out:

- STEP 1: Analysis of the values of average accident rates occurring in EU countries among 20 industries and comparison with the same rates occurring in Poland. The analysis of accident rates in the selected 20 industries results from the statistical classification of economic activities in the European Community - NACE (Statistical Classification of Economic Activities in the European Community managed by Eurostat) - applied in the ESAW. For ESAW data, NACE Rev. 2 is used from the reference year 2008 onwards.
- STEP 2: Analysis of accident rates in mining and construction in EU countries. The comparison of the accident rates occurring in the mining industry with those occurring in the construction industry follows from the ESAW accident statistics, which, giving examples of high-risk sectors, points to agriculture, construction and transport. Accident rates in mining will therefore be compared with an industry that by definition has a high accident rate.

- STEP 3: Analysis of the values of average accident rates occurring in mining and construction in Poland.

3. Analysis of accident rates in 20 sectors of the EU economy

3.1. Step 1 of the research – analysis of the average accident rates found in EU countries and Poland

In the first stage of the analysis, changes in the accident rate in the 20 most important industries in the European Union were observed. The timeframe adopted for the analysis was 2014-2022. The authors used the average accident rate for the 20 selected industries. An analysis of the average accident rate per 100 000 employees in the industry shows a clear downward trend between 2014 and 2022 (Fig. 1). The accident rate fell by 9% during this period. This is a very significant positive development in the area of occupational safety.

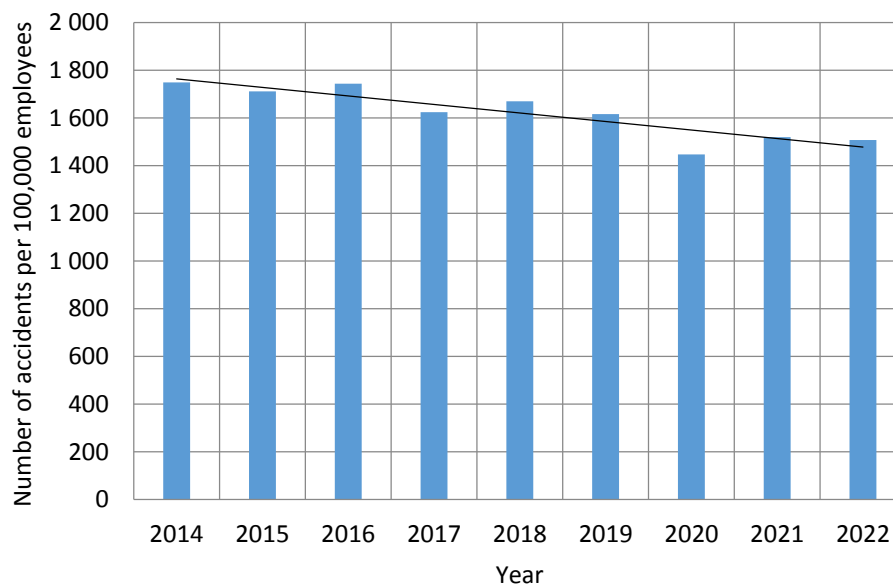


Figure 1. Accident rate averaged over 20 industries of EU countries.

Source: own elaboration based on Eurostat.

An analysis of the fatal accident rate carried out on the basis of an average of the fatal accident rates for the 20 EU countries' industries also showed a very clear downward trend (Fig. 2). It is worth emphasising that, with the overall accident rate analysed above, the fatal accident rate decreased by as much as 18%. This is a very significant, even spectacular, positive development in the area of occupational safety in the countries of the European Union.

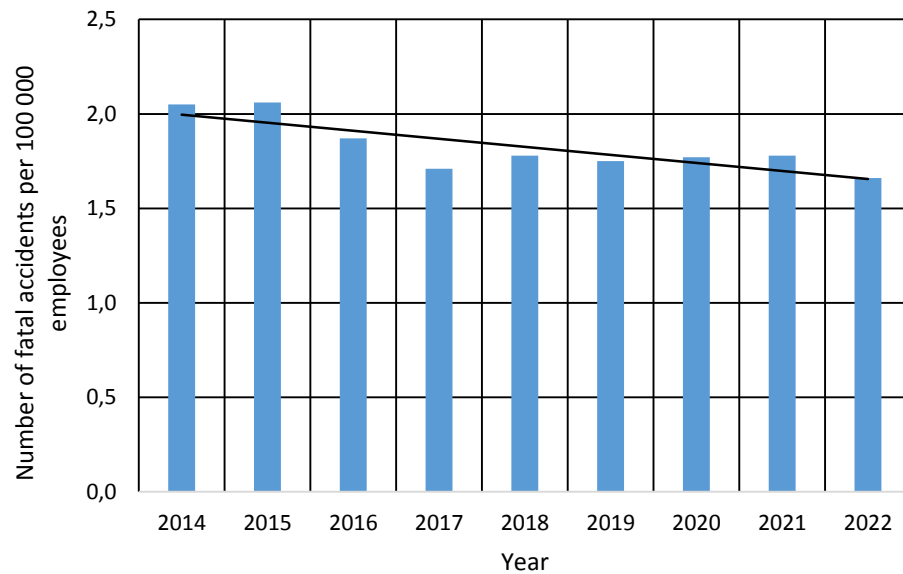


Figure 2. Fatal accident rate averaged over 20 EU country industries.

Source: own elaboration based on Eurostat.

Accident rates analysed for 20 industries in EU countries were also analysed in Poland for comparison. The aim of this research is to determine the trend of change – decreases or increases in the analysed identical indicators for the identical industries.

The accident rate averaged for 20 industries in Poland, with a selection of 20 industries analysed in all EU countries, also shows a clear downward trend in accident rates (Fig. 3). This trend is consistent with the accident rates analysed above for European Union countries.

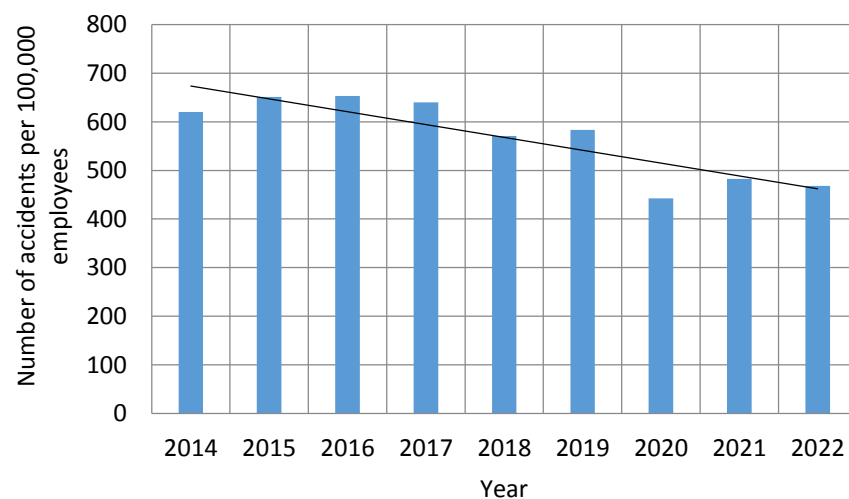


Figure 3. Accident rate averaged over 20 industries in Poland.

Source: own elaboration based on Eurostat.

Averaged across Poland's 20 industries, the fatal accident rate shows that between 2014 and 2022 there was a very large, almost 40%, decrease in the number of fatal accidents (Fig. 4).

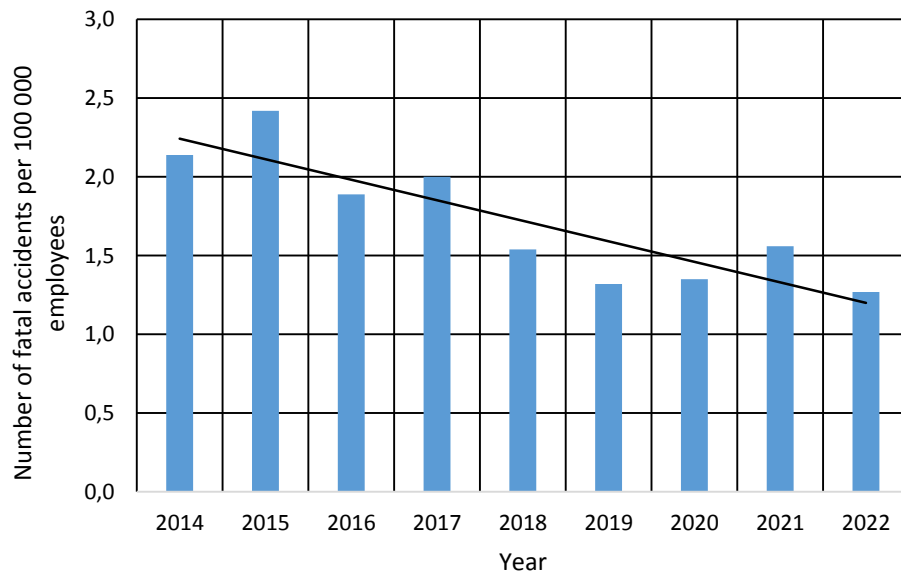


Figure 4. Fatal accident rate averaged over 20 industries in Poland.

Source: own elaboration based on Eurostat.

This decrease even exceeds the changes in this area recorded in the same period in identical industries in European Union countries. This is a very positive development.

3.2. Step 2 of the study - analysis of mining and construction accident rates in EU countries

The next step of the analysis was to analyse the accident rate limited to the mining industry. As a prelude to this step, the authors analysed the mining accident rate averaged over the European Union countries. As can be seen in the graph, the value of the index has remained at a similar level since 2014, with no major changes in decline or increase (Fig. 5).

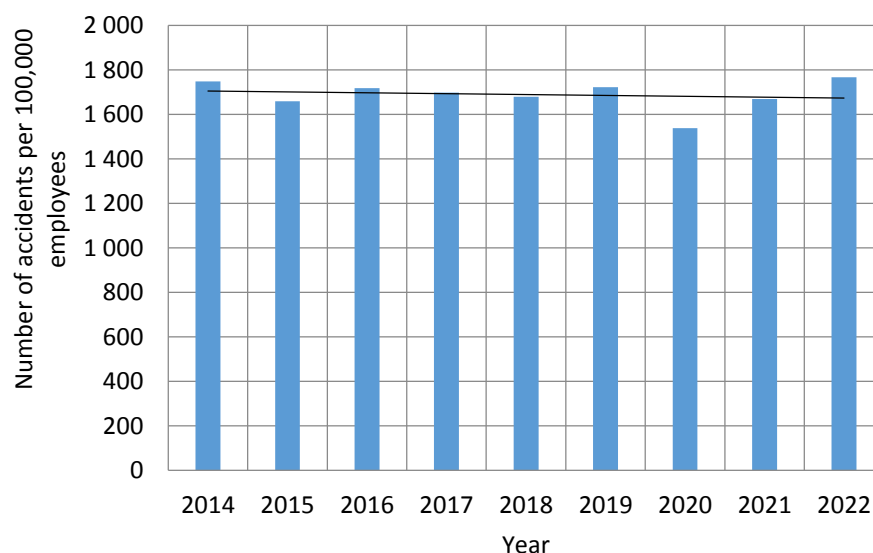


Figure 5. Mining accident rate averaged over EU countries.

Source: own compilation based on Eurostat.

Further analysis, including the fatal accident rate in mining, averaged over the EU countries, shows, as in the 20 industries analysed earlier, a clear downward trend (Fig. 6).

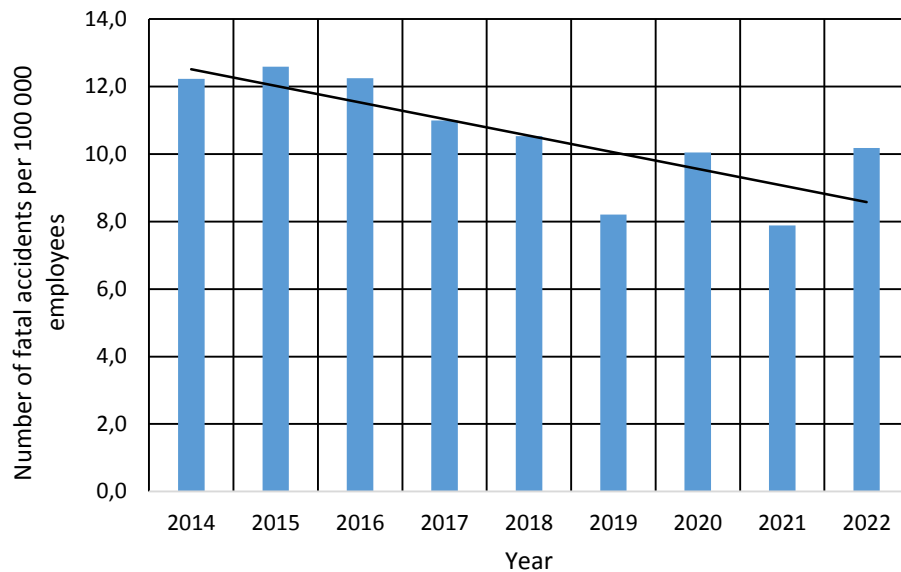


Figure 6. Fatal mining accident rate averaged over EU countries.

Source: own compilation based on Eurostat.

Searching for the sources of the accident rate increase in the Polish mining industry, the authors decided to compare accident rates in that industry with those determined for the construction sector, which also has a high accident rate due to the numerous hazards and high occupational risk at workplaces. The accident rate in the construction industry averaged over the European Union countries per 100,000 employees once again showed a clear downward trend in the analysis (Fig. 7).

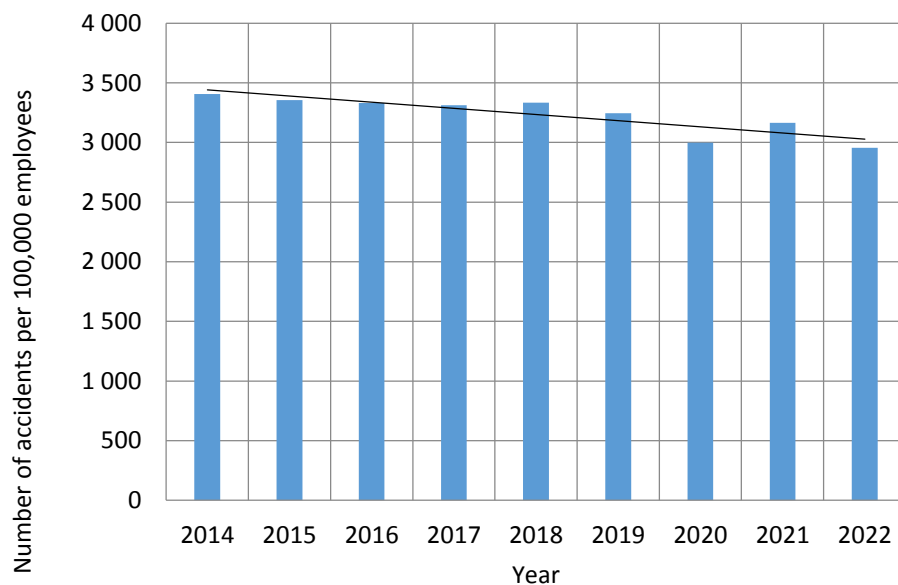


Figure 7. Accident rate in construction averaged over EU countries.

Source: own compilation based on Eurostat.

An analysis of the fatal accident rate in construction, averaged over EU countries, also confirms a downward trend, as does the overall accident rate (Fig. 8).

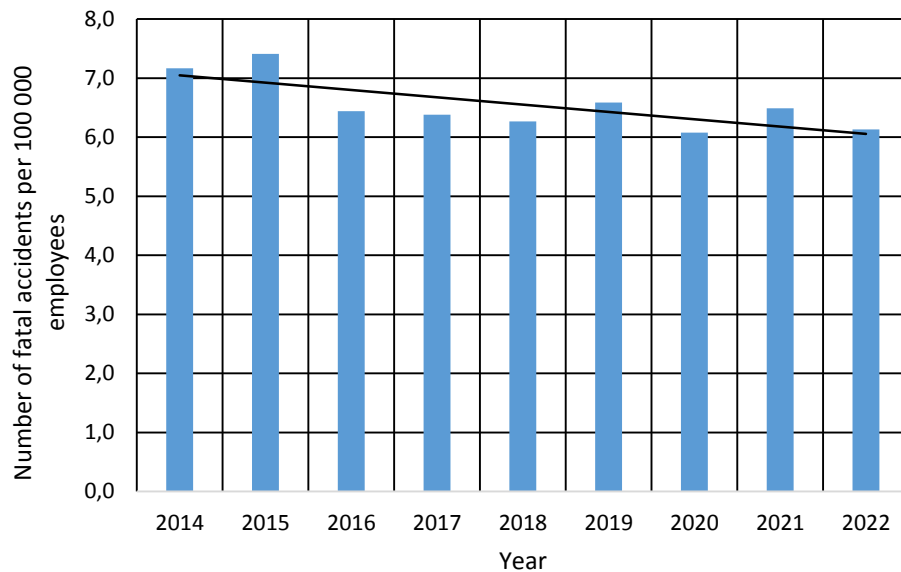


Figure 8. Fatal accident rate in construction averaged over EU countries.

Source: own compilation based on Eurostat.

3.3. Step 3 of the study – analysis of average accident rates in mining and construction in Poland

The analysis methodology adopted led the authors, at the outset of the third stage of the study, to determine the number of accidents in the Polish mining industry by type of mining. The aim of this study was to find out what percentage of the total number of accidents in the Polish mining sector is coal mining. As the analysis of accident rates in the mining industry has shown, accidents in coal mining are the dominant accident category (Fig. 9). On this basis, the authors assumed that the determined negative trends of changes in the total accident rate and in the fatal accident rate relating to mining in Poland are dominantly influenced by causes and trends occurring in hard coal mining.

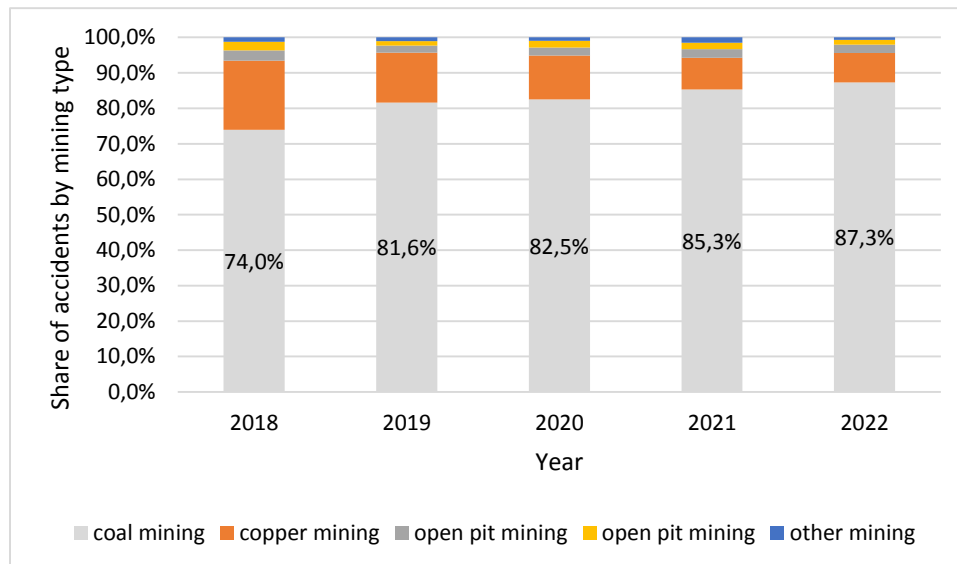


Figure 9. Share of underground mining accidents in the total number of mining accidents in Poland.

Source: own elaboration based on WUG.

The authors then carried out a final assumed analysis of the average accident rates occurring in mining and construction in Poland.

In the analysis of the total accident rate in the Polish mining sector from 2014 to 2022, it is the first analysed indicator to show an increasing trend (Fig. 10). Interestingly, the analysed indicator for the mining industry of the EU countries does not show such trends, so it is a situation without a supra-national trend.

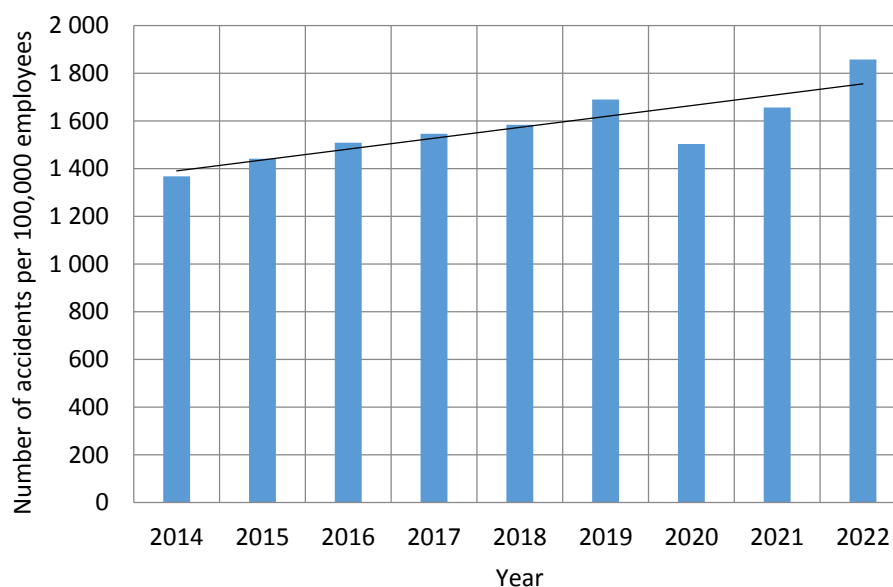


Figure 10. Accident rate in mining in Poland.

Source: own elaboration based on Eurostat.

Unfortunately, the negative upward trend is also confirmed for the analysed fatal accident rate. In the Polish mining sector, there was a marked increase in the rate in 2022 compared to 2021, but also compared to the beginning of the analysed period, i.e. 2014 (Fig. 11).

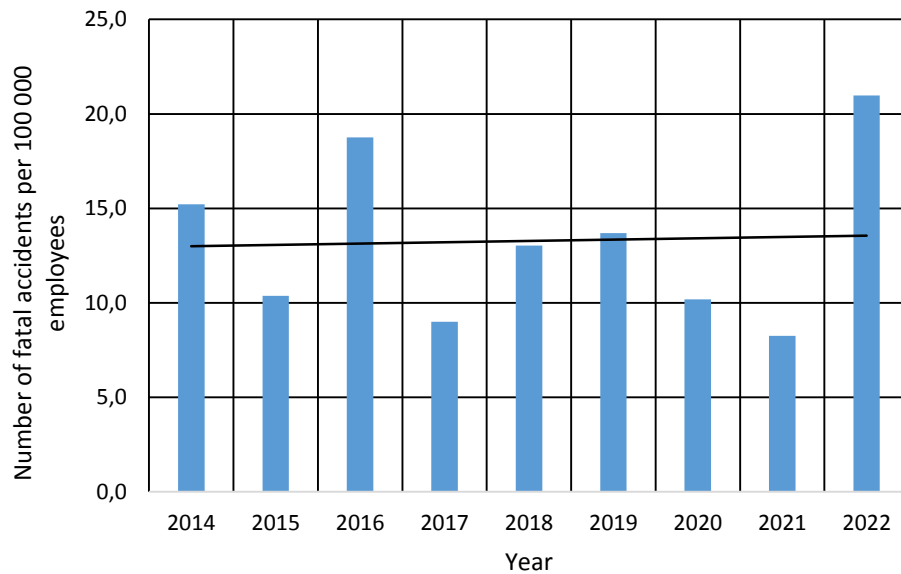


Figure 11. Fatal accident rate in mining in Poland.

Source: own compilation based on Eurostat.

The general accident rate in the construction industry in Poland per 100,000 employees, unlike in the mining industry, shows a clear downward trend over the same analysed period (Fig. 12). The average value of the overall accident rate in the construction industry fell by a spectacular almost 50% over the analysed period.

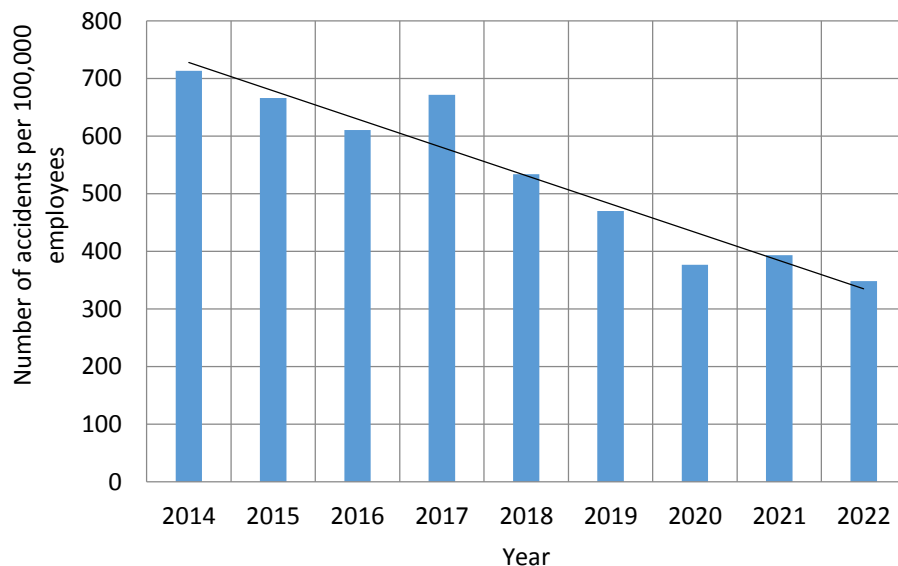


Figure 12. Accident rate in the construction industry in Poland.

Source: own elaboration based on Eurostat.

The next step of the analysis based on a study of the level of fatal accident rates in the construction industry in Poland based on Eurostat statistics once again confirmed the downward trend in accident rates, which are in line with those found in the European Union (Fig. 13).

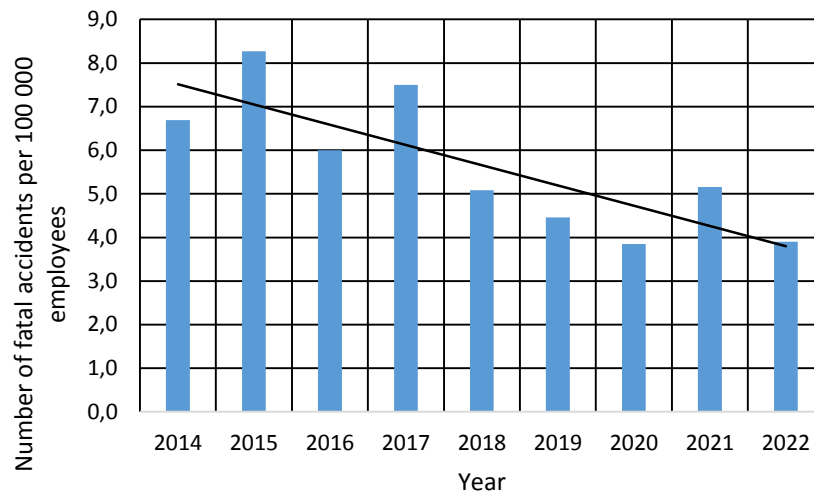


Figure 13. Fatal accident rate in the construction industry in Poland.

Source: own elaboration based on Eurostat.

In the Polish construction industry, the fatal accident rate between 2014 and 2022 also shows a very clear downward trend.

4. Results of research and analysis carried out

The comprehensive analysis of accident rates and fatal accident rates carried out according to the methodology established in the study can be summarised as follows:

- STEP 1 – analysis of accident rates and fatal accident rates occurring in EU countries averaged over the 20 industries described earlier shows a clear downward trend over the entire analysed period. The situation is similar in identical analyses of rates for the indicated industries in Poland. Declines in accident rates are pronounced over the analysed period and range from 9% to even 40% for individual indicators. It can therefore be concluded that occupational safety is increasing on average.
- STEP 2 – the results of the analysis of accident rates and fatal accident rates occurring in mining and construction in EU countries also show a downward trend.
- STEP 3 – analysis of average accident rates and fatality rates in the mining and construction sectors in Poland shows that the only sector where accident rates have been rising for years is the Polish mining industry. Even in such an accident-prone industry as indicated by the statistics - the construction industry - accident rates are decreasing. In the analysed period, the accident rate in this industry fell by a spectacular almost 50%. This is unprecedented in the EU.

The results of the detailed analysis conducted helped confirm the research hypothesis adopted at the outset of the study.

5. Summary and conclusions

An analysis of changes in the value of accident rates and fatal accidents showed that a negative trend of increase is observed only in the Polish mining sector. Such a trend is not present in the mining industry of the EU countries or in the construction industry - both national and EU-wide. Even a comprehensive analysis covering accident rates of 20 industries did not show trends of increasing accident rates. Quite the opposite - clear downward trends. It is therefore not possible to posit that the increase in accident rates in the mining industry is merely the result of the specificity of working under the numerous hazards that are present in the industry's workplaces. If this were the case, an analysis of mining accident rates in the EU countries would also show a positive - increasing - trend, which is not the case. It can therefore be concluded that the reason for the increasing accident rates in the Polish mining industry over the years is due to the complex factors that coexist in the companies of the industry. Given that more than 80% of accidents in the total number of accidents in the Polish mining sector involve accidents in hard coal mining, further analysis should focus on research into occupational safety in this industry. Interestingly, and certainly not unrelated to the accident rate, hard coal mining companies have been undergoing restructuring processes since the 1990s, which involves implementing changes to the companies in terms of their efficiency, in particular their ownership, organisation and management, including health and safety, employment, production and assortment structure, technical and technological issues, sales and supply markets. In the process of restructuring changes, which are also associated with mine closures, mergers of mines and transfer of the crews of these mines between mine divisions and between mines, there is likely to be a reduction in the level of safety culture and consequently an increase in accident rates. Interdisciplinary measures are therefore needed, including in the areas of occupational health and safety management, occupational safety culture, competence management or communication. The results of the research and analysis can be used primarily by entities and institutions that supervise occupational health and safety in mining.

The results of the research and analysis presented here allow us to conclude that further work aimed at identifying the causes of the increase in accidents in the mining industry should only focus on a detailed analysis of the causes of the increase in accidents in Polish coal mining companies.

References

1. Bijańska, J., Wodarski, K. (2020). Model of process management system in enterprises of the hard coal mining industry. *Management Systems in Production Engineering*, Vol. 28(2), pp. 112-120.
2. Cao, Z., Zhou, T., Miao, S. et al. (2025). Exploring the economic occupational health, safety, and fatal accidents in high-risk industries. *BMC Public Health*, 25, 433, doi: 10.1186/s12889-025-21583-0.
3. Chen, J.K.C., Zorigt, D. (2013). Managing occupational health and safety in the mining industry. *Journal of Business Research*, Vol. 66(11), pp. 2321-2331, doi: 10.1016/j.jbusres.2012.04.013.
4. Cliff, D., Harris, J., Bofinger, C., Lynas, D. (2017). Managing occupational health in the mining industry. In: N. Aziz, B. Kininmonth (eds.), *Proceedings of the 17th Coal Operators' Conference*, Mining Engineering, University of Wollongong, 8-10 February 2017, pp. 296-305.
5. ESAW (2020). *European Statistics on Accidents at Work (ESAW). Method for calculating incidence and standardised incidence rates Eurostat*. Luxembourg: European Commission.
6. Estudillo, B., Carretero-Gómez, J.M., Forteza, F.J. (2024). The impact of occupational accidents on economic Performance: Evidence from the construction. *Safety Science*, 177, 106571, doi: 10.1016/j.ssci.2024.106571.
7. EUROSTAT (2025). *European Data, Accidents at Work*. Luxembourg: European Commission. Retrieved from: <https://ec.europa.eu/eurostat>, 5.07.2025.
8. Gajdzik, B., Małyś, T., Sujová, E., Bialy, W. (2022). Accident rate in Polish mining. Current status and forecast. *Acta Montanistica Slovaca*, 27, pp. 620-634, doi: 10.46544/AMS.v27i3.05.
9. Johanson, U., Aboagye, E., Yao, J. (2022). Editorial: Managing occupational health and safety: Incorporating social sustainability into the organization. *Frontiers in Sustainability*, 3, doi: 10.3389/frsus.2022.1039573.
10. Ogrodnik, R., Kęsek, M. (2023). Ocena stanu bezpieczeństwa pracy w oparciu o analizę wypadkowości w górnictwie. *Inżynieria Mineralna*, No. 51(1), pp. 251-258, <http://doi.org/10.29227/IM>.
11. Şimşek, C., Şimşek, H. (2024). The human dimension of sustainable development in the perspective of occupational safety and health. *Yönetim Ve Ekonomi Araştırmaları Dergisi*, Vol. 21(4), pp. 255-274, doi: 10.11611/yead.1376657.
12. Smoliło, J., Chmiela, A. (2021). A liquidation of the mine in SRK S.A. in a processive approach. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, No. 151, pp. 615-632, doi: 10.29119/1641-3466.2021.151.42.

13. Woźniak, Z., Hoła, B. (2024). The structure of near misses and occupational accidents in the polish construction industry. *Heliyon*, 10, e26410, doi: 10.1016/j.heliyon.2024. e26410.
14. WUG (2025). *BHP w górnictwie, Statystyki, Statystyki wypadków*. Katowice: Wyższy Urząd Górniczy. Retrieved from: <https://www.wug.gov.pl/bhp/statystyki#tresc>, 5.07.2025.
15. WUG 2 (2025). *BHP w górnictwie, Stan bezpieczeństwa i higieny pracy w górnictwie, Ocena stanu bezpieczeństwa pracy, ratownictwa górniczego oraz bezpieczeństwa powszechnego w związku z działalnością górniczo-geologiczną w 2024 roku*. Katowice: Wyższy Urząd Górniczy. Retrieved from: https://www.wug.gov.pl/bhp/ stan_bhp_w_gornictwie#tresc, 5.07.2025.
16. Wyganowska, M., Tobór-Osadnik, K. (2022). Analiza poziomu wypadkowości w górnictwie na tle zmian wydajności i zatrudnienia w górnictwie węgla kamiennego. *Inżynieria Mineralna*, No. 46(2), pp. 117-121, doi: 10.29227/IM-2022-01-14.

THE HOUSING PROJECTS AND A POTENTIAL RECOVERY OF THE CITY. THE CASE STUDY OF LODZ

Magdalena ZAŁĘCZNA^{1*}, Agata ANTCZAK-STĘPNIAK²

¹ University of Lodz, Department of Investment and Real Estate; magdalena.zaleczna@uni.lodz.pl,
ORCID: 0000-0003-4385-6119

² University of Lodz, Department of Investment and Real Estate; agata.antczak@uni.lodz.pl,
ORCID: 0000-0002-5858-2774

* Correspondence author

Purpose: The article aims to investigate the changes in the city, looking for the areas with the most dynamic property value increase, analysing the role of public and private actors in changing the city's image.

Design/methodology/approach: Post-industrial cities often experience decline, becoming shrinking cities, and local authorities are feverishly seeking investments and new ideas for economic development. Lodz – the Polish textile industry capital from the past, experienced years of shrinking and decline. There were numerous post-industrial areas of ruined buildings, often dangerous, in the city. For many years, there was no interest in commercial housing investing, despite opening one of Europe's largest shopping centers in the post-industrial area (Manufaktura). Currently, there is an enormous number of commercial housing projects despite the continued depopulation of the city. Is it a hope for recovery due to new housing projects? The methods used to achieve the answer are the analysis of documents, statistical data, value maps, and case studies.

Findings: Łódź is undoubtedly an example of a specific shrinking city - unemployment is decreasing, many investments are being made, and at the same time, the population in the city is decreasing. Safe and aesthetic public spaces and a rich housing offer are necessary for their return and to retain residents. The cases studied indicated that developers start projects even in difficult places, on "bad" streets, because they hope to make a profit. This is inextricably linked to the need to change the image of a given part of the city by investing in public space and improving safety.

Research limitations/implications: The authors are aware of the limitations of their study, which was conducted in specific locations and at a particular time. In the future, a library of case studies can be created. This will allow for conclusions relating to a broader spectrum of issues.

Practical implications: The conclusions of the report indicate the need for cooperation in changing the image of the city between local authorities, investors, and the local community.

Social implications: Residents leave the city when they do not feel safe, cannot find a good job, or appropriate housing. Cooperation between local authorities and private entrepreneurs is essential to encourage returns or arrivals, especially of young people. The housing offer is significant in this regard.

Originality/value: Many shrinking cities are trying to find their way out of regression, attracting new residents, and stimulating economic activity. Łódź, on one hand, is a city that is increasingly perceived in terms of investment potential, but it continues to lose population. The authors analyze commercial housing project locations and conclude that it is stimulated by the processes of revitalizing the degraded urban fabric. After a phase of public investment, commercial projects become active. However, will they find buyers in a shrinking city? The authors argue that expanding the housing offer by making the pool of apartments built by developers and available to local authorities would support the influx of new residents.

Keywords: housing investment; shrinking city, public investment.

Category of the paper: Research paper.

1. Introduction – shrinking cities and recovery

The development of new industries and the disappearance of some of the old ones, lower transport costs and the transfer of production to countries with low labor costs and taxes, technological and cultural changes affecting the demand for consumer products, new structure of households are just some of the factors that, along with globalization, caused some of the dynamically developing industrial cities to enter the process of degradation. The closure of factories and a reduction in the number of employees, the outflow of population, and the lack of ideas of local politicians for new development stimulants are visible in many parts of the world (Mallach, Haase, Hattori, 2017; Martinez-Fernandez et al., 2016). The process of the formation of shrinking cities in developed countries was gradual and stretched over the years. Similarly, there were changes in the definition of shrinking cities; there are various interpretations of the phenomenon, concentrating on a continuous decrease in the total population of a given area and a structural crisis (Pallagst et al., 2013; Weaver, Bagchi-Sen, Knight, Frazier, 2016).

A similar mechanism, but with a delay and more significant dynamics, was felt by post-socialist countries. In artificially supported, centrally controlled economies, the economic calculation was not a priority, and the transformation towards a market economy caused the dramatic closure of unprofitable factories (or a significant part of them). The problems concerned mainly old industrial cities with the predominance of the heavy and textile industries (Sroka, 2022). The authorities and residents of these cities felt sudden changes, deep crisis, and shock, and younger and more active residents were looking for new places to live, often in other countries (Strykiewicz, Ciesiółka, Jaroszeńska, 2012). Researchers point out that for some post-socialist cities, the shrinking stage was a painful part of the transformation process, resulting from political-economic, socio-population, and spatial-planning reasons (Sroka, 2022). This opinion is an apparent reference to the model of the city development cycle, in which the city's decline is a driving force that leads to a shift, new opportunities, and growth. The model of Van den Berg et al. (1982) considers re-urbanization to be a specific stage in the

development of cities as part of a cyclical process; it refers to a distinct phase of urban development after a period of decline, the reversal of suburbanization, looking from the point of view of population change. The model itself has been criticized, among others, for focusing on demographic processes because currently, many factors, including economic ones, are taken into account when assessing re-urbanization processes (Lever, 1993; Champion, 2001; Rerat, 2019; Dembski et al., 2021). There is also no unification in the course of processes in individual cities; suburbanization does not end unambiguously; in some cities, this process is still ongoing, but the inhabitants of the suburbs and the immediate vicinity of the city are being exchanged due to the displacement of the less affluent to cheaper areas (Haffner, Hulse 2021; Dembski et al., 2021). The re-urbanisation process transforms many secondary post-industrial cities, like Liverpool and Leipzig (Couch, Fowles, Karecha, 2009; Kabisch, Haase, Haase, 2010; Wolff et al., 2017). Analysts have underlined that economic and demographic factors play a fundamental role, but urban policy is also important in the resurgence of cities (e.g., Ring et al., 2011; Lord, O'Brien, 2017). Public intervention takes the form of local law related to spatial planning and local privileges for investors, as well as national law defining general norms for the entire country.

Studies looking for factors stimulating urban renewal and stopping the squeeze process indicate diverse conditions and aspects influencing the final results (Haase et al., 2021). First of all, economic growth does not automatically mean an increase in the population of a given city or the stopping of depopulation processes. Comparative studies of individual cases allow for determining the paths of transformation and the causes of change. Some authors indicate land reclamation and environmental upgrading, sprawl containment, improvement in transport infrastructure, physical redesign and restoration, neighborhood renewal, creation of jobs, building new skills among citizens, civic leadership and increased participation, social inclusion, and new actors established by public institutions (Power et al., 2010; Power, Katz, 2016). Other authors focus on the long-term nature of transformations and the need for involvement on a metropolitan scale and consider the need for a long-term vision as essential factors. They emphasize the need to develop a sustainable planning strategy, the need for alliances and partnerships, strong leadership and citizen engagement, diversification of the economy, a strengthening of the central city, investment in education, culture, quality of life, heritage and urban design, and a readiness to take risks (Carter, 2016). Further researchers dealing with the urban renewal process also add active population policy and provision to attract and retain young households, families, and early-stage professionals (Haase et al., 2021).

Our paper is structured as follows. Following this introduction, we provide a summary of the role of housing in re-urbanization, presenting Łódź as a shrinking city and examining developer activity. The two case analyses are then visualized. In the discussion, we try to find answers to the research questions about the drivers of potential recovery of the city.

2. The role of housing in re-urbanization – literature review

Residential buildings with infrastructure are essential to every city. The assessment of a city from a spatial, functional, social, and economic point of view is based on the external image of this resource. The level of development, availability of infrastructure, care for old and historic properties, the aesthetics of the surroundings, and the size of green areas indicate the wealth and culture of residents and the priorities and effectiveness of local urban policy. Without a doubt, a positive image favors the settlement of new residents and encourages them to participate in the life of the local community (Mehta, 2014). On the other hand, neglected buildings with visible signs of devastation discourage people from staying in a given place and stimulate decisions to migrate to another part of the city or, further, beyond its borders. This problem is evident in post-industrial shrinking cities. Buildings abandoned by some residents quickly become victims of devastation, fires, and it is difficult to find funds for necessary repairs and renovations. This problem has not only a technical dimension but also a large social one - most often, the households that remain in the old and neglected stock are those that are not very active in striving for change; often, these are older people who do not have sufficient financial resources to improve their life situation. For the local authorities, these neglected, half-empty, devastated areas are often a problem that is difficult to cope with. The answer lies in local policy instruments, which can take very different forms, starting from stimulating the supply of affordable housing through mass demolition activities undertaken in e.g. the states of the former German Democratic Republic and ending with the regeneration of the existing stock combined with gentrification. Prices are also a significant economic factor – they can increase due to gentrification, and apartments are beyond the limit of affordability for a substantial part of the local community. Wealthy newcomers or investors purchase the better part of the housing stock, counting on profits if the city is attractive and has strong drawing power. City authorities sometimes implement the concept of inclusionary housing; they provide cheaper land for affordable/social housing (Schuetz, Meltzer, 2012). In some countries, for example, in the former GDR, massive funds are allocated for structural transformations of the housing stock (Bernt, 2009; Bernt, 2019; Glock, Häußermann, 2004). Their results, however, are not as positive as politicians expected (Radzimski, 2016; Brandt, Schmitt, 2016). Another direction is the regeneration of existing buildings and infrastructure. In each case, local authorities desire to create residential attractiveness. This attractiveness often goes hand in hand with changing the profile of households that inhabit a given area. Residential attractiveness has many dimensions and definitions (Romão et al., 2018; Girardin et al., 2009; Alexandre et al., 2010). In general, it means a housing policy and strategy to prevent demographic losses, create a social mix, and develop the productive aspect of the residential function of cities by attracting new citizens. These new residents should be mainly well-educated and belong to the upper or creative classes (Miot, 2015). However, researchers point out that the negative consequence of

such a policy may be abandoning their fate or even worsening the situation of households in a difficult life situation, not in a privileged group (Kirszbaum, 2009; Hoover, 2023).

2.1. Łódź as a shrinking city

Łódź is a city that is losing its population very fast (Table 1). In 1988, the number of inhabitants exceeded 854 thousand, but the political transformation caused the collapse of the textile industry, which was the main generator of jobs. The very high level of unemployment stimulated some residents, significantly younger and more mobile ones, to move to more attractive cities, both Polish and foreign. In 2002, there were already 789 thousand inhabitants; according to the last census in 2021, there were 670.6 thousand. The latest data from 2024 indicate a further shrinking of the city; the population dropped to 648.7 thousand. Moreover, the population structure suggests a rapidly growing group of the oldest residents and a decreasing group of the youngest. The depopulation process continues despite economic growth, a significant drop in unemployment, and a developed function as an academic and cultural center (Zasina, 2020).

Table 1

Population in thousands, 1988-2021

Year	1988	2002	2011	2021
Total	854.3	789.3	728.8	670.6
Pre-working age	192.6	127.4	102.7	97.9
Working age	520.7	510.4	465.6	382.4
Post-working age	140.2	151.5	160.5	190.2

Source: Census data.

Other researchers of the shrinking cities problem have already drawn attention to the phenomenon of Łódź; comparative studies of Leipzig, Liverpool, Ostrava, and Łódź indicated specific conditions that stimulated negative depopulation processes (Haase et al., 2021). Attention was drawn to factors that concerned the entire country and resulted from the difficulties of the transformation process, both at the institutional and socio-economic level, including inefficient spatial planning law that did not protect against suburbanization, cultural changes regarding the family model, lack of incentives for settlers from other countries, lower wages in Łódź despite its proximity to Warsaw, lack of a city renewal strategy in the 1990s (Haase et al., 2021). Other researchers have also added a significant problem of the depletion of the housing stock, especially in the city center, which contributed to the image of Łódź as a neglected, dirty, and dangerous city, unattractive to live in (Kazimierczak, Szafrńska, 2019; Szafrńska et al., 2019). In the downtown area of Łódź, there are mainly old buildings from the nineteenth century in poor condition. After the II WW, the socialist authorities took them over, and after 1989, due to change of the political system, the municipality became the owner. The local authorities tried to privatize flats as fast as possible, hoping for the end of problems with huge expenses on municipal housing. However, sitting tenants who bought dwellings for a penny did not have the means to modernize them (Wójcik, Tobiasz-Lis, 2014).

We cannot overlook the findings of consulting reports, which frequently highlight Łódź's defects and problems when comparing the largest cities in Poland (PwC, 2007; Deloitte, Targeo.pl, 2016). The local authorities responded by trying to change the city's assessment, both in the context of the country and locally. The adopted plans and strategies provided for multi-directional actions primarily focused on changing the negative image of the ruined tenement houses in the city center by conducting revitalization. The Simplified Local Revitalization Program for selected urban and post-industrial areas of Łódź was adopted by the City Council of Łódź in 2004. The first pilot projects were then initiated. For the years 2011-2020, a renovation program was adopted for Łódź municipal tenement houses. The crowning achievement of the local government was obtaining significant funds from the EU, which allowed for a substantial expansion of the work's scope (Galuszka, 2017; Kazmierczak, Kosmowski, 2018). Moreover, due to the specific location of production plants, which no longer operate in the city center, attempts were made to stimulate investment activity to develop free spaces and attract desirable residents. The Film School and other universities, the rebuilt Łódź Fabryczna Railway Station, and the revitalized EC1 power plant, which houses museum and exhibition spaces, were also used for city marketing (Zasina, Sokołowicz, Nogalski, 2020). The local government promoted the city by highlighting its central location, major works on the railway tunnel (Łódź is to become the communication center of Poland), and the proximity of the new international airport under construction. The investment in the Manufaktura shopping center, built in post-industrial degraded areas, was also crucial for the image of the city. The significant investment, which brought commercial success, began to affect the surrounding streets after a few years, stimulating their renovation and the development of buildings and squares.

2.2. Creating residential attractiveness – new housing investments in Łódź

The housing market in Łódź was considered unattractive for investors and developers for many years due to low prices and low demand; wealthier residents built individual houses on the city's outskirts (Dzieciuchowicz, Groeger, 2016). The statistics of residential units put into use reflected this: in 1995, 977 apartments were built in the entire city; in 2000, it was 1232, and in 2010, 2082. Local authorities struggled with the unmet housing needs of many low-income households. Despite having many apartments in the city's resources, due to their technical wear and tear, it was impossible to meet the growing needs (Sikora-Fernandez, 2021). A significant part of the stock should be demolished because it is unsuitable for further use. Still, only a tiny part of the ruins of tenement houses was eliminated during regeneration. Despite active privatization, the city owned many apartments (table 2), with the longest queue in Poland waiting for housing assistance (approx. 6.6 thousand households in 2022 and 4 thousand in 2023). Many municipal dwellings are vacant due to ruined buildings.

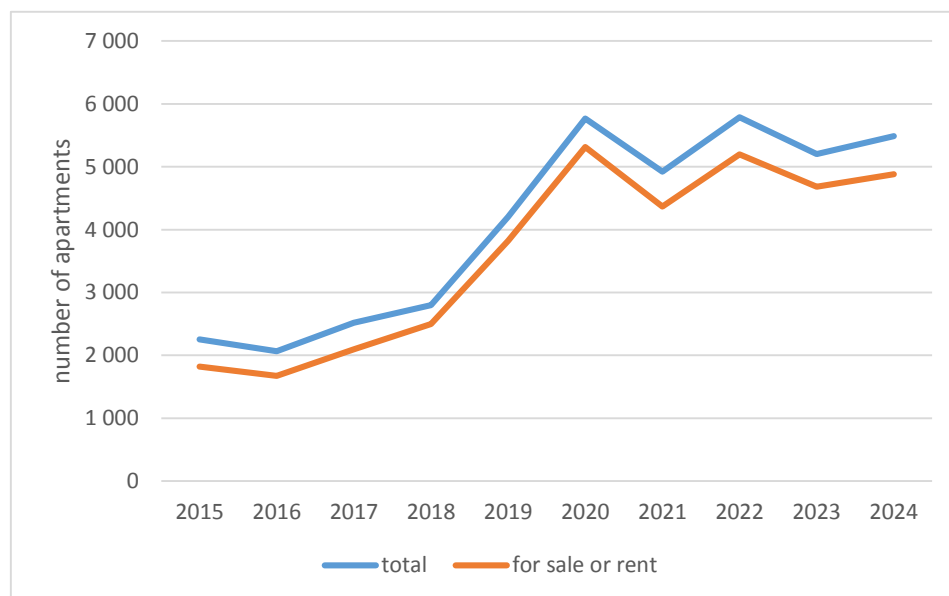
Table 2*Owners of the housing stock (apartments) in Łódź, 2002 and 2023*

	Municipality	Housing cooperatives	Companies	Individuals	Social Building Society	Other	In total
2002	77.362	144.951	8.484	96.967	814	1.857	330.435
2023	38.756	85.414	191	250.056	1.561	237	376.215

Source: CSO data.

Creating residential attractiveness and improving the city's image, by referring to the smart city concept, was to stop the depopulation processes and attract desired residents to the city. The regeneration process covered a significant part of the city center. Still, it only covered public spaces and buildings 100% owned by the city (this resulted from the principles of EU funding). The renovation of squares, arcades, and streets itself gave a lot to the city's image (Groeger, 2011; Jopek, 2018; Zdyb, 2017). The goal of the Łódź Spatial Development Strategy 2020+ was to achieve a sustainable compact city. Developers have begun to develop available plots in the city center, and apartments are finding buyers despite their higher prices than those on the outskirts. The effect of the city policy is the gentrification process, which has become visible in the city center. The revitalization processes have caused an increase in the rent rates of municipal apartments, and many residents temporarily relocated from the revitalized stock have not returned to their old places due to the costs (Tobiasz-Lis, 2014; Ogrodowczyk, 2024).

In 2016-2024, developers put into use over 35,000 apartments in Łódź, and they have been particularly active since 2019 (Fig. 1). Previously, between 2005-2015, they had built only 13.8 thousand apartments.

**Figure 1.** Apartments put into use in total and by developers in Łódź in 2015-2024.

Source: own study based on BDL.

For years, housing prices in Łódź were the lowest among the most prominent Polish cities (Table 3). The city was not considered attractive to live in. However, its proximity to the capital and the announcement of the launch of a high-speed railway started to stimulate investment demand.

Table 3

Prices of apartments sold by developers in chosen cities, 2006-2023 (PLN/1sqm)

City	2006	2010	2015	2019	2024
Warsaw	6186	7441	7462	9476	18685
Krakow	7089	6789	6357	8235	16552
Lodz	3624	4905	4697	6026	10312
Poznan	4724	6591	6234	7396	11769

Source: own work based on NBP data.

Apartment prices in Łódź are still significantly lower than in other attractive Polish cities, but the growth between 2019 and 2024 was 71.1%, in Warsaw it was 96.9%, in Kraków 100.9%, and in Poznań 59.1%.

3. Research methods

The authors were particularly interested in spatial relations between local policy, evaluated by public investments increasing the attractiveness of public spaces and housing, housing demand, and private housing projects. The authors used three research methods to achieve the assumed goal: desk research, case study, and conjunctural analysis.

The desk research method allows for collecting and analyzing data without the need to leave home. Their sources can be libraries, legal acts, databases, press articles, the Internet, and internal reports of various companies or organizations (Nowak, Kaniewski, 2016). These data were initially collected for a different purpose. In this article, the primary source of existing data was the Internet, including press articles, real estate portals, and statistical data or portals using spatial data (ŁOG maps and geoportal). On the other hand, the case study method involves an in-depth analysis of individual cases to learn and understand specific phenomena and behaviors in a natural context (Yin, 2012). According to Robinson (2006), cities' spatial phenomena help us understand different development paths that determine contemporary development processes. The case study method gives theoretical (analytical) generalization; this argument is underlined by Guba and Lincoln (1989) and Stake (1998). Even a single case study is methodologically justified due to universality, decisive significance, uniqueness, novelty, or longevity of the case (Yin, 2014). In the study presented below, the case studies were two selected areas of the city of Łódź, located in the city center, on the western and north-western sides of Piotrkowska Street.

Conjunctural analysis, in principle, is an approach that helps better understand the phenomena being studied. However, conjunctural analysis is understood very broadly here. It defines a space, moment, or place affected by various forces, causes, and determinants. Conjunctural analyses are usually used to study politically contested situations, developing crises, and specific historical turning points (Sheppard et al., 2024; Lorne et al., 2023). Initially, this method was used to understand the political actions and social and cultural movements that contributed to the defeat of the left in Italy in the early 20th century (Gramsci, 1971), later also by Stuart Hall to understand the crisis of Fordism and the rise of Thatcherism in Great Britain (Hall, 1979). It is indicated that "thinking conjuncturally allows us to historicise the present; and it is through our analysis of the present in all its complexity that we may be able to see the opportunity to take steps towards a new way of organizing society" (Grayson, Little, p. 62). Today, however, conjunctural analysis is also used to explain other phenomena, such as factors influencing the development of cruise tourism (Poort et al., 2021) or housing policy (Gustafsson, 2021). From a historical perspective, this article analyzes the development determinants that have influenced the current level of investment in two areas of Łódź. The authors focused on the reasons driving developers to start new projects in the shrinking city Łódź. Authors were particularly interested in spatial relations between local policy, evaluated by public investments increasing the attractiveness of public spaces and housing, housing demand, and private housing projects.

The study was conducted in several stages:

- first, the locations of residential development projects that have been implemented and are under implementation in the city since 2016 were analyzed,
- then, the changes in land values in Łódź between 2016 and 2024 were examined to select areas where positive changes occurred,
- the selection of locations was made focusing on areas where concentrated development activity and a significant increase in land value occurred simultaneously,
- the presence and type of public investments were identified in the two selected areas.

The time scope of the study mainly covers the years 2016-2024. This results from the availability of a conceptual map of land values presented on the Łódź Geodesy Center website. The area of Stare Polesie and the vicinity of Manufaktura were selected for detailed study, as areas where a significant increase in land value occurred during the studied period and housing and public projects were implemented. The points or areas marked on the maps indicate investments that have already been put into use or are being implemented. However, many projects that impact the implementation of subsequent ones were carried out in previous years, which was emphasized in the descriptive part of the research results. It should also be noted that the investments marked on the maps do constitute only a targeted sample that was identified based on various real estate portals, city hall websites, or press articles. Nevertheless, their number and nature allow for drawing conclusions.

4. Results

In Łódź, in recent years, there has been a significant increase in land value in specific locations (the darker the color on the maps - Fig. 2 and 4 -, the higher the value). The authors selected two areas for the study where this increase was very noticeable.

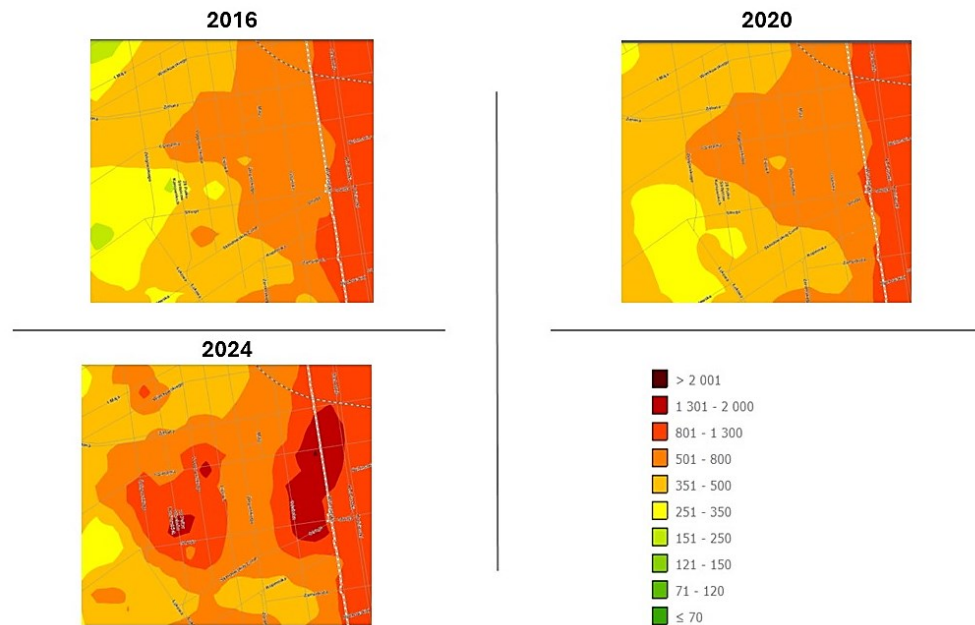


Figure 2. Change in land value in Stare Polesie in the years 2016-2024.

Source: own study based on the Conceptual Map of Land Values of the Łódź Geodesy Center.

Changes in land values in this area are evident in the vicinity of Gdańska, Wólczajska, and Zachodnia streets on the section between Zielona and Struga streets, as well as in the vicinity of 28 Pułku Strzelców Kaniowskich Street. In addition, the most significant increase in value occurred in the last four years. This is the area of Stare Polesie, where before World War II, there were many small textile factories, residences, as well as tenement houses. They were not destroyed, but after the war, they were taken over by the socialist authorities, who did not renovate the buildings (Zysiak et al., 2022). During the political transformation, many industrial plants were liquidated, contributing to a significant increase in unemployment in the city and the deterioration of post-factory buildings (Jakóbczyk-Gryszkiewicz, 2011). The buildings were subject to degradation, among others, due to the depopulation of this part of the city (Zielone Polesie..., 2017), but also due to the low level of wealth of the residents. The local government in 2010 decided to modernize the most neglected tenement houses under the Miał100 Kamienic program (since 2011), and since 2014, "Miasto Kamienic" (Janicka-Świerguła, 2017). The main task of this program was to improve the living conditions of the residents of the renovated tenement houses and the aesthetic values of these buildings while maintaining their cultural heritage (Podyma et al., 2016). The change of the image of these buildings, as well as the relocation of some residents (a part of the previous tenants, due to

higher rent rates, decided not to return to these buildings), encouraged private investors to undertake development activities (Fig. 3).

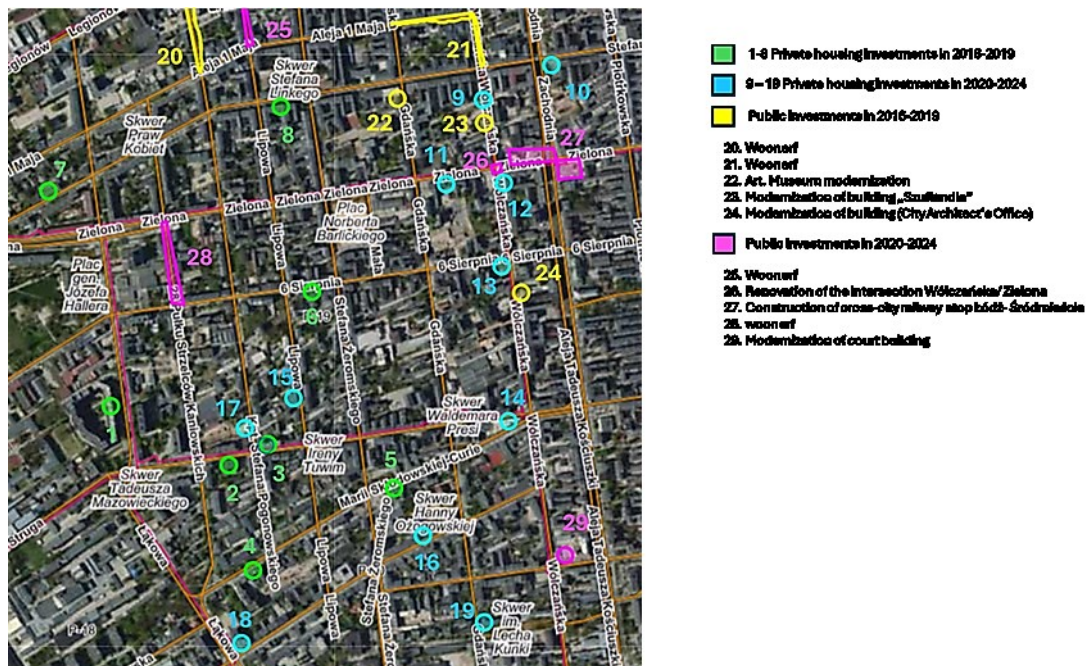


Figure 3. Public investments and private housing projects in 2016-2024 in Stare Polesie.

Source: own study based on Geoportal and internet sources.

In the years 2016-2024, several private investors undertook the implementation of housing projects, especially in the eastern and western parts of the analyzed area. The total number of projects was significant, 19 were identified in such a small area (8 in 2016-2019 and 11 after 2019). The analysis of the modernization activity of the city authorities indicates the public space and tenement houses renovations, but also new road infrastructure (including the implementation of woonerfs (Hac, 2021). Developers' interest in Wólczńska Street in recent years is probably related to its significant transformation. In 2019, the city completed, among other things, the reconstruction of the buildings at ul. Wólczńska 36, where the City Architect's Office is currently located. As part of this project, the building located on the side of the plot was also modernized – presently it is occupied by the Municipal Urban Planning Studio. The courtyard between the buildings was transformed into the Lapidarium of Architectural Detail, where decorations saved from Łódź factories, villas, and tenement houses are exhibited (Jach, 2022).

The second area of Łódź that was selected for detailed analysis is the area around Manufaktura (the border of Stare Polesie and Bałuty). Manufaktura is currently the third-largest shopping center in Poland, built on the premises of the former textile factory of Izrael Poznański. After World War II, the plants were nationalized, and since the 1980s, employment and production have seen a visible decline (Mastalerz, 2017). The systemic transformation contributed to the plant's declaration of bankruptcy. Investors and ideas for developing this huge space were sought for many years, and the buildings became more and more ruined (compare:

Michalski, 2014). Nearby, there are multi-family houses that Poznański built in the 19th century for his employees and were taken over by the state during the socialist period. Due to the plant's closure, many people lost their jobs and moved out in search of new work; the area was dangerous, and public space was devastated. The investor, the Apsys company, completed the revitalization and construction works in 2006 (Mastalerz, 2017). Since then, Manufaktura has been gaining popularity as the center of city life, not only of a commercial nature but also of a cultural and entertainment nature. However, for years, it was a kind of "island of wealth and luxury" in a devastated area, surrounded by ruined tenement houses and dangerous streets.

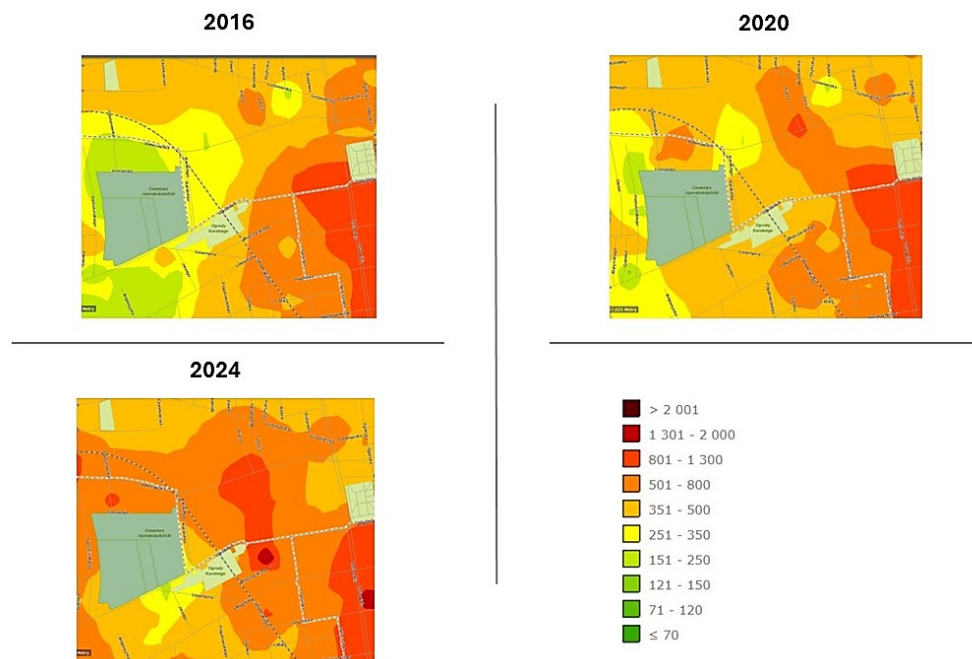


Figure 4. Change in land value in the vicinity of Manufaktura in 2016-2024.

Source: own study based on the Conceptual Map of Land Values of the Łódź Geodesy Center.

In this area, the change in land value is visible on both the northern and southern sides of Manufaktura. In 2016-2019, the first housing project appeared on the north side (Fig. 5). The south side of Manufaktura was more degraded. Although many tenement houses on Legionów Street had been previously modernized as part of the Mia100 Kamienic program, the neighborhood was devastated. Since 2017, the city has been conducting revitalization activities in this area. Roads, individual buildings, and entire blocks are being rebuilt, providing renovated public spaces.

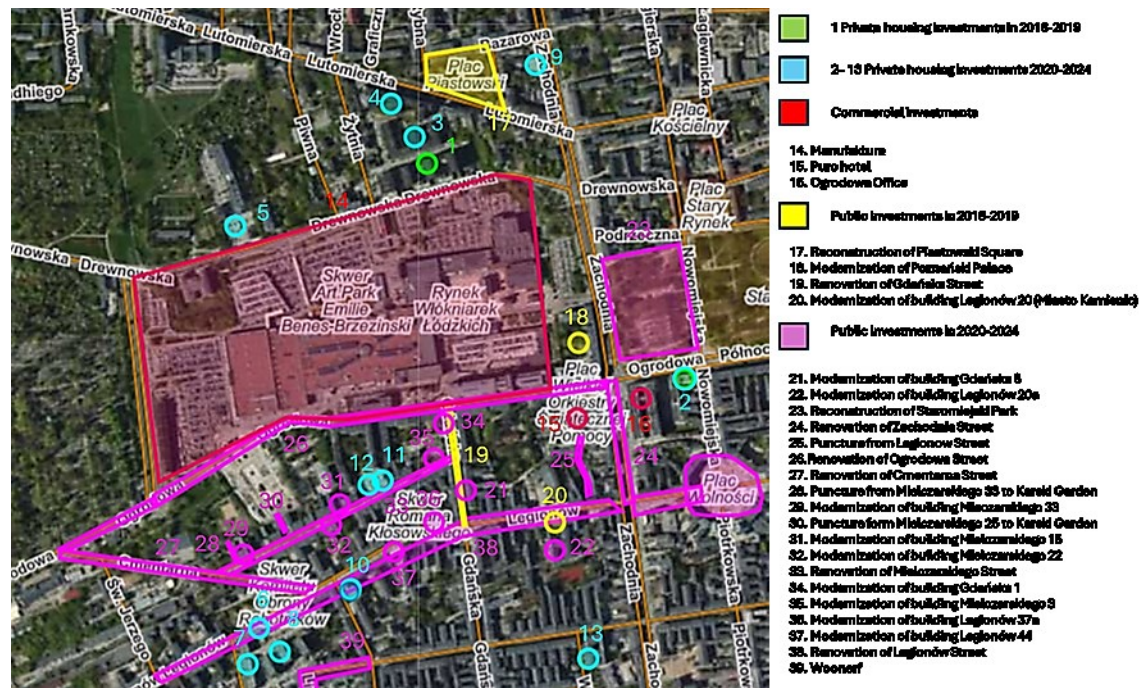


Figure 5. The most important residential and public investments in the vicinity of Manufaktura in 2016-2024.

Source: own study based on Geoportal and the Internet.

In 2018, investors built two other extensive commercial facilities near Manufaktura (an officebuilding and a hotel. In 2019, the reconstruction of the Poznański Palace, which serves as a museum, was also completed. Along with the ongoing revitalization, private investors interested in implementing housing projects also appeared on the southern side of Manufaktura. In recent years, a 3-stage investment at Legionów 66 and an investment at Mielczarskiego 9 have been started. The authors identified eleven new private housing projects in the years 2019-2024 in the analyzed area. Many public revitalization projects are currently under implementation, which may further stimulate demand for housing in these areas and increase their value in the future.

5. Discussion and conclusions

Developers and investors get involved in projects if they see the location's potential, not only the low price of land. This potential is determined by local policy. The city authorities try to stem the outflow of residents and attract new ones with desirable features, which is strongly related to creating a belief in the city's attractiveness. Intensive revitalization activities financed from public funds will not be enough to rebuild the city's image if private capital is not involved. However, many dangers and problems appear for both sides. Various households inhabit the city; some of them have a difficult life situation and are waiting for help from local authorities. There are many such households in shrinking cities. Revitalization projects often

concern problematic and excluded areas with the great potential. After making changes, sitting tenants frequently cannot afford to stay in the renovated stock; they do not come back after temporary relocation. Sometimes, new development projects are also enclaves surrounded by walls; their residents do not walk down or come into contact with native inhabitants; they create their world. Disproportions in access to education and culture are growing.

Łódź is undoubtedly an example of a specific shrinking city - unemployment is decreasing, many investments are being made, and at the same time, the number of inhabitants is constantly decreasing. Safe and aesthetic public spaces and a rich housing offer are necessary for their return and to retain residents. The cases studied indicated that developers start projects even in difficult places, on "bad" streets, because they hope to make a profit, i.e., find buyers, but this is inextricably linked to the need to change the image of a given part of the city by investing in public space and improving safety. The authorities of Łódź have been trying for many years to conduct revitalization activities, but only since 2014 have they taken on significant importance for the entire city center. Some of the analysed development projects are directly situated in revitalized areas, and others are under the influence of such areas in neighbourhood. The first signs of change became visible shortly after the revitalization began, and with each passing year, more and more organized, people-friendly spaces emerged. Moreover, residents and potential investors were aware of the broad scope of public funding works. The change was spectacular.

Construction processes are long-term, including the preparatory phase. Investors consider various socio-economic factors when they try to predict the future. Based on the authors' research, it is impossible to conclude that revitalization efforts financed by public funds are the driving force behind specific development projects. However, there is undoubtedly a correlation between improving the appearance of a city, increasing safety, and the willingness to invest, with revitalization playing a vital role here (Jadach-Sepioło, 2020). Interestingly, developers rarely include information about the transformations of analyzed areas in their marketing offers. Most often, they simply cite the excellent, central location, with good access to public transportation (including the upcoming railway), green spaces, and services. Sometimes, developers highlight the district's historic architecture and mention the proximity of Manufaktura, Poznański Palace, and Piotrkowska Street. In only a few projects, developers included information that they were being developed in areas where some revitalization work had already been carried out, while others were still underway.

In Łódź, a significant issue is the risk of overinvestment in an area with limited demand potential. In 2024, developers had a record number of apartments on sale, still waiting for buyers. They benefit from the improvement of the city's image and, at the same time, contribute to this process through their actions. The question arises whether they could cooperate with local authorities in meeting housing needs. The city authorities have a serious problem in fulfilling housing tasks. Young people are looking for a place to start a family in a more friendly environment. What if developers offered, in agreement with local authorities, a pool of

apartments in every project for municipal tenants? Of course, not for social rentals, but typical municipal ones for low-income families with children. Perhaps this is a way to attract new residents to Łódź.

In conclusion, the authors emphasize the need for cooperation between public actors, especially local authorities, and private investors to achieve favorable results in improving the city's image. The goals of the actions of the city authorities and private housing developers are different, but both sides strive to increase residential attractiveness.

References

1. 200 lat Łodzi przemysłowej. *Kronika miasta Łodzi* (2020). Urząd Miasta Łodzi. Retrieved from: https://uml.lodz.pl/files/public/dla_mieszkanca/KML_200_LAT_LODZI_PRZEMYSLOWEJ_EDYCJA_ON_LINE.pdf
2. Alexandre, H., Cusin, F., Juillard, C. (2010). L'attractivité résidentielle des agglomérations françaises. *Observateur de l'immobilier*, 76, pp. 3-66. Retrieved from: <https://www.banquedesterritoires.fr/sites/default/files/ra/Consulter%20le%20rapport%20%22L%27attractivite%20r%C3%A9sidentielle%20des%20agglom%C3%A9rations%20fran%C7aises%22.pdf>, 20.09.2024.
3. Antczak-Stepniak, A. (2022). The role of real estate development activity in the re-urbanization of cities - a case study of Łódź, Poland. *Environmental & Socio-economic Studies*, 10(4), pp. 59-70, doi: 10.2478/enviro-2022-0024
4. Bernt, M. (2009). Partnerships for demolition: The governance of urban renewal in East Germany's shrinking cities. *International Journal of Urban and Regional Research*, 33(3), pp. 754-769, doi: 10.1111/j.1468-2427.2009.00856.x
5. Bernt, M. (2019). The emergence of "stadtumbau ost". *Urban Geography*, 40(2), pp. 174-191. Doi: 10.1080/02723638.2017.1332926
6. Brandt, H.S.V., Schmitt, G. (2016). *Stadterneuerung*. Wiesbaden: Springer, pp. 214-243. Doi: 10.1007/978-3-658-05763-3
7. Carter, D.K. (2016). *Remaking post-industrial cities. Lessons from North America and Europe*. London: Routledge.
8. Champion, T. (2001). Urbanization, suburbanization, counterurbanization and reurbanization. *Handbook of urban studies*, 160(1), pp. 143-161. Doi: 10.4135/9781848608375.n9
9. Couch, C., Fowles, S., Karecha, J. (2009). Reurbanization and housing markets in the central and inner areas of Liverpool. *Planning practice & research*, 24(3), pp. 321-341. Doi: 10.1080/02697450903020767
10. Deloitte, Targeo.pl (2016). *Raport o korkach w 7 największych miastach Polski Warszawa*,

- Wrocław, Kraków, Poznań, Gdańsk, Łódź, Katowice. Retrieved from: https://korkometr.targeo.pl/Raport_Korki_2015.pdf
11. Dembski, S., Sykes, O., Couch, C., Desjardins, X., Evers, D., Osterhage, F., Siedentop, S., Zimmermann, K. (2021). Reurbanisation and suburbia in Northwest Europe: A comparative perspective on spatial trends and policy approaches. *Progress in Planning*, 150, 100462. Doi: 10.1016/j.progress.2019.100462
 12. Dzieciuchowicz, J., Groeger, L. (2016). *Nowa przestrzeń mieszkaniowa: Lofty i rezydencje w Łodzi*. Łódź: Łódź University Press.
 13. Galuszka, J. (2017). Examining patterns of policy change in a post-socialist city: the evolution of inner-city regeneration approaches in Łódź, Poland, after 1989. *Town Planning Review*, 88(6), pp. 639-664. Doi: <http://dx.doi.org/10.3828/tpr.2017.39>
 14. Girardin, F., Vaccari, A., Gerber, A., Biderman, A., Ratti, C. (2009). Quantifying urban attractiveness from the distribution and density of digital footprints. *International Journal of Spatial Data Infrastructures Research*. 4, pp. 175-200. Doi: 10.2902/1725-0463.2009.04.art10
 15. Glock, B., Häußermann, H. (2004). New trends in urban development and public policy in eastern Germany: dealing with the vacant housing problem at the local level. *International Journal of Urban and Regional Research*, 28(4), pp. 919-929. Doi: 10.1111/j.0309-1317.2004.00560.x
 16. Gramsci, A. (1971). *Selections from the prison notebooks*. London: Lawrence and Wishart.
 17. Grayson, D., Little, B. (2017). Conjunctural analysis and the crisis of ideas. *Soundings: A Journal of Politics and Culture*, 65, 59-75, Retrieved from: <https://journals.lwbooks.co.uk/soundings/vol-2017-issue-65/article-7531/>
 18. Groeger, L. (2011). Przestrzeń publiczna generatorem atrakcyjności przestrzeni mieszkaniowej wybranych osiedli mieszkaniowych w Łodzi. In: I. Jażdżewska (ed.), *Przestrzeń publiczna miast, XXIV „Konwersatorium Wiedzy o Mieście”* (pp. 217-230) Łódź: Wydawnictwo Uniwersytetu Łódzkiego. Doi: 10.18778/7525-650-5.17
 19. Guba, E., Lincoln, Y.S. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage.
 20. Gustafsson, J. (2021). Spatial, Financial and Ideological Trajectories of Public Housing in Malmö, Sweden. *Housing, Theory and Society*, 38(1), pp. 95-114, DOI: 10.1080/14036096.2019.1686061
 21. Haase, A., Bontje, M., Couch, C., Marcinczak, S., Rink, D., Rumpel, P., Wolff, M. (2021). Factors driving the regrowth of European cities and the role of local and contextual impacts: A contrasting analysis of regrowing and shrinking cities. *Cities*, 108, 102942. Doi: 10.1016/j.cities.2020.102942
 22. Hac, A. (2021). *Woonerfy po łódzku – spacer po mieście zielonych ulic*. Retrieved from: <https://uml.lodz.pl/aktualnosci-lodzpl/artykul-lodzpl/woonerfy-po-lodzku-spacer-po-miescie-zielonych-ulic-zobacz-zdjecia-id42987/2021/8/26/>, 11.08.2024.
 23. Hall, S. (1979). The Great Moving Right Show. *Marxism Today*, 23(1), pp. 14-20.

24. Hoover, D.J. (2023). The Injustice of Gentrification. *Political Theory*, 51(6), pp. 925-954. Doi: 10.1177/00905917231178295
25. Jach, P. (2022). *Jak inwestycje zmieniają Wólczńska? Budowy już trwają, kolejne w planach*. UMŁ. Retrieved from: <https://uml.lodz.pl/aktualnosci-lodzpl/artykul-lodzpl/jak-inwestycje-zmieniaja-wolczanska-budowy-juz-trwaja-kolejne-w-planach-id49151/2022/04/11/>, 11.08.2024.
26. Jadach-Sepiolo, A. (2020). *Model rewitalizacji miast polskich na tle doświadczeń niemieckich*. Warszawa: Instytut Rozwoju Miast i Regionów.
27. Jakóbczyk-Gryszkiewicz, J. (2022). Łódź u progu XXI wieku. *Studia Miejskie*, 4, pp. 131-138. Retrieved from: <https://yadda.icm.edu.pl/cejsh/element/bwmeta1.element.ojs-issn-2543-5302-year-2011-volume-4-article-2291>
28. Janicka-Świerguła, K. (2017). Rewitalizacja dziedzictwa architektonicznego Łodzi w ramach programu „Mia100 kamienic”. *Journal of Civil Engineering, Environment and Architecture*, t. XXXIV, z. 64(3/II/17), pp. 103-114, DOI:10.7862/rb.2017.157
29. Jopek, D. (2018). Procesy transformacji współczesnych miast na wybranych przykładach miast. *Budownictwo i Architektura*, 17(2), pp. 183-192. Doi: 10.24358/Bud-Arch_18_172_15
30. Kabisch, N., Haase, D., Haase, A. (2010). Evolving reurbanisation? Spatio-temporal dynamics as exemplified by the East German city of Leipzig. *Urban Studies*, 47(5), pp. 967-990. Doi: 10.1177/0042098009353072
31. Kazimierczak, J., Kosmowski, P. (2018). Post-industrial urban areas in the context of ruination, demolition and urban regeneration in a post-socialist city: Experiences of Łódź, Poland. *Finisterra*, 53(109), pp. 35-51. Doi: 10.18055/finis12092
32. Kazimierczak, J., Szafrńska, E. (2019). Demographic and morphological shrinkage of urban neighbourhoods in a post-socialist city: The case of Łódź, Poland. *Geografiska Annaler: Series B, Human Geography*, 101(2), pp. 138-163. Doi: 10.1080/04353684.2019.1582304
33. Kirszbaum, T. (2009). Un Janus aux deux visages: la diversité dans l'habitat: Réflexions sur les politiques de déségrégation résidentielle aux Etats-Unis et en France. *Raisons politiques*, 03, pp. 49-65. Doi: 10.3917/rai.035.0049
34. Lever, W.F. (1993). Competition within the European urban system. *Urban Studies*, 30(6), pp. 935-948. Doi: 10.1080/00420989320080871
35. Lord, A., O'Brien, P. (2017). What price planning? Reimagining planning as “market maker”. *Planning Theory & Practice*, 18(2), pp. 217-232. Doi: 10.1080/14649357.2017.1286369
36. Lorne, C., Thompson, M., Cochrane, A. (2023). Thinking conjuncturally, looking elsewhere. *Dialogues in Human Geography*, 14(3), pp. 1-5 doi: 10.1177/20438206231202825
37. Mallach, A., Haase, A., Hattori, K. (2017). The shrinking city in comparative perspective:

- Contrasting dynamics and responses to urban shrinkage. *Cities*, 69, pp. 102-108. Doi: 10.1016/j.cities.2016.09.008
38. Martinez-Fernandez, C., Weyman, T., Fol, S., Audirac, I., Cunningham-Sabot, E., Wiechmann, T., Yahagi, H. (2016). Shrinking cities in Australia, Japan, Europe and the USA: From a global process to local policy responses. *Progress in planning*, 105, pp. 1-48, doi: 10.1016/j.progress.2014.10.001
 39. Mastalerz, A. (2017). Oblicza transformacji obiektów przemysłowych w kontekście rewitalizacji i ochrony dziedzictwa kulturowego – na przykładach zespołów pofabrycznych z regionu łódzkiego. *Architecturae et Artibus*, 4, pp. 27-45. Retrieved from: <http://aeawa.pb.edu.pl/wp-content/uploads/2018/07/Architektura-4-2017-artykul-II.pdf>
 40. Mehta, V. (2014). Evaluating public space. *Journal of Urban design*, 19(1), pp. 53-88. Doi: 10.1080/13574809.2013.854698
 41. Michalski, M.B. (2014). Jak zrodziła się łódzka Manufaktura (czyli prawdziwa historia procesu transformacji ZPB „Poltex”). In: B. Mikołajczyk, A. Kurczewska (eds.). *Blżej praktyki – wzajemne inspiracje nauki i biznesu* (71-133). Łódź: Wydawnictwo Uniwersytetu Łódzkiego, doi: 10.18778/7969-258-3.07
 42. Miot, Y. (2015). Residential attractiveness as a public policy goal for declining industrial cities: Housing renewal strategies in Mulhouse, Roubaix and Saint-Etienne (France). *European Planning Studies*, 23(1), pp. 104-125. Doi: 10.1080/09654313.2013.820098
 43. Nowak, W., Kaniewski, R. (2016). Analiza danych zastanych generowanych przez system symulacyjny JTLS. *Zeszyty Naukowe AON*, 3(104), pp. 141-158. Retrieved from: <http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-d5654684-3a4f-4610-b7bf-168b5c09b6d8>
 44. Ogrodowczyk, A. (2024). ‘Inner-city is not the place for social housing’ – State-led gentrification in Łódź. *Cities*, 145, 104684. Doi: 10.1016/j.cities.2023.104684
 45. Pallagst, K., Wiechmann, T., Martinez-Fernandez, C. (Eds.) (2013). *Shrinking cities: International perspectives and policy implications*. Routledge.
 46. Podyma, A., Sikorska, A., Warczyńska, M., Bartosiewicz, B. (2016). Wymiar społeczny programu Mia100 Kamienic w Łodzi. In: E. Masierek (ed.), *Aktualne wyzwania polityki mieszkaniowej dużych miast w Polsce i na Ukrainie*. *Space – Society – Economy*, 15 (pp. 115-129). Doi: 10.18778/1733-3180.15.08
 47. Poort, M.E., Persson-Fischier, U., Martinsson-Wallin, H., Gansauer, F., Demuro, C., Van der Zee, A., Elf Donaldson, E., Liu, S. (2021). More or less? A conjunctural analysis of differing views on the development of cruise tourism. *Studia Periegetica*, 36(4), pp. 49-70. Doi: 10.5604/01.3001.0015.8058
 48. Power, A., Katz, B. (2016). *Cities for a small continent: International handbook of city recovery*. Bristol: Policy Press. Doi: 10.2307/j.ctt1t89dtx
 49. Power, A., Plöger, J., Winkler, A. (2010). *Phoenix cities: The fall and rise of great industrial cities*. Bristol: Policy Press. Doi: 10.2307/j.ctt9qgqch

50. PWC (2007). *Raport na temat wielkich miast Polski: Łódź*. Retrieved from: https://www.pwc.pl/pl/sektor-publiczny/raporty_lodz-pol.pdf
51. Radzimski, A. (2016). Changing policy responses to shrinkage: The case of dealing with housing vacancies in Eastern Germany. *Cities*, 50, pp. 197-205. Doi: 10.1016/j.cities.2015.10.005
52. Rérat, P. (2019). The return of cities: The trajectory of Swiss cities from demographic loss to reurbanization. *European planning studies*, 27(2), pp. 355-376. Doi: 10.1080/09654313.2018.1546832
53. Rink, D., Haase, A., Großmann, K., Bernt, M., Couch, C., Cocks, M., Violante, A., Cortese, C., Calza Bini, P. (2011). *How shrinkage and local governance are interrelated across urban Europe: a comparative view*. D12 Discussion paper Helmholtz Centre for Environmental Research. Retrieved from: https://www.ufz.de/export/data/400/39010_Shrink_Smart_WP6_D12_FINAL.pdf
54. Robinson, J. (2006). *Ordinary cities: Between modernity and development*. London: Routledge. Doi: 10.4000/belgeo.8184
55. Romão, J., Kourtit, K., Neuts, B., Nijkamp, P. (2018). The smart city as a common place for tourists and residents: A structural analysis of the determinants of urban attractiveness. *Cities*, 78, pp. 67-75. Doi: 10.1016/j.cities.2017.11.007
56. Schuetz, J., Meltzer, R. (2012). Inclusionary zoning to support affordable housing. *International encyclopedia of housing and home*, 32-36. Retrieved from: https://www.rachelmeltzer.com/uploads/1/4/5/3/14532900/appendix_11_inclusionary_zoning_encyclopedia.pdf
57. Sheppard, E., Peck, J., Leinter, H. (2024). Conjunctural analysis. In: D. Richardson et al. (eds.), *The International Encyclopedia of Geography: People, the Earth, Environment, and Technology*. Oxford: Wiley & Sons. Doi: 10.1002/9781118786352.wbieg2203
58. Sikora-Fernandez, D. (2021). Rola władz lokalnych w zaspokajaniu potrzeb mieszkaniowych mieszkańców wspólnoty samorządowej – wybrane aspekty na przykładzie miasta Łodzi. *Studia BAS*, 2, pp. 129-146. Doi: 10.31268/StudiaBAS.2021.20
59. Sroka, B.T. (2022). Urban Shrinkage as a Catalyst of a Transition, Revolving around Definitions. *Sustainability*, 14(20), 13203. Doi: 10.3390/su142013203
60. Stake, R.E. (1998). Case studies. In: N.K. Denzin, Y.S. Lincoln (eds.), *Strategies of qualitative inquiry* (pp. 86-109). Thousand Oaks, CA: Sage.
61. Strykiewicz, T., Ciesiółka, P., Jaroszevska, E. (2012). Urban shrinkage and the post-socialist transformation: The case of Poland. *Built Environment*, 38(2), pp. 196-213. Doi: 10.2148/benv.38.2.196
62. Szafrńska, E., Coudroy de Lille, L., Kazimierzczak, J. (2019). Urban shrinkage and housing in a post-socialist city: relationship between the demographic evolution and housing development in Łódź, Poland. *Journal of Housing and the Built Environment*, 34, pp. 441-464. Doi: 10.1007/s10901-018-9633-2

63. Tobiasz-Lis, P. (2014). Wpływ procesu gentryfikacji na dysproporcje w centrum Łodzi. In: A. Suliborski, M. Wójcik (eds.), *Dysproporcje społeczne i gospodarcze w przestrzeni Łodzi. Czynniki, mechanizmy, skutki* (pp. 171-185). Łódź: Wydawnictwo Uniwersytetu Łódzkiego. Doi: 10.18778/7969-240-8.08
64. Van den Berg, L., Braun, E. (1999). Urban competitiveness, marketing and the need for organising capacity. *Urban studies*, 36(5-6), pp. 987-999. Doi: 10.1080/0042098993312
65. Van den Berg, L., Drewett, R., Klaassen, L.H., Rossi, A., Vijverberg, C.H. (1982). *A study of growth and decline, Vol. 1*. Oxford: Pergamon Press. Doi: 10.1016/C2013-0-03056-3
66. Weaver, R., Bagchi-Sen, S., Knight, J., Frazier, A.E. (2016). *Shrinking cities: Understanding urban decline in the United States*. Routledge. Doi: 10.4324/9781315757582
67. Wójcik, M., Tobiasz-Lis, P. (2014). Ocena przestrzennych dysproporcji w Łodzi z perspektywy mieszkańców miasta. In: A. Suliborski, M. Wójcik (eds.), *Dysproporcje społeczne i gospodarcze w przestrzeni Łodzi. Czynniki, mechanizmy, skutki* (pp. 305-320). Łódź: Łódź University Press.
68. Wolff, M., Haase, A., Haase, D., Kabisch, N. (2017). The impact of urban regrowth on the built environment. *Urban Studies*, 54(12), pp. 2683-2700. Doi: 10.1177/0042098016658231
69. Yin, R.K. (2012). *A (very) brief refresher on the case study method. The Applications of Case Study Research*, pp. 3-20. Retrieved from: https://study.sagepub.com/sites/default/files/a_very_brief_refresher_on_the_case_study_method.pdf
70. Yin, R.K. (2014). *Case study research: Design and methods*. London: Sage.
71. Zasina, J. (2020). *Miasta studentów–miasta konsumentów. Zachowania konsumenckie studentów w rozwoju Łodzi i Turynu*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
72. Zasina, J., Sokołowicz, M.E., Nogalski, S. (2020). Lodz City Tour: The changing nature of the urban restructuring of a post-socialist industrial city. *disP-The Planning Review*, 56(2), pp. 8-19. Doi: 10.1080/02513625.2020.1794119
73. Zdyb, M. (2017). Proces rewitalizacji a jakość życia mieszkańców–projekty Zielone Polesie i woonerfy w Łodzi. *Space–Society–Economy*, 21, pp. 73-97. Doi: 10.18778/1733-3180.21.04
74. *Zielone Polesie. Miejski program odnowy dzielnicy Stare Polesie w Łodzi* (2017). Miejska Pracownia Urbanistyczna w Łodzi. Retrieved from: https://mpu.lodz.pl/files/mpu/public/PROGRAMY_DZIELNIC/zielone_polesie/7_Do_pobrania/ZP_facebook_small3.pdf
75. Zysiak, A., Kocemba-Żebrowska, J., Madejska, M., Kurkowska, E., Szymański, M., Różycka-Stasiak, W., Gruda, M. (2022). *Wielki przemysł, wielka cisza. Łódzkie zakłady przemysłowe 1945-2000*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.

LEGAL REGULATIONS ON NON-FINANCIAL REPORTING STANDARDS IN THE CONTEXT OF ESG IN THE FOOD SECTOR

Monika ZIOŁO^{1*}, Lidia LUTY²

¹ Department of Statistics and Social Policy, University of Agriculture in Krakow; monika.ziolo@urk.edu.pl,
ORCID: 0000-0003-0884-4083

² Department of Statistics and Social Policy, University of Agriculture in Krakow; lidia.luty@urk.edu.pl,
ORCID: 0000-0001-8250-8331

* Correspondence author

Purpose: In the face of growing environmental and social awareness, as well as the need for transparency in the conduct of business, environmental, social and corporate governance (ESG) issues are gaining importance in every sector of the economy, including Poland's key food sector. This article analyses the most important legal regulations at the European Union and national level that shape the approach to ESG in the Polish food sector.

Methodology: This article analyses the most important regulations at EU and national level that shape the approach to ESG in the Polish food sector. Sources of material for the analysis included sustainability reports of the United Nations, the Commission of the European Union, and information from companies already implementing and reporting ESG principles. Due to the fact that this is a new solution in the hitherto functioning principles of corporate social responsibility, publicly available sources were also used: internet and press information. Available Polish and foreign literature was used.

Findings: Adaptation to ESG principles is becoming not only a regulatory requirement, but also a strategic necessity for building the long-term value and competitiveness of Polish food companies.

Research limitations/implications: The introduction of ESG reporting under standards such as GRI, SASB, and ISSB carries significant implications for both organizations and stakeholders. First and foremost, it entails the need for greater transparency regarding the impact of business activities on the environment, society, and corporate governance. The implementation of standards such as GRI or SASB promotes global harmonization of reporting, making it easier to compare results across different entities and markets. As a result, the role of ESG reports is growing as a tool for building reputation, attracting capital, and achieving long-term value objectives for stakeholders.

Originality/Value: This paper uniquely examines how evolving legal frameworks for non-financial reporting influence ESG practices in the food sector, where environmental and social impacts are especially significant. It bridges regulatory analysis with sector-specific sustainability challenges, offering insights valuable for both academic research and industry application.

Keywords: ESG, economic indicator, non-financial reporting, sustainable development.

Category of the paper: research paper.

1. Introduction

The concept of sustainability has become a major global trend, with the international community increasingly recognising the close links between economic growth and addressing environmental, climate and social issues (Plaskowva, Bychova 2024). In this context, ESG (Environmental, Social, Governance) principles are a key element in assessing the non-financial performance of companies, reflecting their responsible approach to the environment, the creation of favourable social conditions and the provision of high quality corporate governance (PWC, 2021).

Investor and other stakeholder interest in ESG issues is steadily growing, forcing companies, including those in the agro-industrial sector, to be more transparent and accountable (Gerber, Smit, Botha, 2024).

The food sector in Poland plays an important role in the economy, providing food security and employment. However, the sector's activities are also associated with significant environmental impacts, including through greenhouse gas emissions, natural resource consumption and waste generation.

The significant environmental impact of the food sector therefore necessitates actions aimed at reforming current management practices, the appropriate use of resources in agriculture and the food processing and distribution sector. As contemporary food systems contribute to climate change, many companies operating in the food sector have adopted strategies to conduct sustainable production practices, which are crucial for human and environmental health (Ratajczak, 2016; Bobola, 2009; Gołbiewska et al., 2022).

Therefore, adaptation to ESG principles is becoming not only a regulatory requirement, but also a strategic necessity for building long-term value and competitiveness of Polish food enterprises.

The aim of this paper is to identify and analyse the key ESG regulations that are most relevant to the Polish food sector. The paper also aims to present the characteristics of ESG factors and their importance in the context of the specificity of the sector, taking into account the existing and planned changes in regulations at the European Union and national level.

2. Main areas analysed in relation to ESG

ESG was first defined in contemporary terms in a 2004 United Nations (UN) report entitled “Who cares wins” (IFC, 2004). The rapid increase in corporate interest in analysing ESG issues is linked to the adoption of the Sustainable Development Goals (SDGs) by the UN in 2015, which indicate ways to achieve global sustainable development by 2030 (UN, 2015).

These goals address global environmental challenges (e.g., natural resource depletion, biodiversity loss, climate change), social challenges (e.g., global hunger, growing inequality) and grand governance challenges (e.g., gender disparity, corruption) (Fig. 1). Although sustainability goals are set at the macro level for countries and governments, companies are considered to be the main actors committed to achieving them. Therefore, the concept of “corporate sustainability”, which reflects the idea of ensuring sustainability in business practices, has become apparent in corporate activities. This has resulted in environmental, social and corporate governance factors becoming relevant in the assessment and analysis of business.



Figure 1. Main pillars of ESG.

Source: Own study.

3. The relevance of ESG to the Food Sector

The Polish food sector is subject to a wide range of regulations at national and EU level, which increasingly take into account ESG aspects. Among the most important of these are:

- Nonfinancial Disclosure Reporting Directive (NFRD) 2014/95/EU (EC, 2014): This directive, implemented into Polish law, imposed an obligation on certain large public interest entities to report non-financial information, including data on the environment, social and labour issues, respect for human rights and anti-corruption and anti-bribery. Although this directive will be replaced by the CSRD, it represented an important step towards increasing ESG transparency.
- Sustainable Finance Disclosure Regulation (SFDR) (EC, 2019): This regulation applies to financial market players and requires them to disclose information on sustainable investments and to integrate sustainability risks into their decision-making processes. While SFDR does not directly affect food companies, it indirectly impacts them through the expectations of investors and financial institutions regarding their ESG profile.

- EU Taxonomy Regulation (EC, 2020): This regulation establishes a classification system (taxonomy) for environmentally sustainable economic activities. It aims to promote investment in projects and activities that contribute to the achievement of EU environmental objectives, such as climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, the transition to a circular economy, pollution prevention and control, and the protection and restoration of biodiversity and ecosystems. For large companies subject to the NFRD (and, in the future, the CSRD), this regulation introduces an obligation to disclose the extent to which their activities comply with the taxonomy. This is important for the agri-food sector because of its impact on the environment.
- Corporate Sustainability Reporting Directive (CSRD) (EC, 2022): This new directive will replace the NFRD and significantly expand the scope of entities required to report sustainability information. Broader groups of large companies as well as listed small and medium-sized enterprises (SMEs) will be covered by the reporting obligation. The CSRD also introduces more detailed reporting standards (European Sustainability Reporting Standards - ESRS) and an obligation to audit reported information. The directive will take effect from 2024 and will have a significant impact on the Polish food sector, increasing the scope and quality of reported ESG data.
- European Sustainability Reporting Standards (ESRS): These are standards being developed to implement CSRD. They set out detailed requirements for the information that companies will need to disclose in their sustainability reports, covering a wide range of environmental, social and corporate governance issues.

In addition, at the national level, any environmental, labour law, food safety and corporate governance regulations that indirectly affect ESG practices in the food sector are relevant (Borucki, 2021). It is also worth mentioning the initiatives and recommendations of organisations such as the Warsaw Stock Exchange (WSE), which promote ESG reporting among listed companies (WSE, 2021).

4. The role of ESG Reporting Standards (GRI, SASB, ISSB)

In addition to the aforementioned regulations, international standards and guidelines such as the Global Reporting Initiative (GRI) play an important role in shaping ESG reporting practices in the food sector. GRI standards are widely used by organisations around the world to report their economic, environmental and social impacts (GRI, 2006, 2022). GRI also offers sector-specific standards, including GRI 13 for agriculture, aquaculture and fisheries, which help companies in these sectors identify and report on the ESG issues most important to them (Horuckowava, Baudasse, 2017; Krasnodomska et al., 2024).

Other important reporting frameworks include the Sustainability Accounting Standards Board (SASB) standards, which focus on the disclosure of ESG information that is relevant to investors and impacts on company value. The International Sustainability Standards Board (ISSB) was also established in 2022 to develop global sustainability reporting standards, building on SASB standards and Task Force on Climate-related Financial Disclosures (TCFD) guidelines, among others.

The use of these standards, although often voluntary (with the exception of references in regulations such as CSRD), contributes to the comparability and quality of reported ESG information in the food sector (Tab. 1). Polish companies increasingly refer to GRI standards when preparing their sustainability reports.

Table 1.

Main aspects assessed in non-financial reporting

The Pillars of ESG	Key Aspects	Examples in the Food Sector
Environment (E)	Climate change, greenhouse gas emissions, consumption of natural resources (water, energy, land), pollution (water, soil, air), waste and its disposal, biodiversity, ecosystems	Emissions from agricultural production and food transport, crop water efficiency, use of sustainable agricultural practices, reduction of packaging waste, impact on local wildlife
Social (S)	Human rights, labour standards (health and safety, wages), community relations, food safety, product responsibility, diversity and inclusion	Working conditions on farms and processing plants, relations with local suppliers and residents, quality and safety of food products, nutritional information and food origin
Governance (G)	Governance structure, board independence, shareholder rights, information transparency, business ethics, anti-corruption, risk management, executive remuneration	Composition and functioning of the supervisory board, company information policy, internal control systems, code of ethics, investor relations, supply chain risk management

Source: Study based on Gołębiewski, 2023.

The concept of materiality plays a key role in ESG reporting. It refers to the identification and disclosure of information that has a significant economic, environmental and social impact, or that can materially influence stakeholder assessments and decisions. For the agri-food sector, relevant ESG issues may include, but are not limited to, water use, agricultural emissions, labour practices in the supply chain, food safety and relations with local communities (Topp-Becker et al., 2017; Tubiello et al., 2022; Maroun et al., 2018; Rasiah et al., 2025; Rattanasuksri et al., 2025).

In the context of GRI 13, the standard proposes a list of topics that companies in the agri-food sector should consider in their ESG reports. Identifying and focusing on relevant issues allows for more focused and valuable reports, avoiding information overload. The introduction of ESG reporting under standards such as GRI, SASB, and ISSB carries significant implications for both organizations and stakeholders. First and foremost, it entails the need for greater transparency regarding the impact of business activities on the environment, society, and corporate governance.

Harmonization of ESG standards is becoming crucial for reporting consistency. While GRI focuses on companies' impact on the environment (impact materiality) and SASB on information relevant to investors (financial materiality), ISSB strives for global harmonization. Companies must adapt their reports to different time horizons, and in the long term, a uniform global system may emerge, requiring investment in reporting processes and systems. Growing regulatory pressure (CSRD, SEC) is making ESG mandatory and requiring quality, auditability and integration with data management at a level comparable to finance. The implementation of reporting also involves additional costs and the need for ESG team members to acquire new skills related to IT system training or familiarisation with analytical tools for assessing climate risks. Although this may be a burden for the company in the short term, it may bring a competitive advantage in the long term.

ESG reporting changes the approach to management – it becomes part of strategy and risk management, not just a public relations issue. The introduction of new reporting standards also has an impact on investors and access to capital because it increases trust, facilitates financing, and failure to report risks exclusion from investment portfolios. Table 2 below shows the differences between various reporting standards (GRI, SASB, ISSB).

Table 2.

The differences between various reporting standards (GRI, SASB, ISSB)

Specification	GRI (Global Reporting Initiative)	SASB (Sustainability Accounting Standards Board)	ISSB (International Sustainability Standards Board)
Objective	Reporting an organization's impact on society and environment	Reporting financially material ESG factors	Global ESG reporting aligned with financial disclosure
Materiality perspective	Double (impact materiality) – company's impact on environment and society	Financial materiality – ESG impact on enterprise value	Financial (currently), future plans to include double materiality
Report recipients	Broad stakeholders (society, NGOs, customers)	Investors and financial markets	Investors, regulators, global capital markets
Thematic areas	Broad – environmental, social, governance	Industry-specific – financially relevant topics	Global ESG standards under IFRS S1 and S2
Obligatory nature	Voluntary (often required in EU via CSRD)	Voluntary (strongly recommended by markets)	Becoming mandatory in multiple jurisdictions
Link to financial reporting	Low (focus on non-financial impacts)	Strong (impact on financial performance)	Very strong – integrated with IFRS
Report structure	Modular, general and sector-specific indicators	Industry-specific standards (77 industries)	IFRS S1 (general), IFRS S2 (climate)

Source: own study based on standards.

The implementation of standards such as GRI or SASB promotes global harmonization of reporting, making it easier to compare results across different entities and markets. As a result, the role of ESG reports is growing as a tool for building reputation, attracting capital, and achieving long-term value objectives for stakeholders.

5. Challenges and Opportunities for the Polish Food Sector

The implementation and reporting of ESG in the Polish food sector presents both challenges and opportunities. Challenges include the lack of uniform sector-specific reporting guidelines, potential difficulties in collecting and verifying ESG data, especially for smaller companies in the supply chain, and the need for additional costs associated with implementing sustainable practices and reporting. Research indicates that the agriculture and food sector in Poland has some of the lowest rates of compliance with recommendations and quality of published data on climate reporting. Figure 2 shows a proposed sequence of steps for preparing a report that takes ESG considerations into account in medium and large companies.



Figure 1. Stages of implementing ESG Reporting According to CSRD and ESRS.

Source: Own study.

The implementation of ESG reporting in Polish food sector companies, in accordance with the EU's Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS), involves a structured, multi-phase process. It begins with an assessment of whether the company falls under the scope of CSRD based on size, turnover, and balance sheet criteria, followed by a gap analysis comparing current ESG practices with ESRS requirements.

Once obligations are confirmed, companies form a cross-functional sustainability team involving key departments such as finance, HR, production, procurement, and compliance. This team oversees the implementation and ensures sector-specific expertise, especially in areas like agricultural sourcing, environmental impact, and labor practices.

A double materiality assessment is then conducted to identify ESG topics that are most relevant, both in terms of the company's impact on the environment and society, and the financial risks and opportunities ESG issues pose to the business. This includes consultations with stakeholders such as suppliers, customers, NGOs, and local communities.

Companies then focus on establishing reliable systems for collecting ESG data, including implementing IT tools for tracking energy use, emissions, waste, and social indicators across their operations and supply chains. This is particularly important in the food industry, where upstream data from agricultural producers plays a key role in assessing product-level environmental impacts.

Next, ESG factors are integrated into corporate strategy and risk management processes. Sustainability policies are formalized, ESG targets are linked to performance indicators and executive compensation, and ESG-related risks are embedded within broader enterprise risk management frameworks.

With governance and data systems in place, the company prepares a sustainability report in compliance with ESRS, including disclosures on strategy, governance, materiality, and metrics. The report also includes information on EU taxonomy alignment and must undergo external assurance.

Finally, ESG efforts are communicated through the ESEF format and published for stakeholders including investors, customers, and regulators. Companies continue to evolve their ESG strategy, aligning it with long-term goals such as carbon neutrality or Science Based Targets, and adapting to new regulations such as the Packaging and Packaging Waste Regulation (PPWR) or the Corporate Sustainability Due Diligence Directive (CSDDD).

On the other hand, the implementation of ESG creates a number of opportunities for the Polish food sector. It can contribute to strengthening competitive advantage by building a positive image and consumer loyalty. Environmentally conscious consumers increasingly prefer products from companies that demonstrate a responsible ESG approach. In addition, a strong ESG profile can facilitate access to finance as investors increasingly consider ESG criteria in their decisions. Finally, implementing sustainable practices can lead to improved operational efficiency and cost reductions in the long term.

6. Conclusion

The Polish food sector faces the need to adapt to increasing regulatory requirements and stakeholder expectations regarding ESG. Key EU regulations such as the CSRD, together with the Taxonomy Regulation, will have a significant impact on the reporting practices and business strategies of companies in the sector. The implementation of international reporting standards, such as the GRI, can help increase the quality and comparability of disclosures.

While there are challenges to implementing ESG, it also presents significant opportunities for the Polish food sector, including strengthening competitiveness, improving access to finance and building stakeholder trust. Companies that proactively address ESG issues and integrate it into their strategy will be better prepared for future challenges and will be able to take full advantage of emerging opportunities in a dynamically changing business environment. Further support and education for companies on sustainability and ESG reporting is also needed.

References

1. Bellantuono, N., Pontrandolfo, P., Scozzi, B. (2018). Guiding materiality analysis for sustainability reporting: The case of agri-food sector. *International Journal of Technology, Policy and Management*, 18(4), 336-359.
2. Bobola, A.M. (2009). Biznes spożywczy – społecznie odpowiedzialny (The food business - socially responsible). *Roczniki Naukowe, SERiA*, XI(3), 41-45.
3. Borucki, T. (2021). *Ład korporacyjny*. PWE.
4. Conca, F.J., Manzaneque, M., Romero, M.J. (2021). The influence of ownership structure on ESG disclosure in listed companies. *Sustainability Accounting, Management and Policy Journal*, 12(5), 1077-1104.
5. Dyrektywa Parlamentu Europejskiego i Rady (UE) 2022/2464 z dnia 14 grudnia 2022 r. w sprawie zmiany rozporządzenia (UE) nr 537/2014, dyrektywy 2004/109/WE, dyrektywy 2006/43/WE oraz dyrektywy 2013/34/UE w odniesieniu do sprawozdawczości przedsiębiorstw w zakresie zrównoważonego rozwoju (Corporate Sustainability Reporting Directive – CSRD).
6. Dyrektywa Parlamentu Europejskiego i Rady 2014/95/UE z dnia 22 października 2014 r. zmieniająca dyrektywę 2013/34/UE w odniesieniu do ujawniania informacji niefinansowych i informacji dotyczących różnorodności przez niektóre duże jednostki i grupy.

7. European Parliament and Council (2019, November 27). Regulation (EU) 2019/2088 on sustainability-related disclosures in the financial services sector (OJ L 317, 9.12.2019, pp. 1-16). *Official Journal of the European Union*.
8. European Parliament and Council (2020, June 18). Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (OJ L 198, 22.6.2020, pp. 13-43). *Official Journal of the European Union*.
9. European Parliament and Council (2022, December 14). Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (OJ L 322, pp. 15-80). EUR-Lex. <https://eur-lex.europa.eu/eli/dir/2022/2464/oj/eng>
10. Gerber, R., Smit, A., Botha, M. (2024). An evaluation of environmental, social, and governance reporting in the agricultural sector. *Business Strategy & Development*, 7(1), e316.
11. Gerber, R., Smit, A., Botha, M. (2024). Table 4: Social pillar of ESG material topics for listed agribusinesses. *Business Strategy & Development*, 7(1), e316.
12. Gołębiewska, B., Łuniewski, Ł., Puławski, A. (2022). Corporate social responsibility and its implementation in dairy cooperatives in Poland. *Annals PAAAE*, 24(1), 82-92. DOI:10.5604/01.3001.0015.7474.
13. Gołębiewski, J. (2023). Znaczenie i istota ESG w sektorze żywnościowym w Polsce. *Annals PAAAE*, Vol. XXV, No. 1, DOI: 10.5604/01.3001.0016.2825
14. GPW (Giełda Papierów Wartościowych w Warszawie) (2021). *Wytyczne do raportowania ESG. Przewodnik dla spółek notowanych na GPW*.
15. GRI (Global Reporting Initiative) (2022). *GRI 13: Item 02 – GRI Sector Standards Project for Agriculture, Aquaculture, and Fishing – Final draft*.
16. Horuckova, M., Baudasse, T. (2017). Content analysis applied to social and environmental reporting. *Acta Academica Karviniensia*, 16(1), 32-45.
17. Krasodomska, J., Zarzycka, E., Dobija, D. (2024). Czynniki determinujące raportowanie przez przedsiębiorstwa informacji o działaniach podjętych na rzecz osiągnięcia celów zrównoważonego rozwoju (Sustainable Development Goals – SDGs). *Zeszyty Teoretyczne Rachunkowości*, 47(1), 99-118.
18. Kumar, S. (2023). *Environmental, Social, and Governance (ESG) in Business*. Routledge.
19. Maroun, W., Romi, A.M., Flower, J. (2018). Exploring the association between environmental disclosure and environmental performance: Evidence from the South African agricultural sector. *Meditari Accountancy Research*, 26(3), 432-457.
20. Plaskova, N., Bychkova, S., Tsydenova, E., Pushinin, A. (2024). ESG agenda in the context of economic security of agricultural enterprises. *BIO Web of Conferences*, 140, 06003 <https://doi.org/10.1051/bioconf/202414006003>.
21. PWC (2021). *Global Consumer Insights Survey 2021*.

22. Rasiah, D., Saufi, R.A. (2025). Integrating Environmental, Social, and Governance (ESG) Principles to Enhance Competitiveness in Thailand's Rice Industry. *Corporate Governance and Sustainability Review*, 9(1), 1-13.
23. Ratajczak, M. (2016). Knowledge of the concept of corporate social responsibility in agribusiness enterprises (based on the example of the SME sector in Malopolska). *Management*, 20(1), 337-351.
24. Rattanasuksri, N., Sonsuphap, R., Chatikavanij, T. (2025). Socio-economic sustainability strategy from the perspective of the agricultural business in developing countries. *Corporate Governance and Sustainability Review*, 9(1), 8-17. <https://doi.org/10.22495/cgsrv9i1p1>
25. Topp-Becker, J., Ellis, J.D. (2017). The role of sustainability reporting in the Agri-food supply chain. *Journal of Agriculture and Environmental Sciences*, 6(1), 7-29.
26. Tubiello, F.N., Karl, K., Flammini, A., Gütschow, J., Obli-Laryea, G., Conchedda, G., Rossi, S. (2022). Pre-and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems. *Earth System Science Data*, 14(4), 1795-1809.
27. Vrabcova, P., Urbancova, H. (2021). Approaches of selected organisations in The Czech Republic to promoting the concept of sustainable development and corporate social responsibility. *Agricultural Economics*, 67(7), 255-265.

ENVIRONMENTALLY-FRIENDLY MARKET BEHAVIORS OF CONSUMERS VERSUS SUSTAINABLE CONSUMPTION

Dagmara K. ZUZEK

University of Agriculture in Krakow; dagmara.zuzek@urk.edu.pl, ORCID: 0000-0002-7620-1621

Purpose: The purpose of the paper is to assess behaviors of consumers who implement sustainable consumption actions, conditions thereof and tools supporting environmentally-friendly attitudes shaping such behaviors.

Design/methodology/approach: The analysis of buying behaviors related to sustainable consumption was the main focus of the research. The research aimed at indicating the most important consumer behaviors related to sustainable consumption and factors that determine such behaviors. Also differences between declarations made by consumers and their actual behaviors were verified as well as their significance. Such diversity of attitudes opens up new opportunities for brands and institutions – it makes it possible to create personalized shopping experience that not only responds to the needs of various groups but can also affect their involvement in sustainable development in real terms.

Findings: A diagnostic poll method was applied, including an online survey technique which made it possible to reach a large number of respondents. The questionnaire included close-ended questions (single choice and multiple choice) as well as demographic questions. The questions pertained to, among other things, buying habits, environmentally-friendly actions taken by consumers, knowledge of ecology as well as factors that encourage and discourage environmentally-friendly consumer choices. The research was conducted at the end of 2024 and in early 2025 based on a sample of 350 persons (purposive sampling). The respondents included consumers aged 18 - 60, mostly the inhabitants of towns and cities).

Research limitations/implications: Sustainable consumption has become increasingly important and its impact on consumers' purchasing decisions has been increasingly clear. People have become more aware of the concept of sustainable consumption, a relatively new phenomenon in Poland, rational purchases to prevent food waste and *sustainable shopping* all of which have begun to affect daily habits. The above was confirmed by the conducted research.

Keywords: sustainable consumption, consumer market behaviors, determinants of consumption conditions.

Category of the paper: research paper.

1. Introduction

As environment problems such as climate change, air pollution and environmental degradation grow, pro-environmental attitudes have gained importance when it comes to actions taken both by institutions and households. Consumers play a special role in the process as their buying decisions have real influence on the functioning of the market and on environmental practices implemented by enterprises. Therefore pro-environmental actions taken by consumers have become a key element of sustainable growth, in that way supporting transformation towards a greener economy.

Apart from the product's price and quality, its impact on the environment is also important to modern consumers. Choosing environmentally-friendly products, avoiding plastics, relying on public transportation and limiting consumption are only some examples of actions taken by consumers who are ecologically aware.

The purpose of the paper is to assess behaviors of consumers who implement sustainable consumption actions, conditions thereof and tools supporting environmentally-friendly attitudes shaping such behaviors.

2. Conditions of sustainable consumption – a theoretical approach

To a large extent the concept of sustainable consumption refers to consumer behaviors that has not been clearly defined as an economic category. Reference books lack consistent definitions and nomenclature related to sustainable consumption (Neale, 2015).

The concept of sustainable consumption was adopted in Oslo during the Symposium on Sustainable Consumption in 1994. Sustainable consumption was defined as “the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of further generations” (www.iisd.ca).

As A. Dąbrowska and I. Ozimekek stated (2010) sustainable consumption is not simply the problem of changes of consumption but it is a strategic concept the purpose of which is to reconstruct a natural capital.

J. Zralek (2012) defines sustainable consumption as: “the form and quantity that determine pro-environmental values and consumer attitudes leading to environmental awareness and environmentally responsible process of taking market decisions”.

Sustainable consumption requires counterbalance in all possible aspects (Łuczka, 2016):

- economic: effective proportion is set between ongoing and future consumption; hence consumption processes do not significantly distort economic balance,
- ecological: usefulness of consumption is maximized with the usefulness and quality of natural resources and natural environment being preserved, allowing to directly consume natural goods, favoring such forms of consumption which are less burdensome to the environment,
- social: consumption is relatively equally distributed, i.e. it is available to all people regardless of time and space at least in regard of goods in demand, favoring such forms of consumption which result in as few social problems as possible,
- psychological: consumption processes contribute to improving the quality of life, i.e. an optimal balance between material consumption and satisfaction of material needs,
- demographic: demographic conditions do not constitute a permanent barrier to increase in consumption; life expectancy increases, health improves,
- spatial: methods of satisfying needs do not violate spatial order,
- time: said dimensions of sustainable consumption can be achieved indefinitely.

Sustainable consumption in practice requires specific transformations of both demand and supply (Adamczyk, 2012). In the former case they involve changes of patterns of consumption that mostly refer to its ecological rationality, that is choosing goods and services to be consumed which help minimize the impact on the environment throughout their entire lifecycle. In the latter case they involve decreased consumption of natural resources in production processes thanks to the improved ecological efficiency of the production of goods and services and, consequently, lower pressure of consumption on the environment.

The aforementioned definitions of sustainable consumption are narrow and focus on its ecological aspects, whereas the two remaining aspects of sustainable growth, that is, the economic and social one, are considered less important.

3. Symptoms and costs of sustainable consumption

The concept of sustainable consumption in reference books is used in regard of diverse components of consumers' market behaviors. Such approach to consumption means using goods and services that satisfy basic human needs and improve their life quality, at the same time minimizing the consumption of natural resources, toxic materials and the quantity of waste and pollutants that have been produced without jeopardizing future generations (Ryszawska-Greszczak, 2007).

Sustainable attitude to consumption can be seen in (Bywalec, 2007):

- the rational use of consumer goods,
- reducing the consumption of such goods that are highly absorbent of rare, non-recoverable resources of the Earth and at the same time produce hazardous consumer waste,
- buying and consuming goods that produce a very small amount of waste,
- consuming so-called ecological goods (mostly food) being goods that are not supplemented with imitations, e.g. artificial protein, artificial leather, artificial wood,
- consuming goods that do not come from non-humanitarian livestock farms as well as slave labor or poorly paid work.

According to K. Mazurek-Łopacińska and M. Sobocińska (2009) that issue involves “adopting an attitude towards the world as part of which consumer behaviors are consistent with principles of the protection of natural environment” (Mazurek-Łopacińska, Sobocińska, 2009). D. Kielczewski’s (2005) view of sustainable consumption is similar: “the greening of consumption should mean growing interest in ecological issues and health properties of goods being consumed as well as promoting respect towards natural environment” (Kielczewski, 2005). Sustainable consumption aims at minimizing the adverse impact of individuals’ consumer behaviors on the condition of the environment (Zalega, 2015).

Being a responsible consumer means being aware of the consequences of one’s decisions as well as being willing to limit their adverse effects and, consequently, benefitting from such action. Benefits resulting from decisions taken by the consumer may relate to the natural environment, standards of living of certain communities (limited child labor, unfair work conditions etc.) as well as the consumer themselves, their health, well-being, the situation of their family and friends or their local environment where they have been functioning. A responsible consumer is also aware of costs of taking decisions resulting from their attitude.

There are three pillars of sustainable consumption: a consumer’s environmental imperative, a change of how an individual functions as a consumer and environmental awareness, where the ecological imperative means taking into account goods of the natural environment throughout the entire process of satisfying consumer needs (Kryk, 2011).

Socially responsible consumers may demonstrate different behaviors (Bylok, 2016):

1. purchasing consumer goods that have been manufactured in a manner that is least harmful to the natural environment,
2. consuming so-called ecological goods (mostly foods) without artificial additives, preservatives etc.,
3. acquiring goods recognized as ethical, that is, paying attention to the ethics of their manufacturing process, e.g. fair trade coffee or products manufactured without violating the dignity of workers involved in the manufacturing process,

4. acquiring goods produced at lowest environmental and social costs, e.g. acquiring cleaning agents with a relatively low content of harmful chemical compounds, biologically neutral food for children,
5. promoting environmentally-friendly lifestyles, e.g. voluntary simplicity of consumption, slow food,
6. promoting awareness of being co-responsible for risks related to overconsumption and overproduction of post-consumption waste among other consumers, e.g. on social media sites,
7. participating in actions aimed at reducing consumption, e.g. in consumer co-operatives, pro-ecological movements”.

4. Environmentally-friendly consumer behaviors – the author’s own research

A quantitative survey was conducted in order to determine environmentally-friendly consumer behaviors and identify major factors impacting buying decisions that help protect natural environment. It allowed to collect statistical data on consumers’ pro-environmental behaviors and to identify relationships between variable. The quantitative method was selected with a view to obtaining cross-sectional data from a larger group of respondents and drawing generalized conclusions. A diagnostic poll method was applied, including an online survey technique, which made it possible to reach a large number of respondents. The questionnaire included close-ended questions (single choice and multiple choice) as well as demographic questions. The questions pertained to, among other things, buying habits, environmentally-friendly actions taken by consumers, knowledge of ecology as well as factors that encourage and discourage environmentally-friendly consumer choices. The research was conducted at the end of 2024 and in early 2025 based on a sample of 350 persons (purposive sampling). The respondents included consumers aged 18-60, mostly the inhabitants of towns and cities). Such selection of the sample made it possible to obtain diversified answers and analyze differences in environmental attitudes in various demographic groups. Although the sample is not representative for the entire population of Poland, it is a source of important information about trends and attitudes among consumers who are more environmentally aware as well as about an urban lifestyle.

Approximately 35% of the respondents stated that they understood the concept of sustainable consumption. The higher the education level, the larger the number of respondents who understand the concept (45% of respondents with higher education, 37% with intermediate education, 21% with lower education). The youngest respondents (18-24 years) hardly understood the concept which may be surprising because children as young as those attending

elementary schools are taught about environmental issues, e.g. about waste segregation. In the context of preserving natural environment for future generations, that age group is prone to suffering the most from adverse environmental changes. A demographic analysis also led to interesting conclusions. Namely, women and respondents with higher education are more inclined to adopt pro-ecological attitudes which is consistent with the results of other research in that area. The above shows, among other things, that educational activities need to be targeted at less environmentally active groups, e.g. younger men or people with lower education. The awareness of the concept of sustainable consumption increases with the increase of the income of the respondent and their household.

The respondents most often stated that sustainable consumption involved: saving resources for future generations (45%); saving energy, water, preventing air pollution (38%); increased expenditure towards the protection of natural environment (28%). Only approx. 12% of the respondents were unable to define sustainable consumption. In particular, the above referred to older people, including those poorly educated and less wealthy ones.

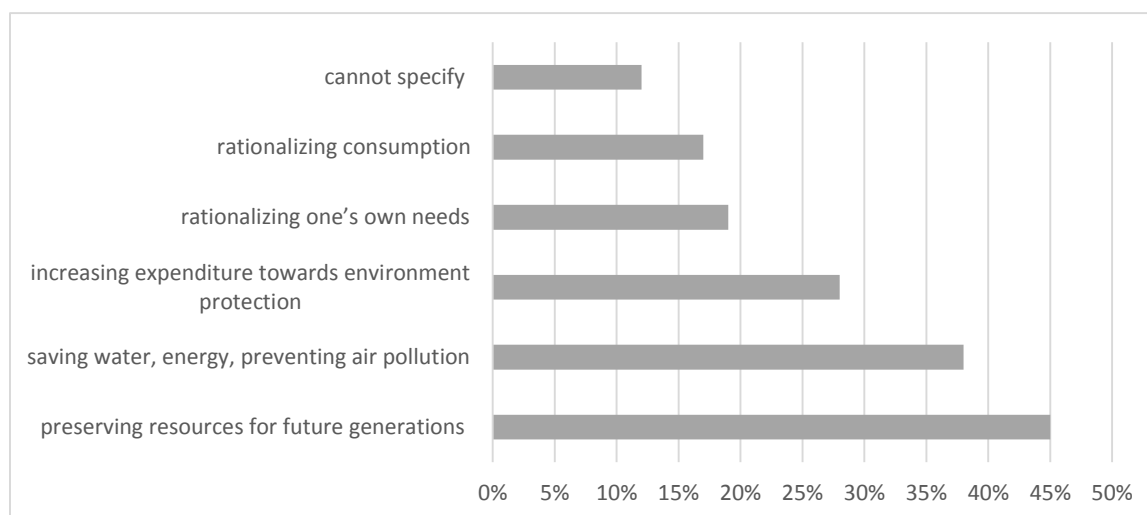


Figure 1. Understanding the concept of sustainable consumption.

Source: own research.

The respondents attached different contexts to sustainable consumption. Based on the definition of sustainable consumption as “responding to consumer needs so as not to jeopardize the needs of further generations”, 67% of the respondents confirmed that they live by the sustainable consumption concept, 35% of the respondents stated that they live by that rule to a large degree, whereas nearly 9% said that they did not. As regards income, education or place of residence, the respondents with higher education and higher incomes who live in larger towns/cities have been implementing the concept of sustainable consumption and satisfying their needs in accordance therewith. The research shows that ecological awareness of consumers is relatively high – as many as 73% of the respondents have noticed that their daily choices affect the environment. The above may show that the knowledge and interest in environmental issues in the society have grown, perhaps due to educational campaigns and the presence of environmental issues in media.

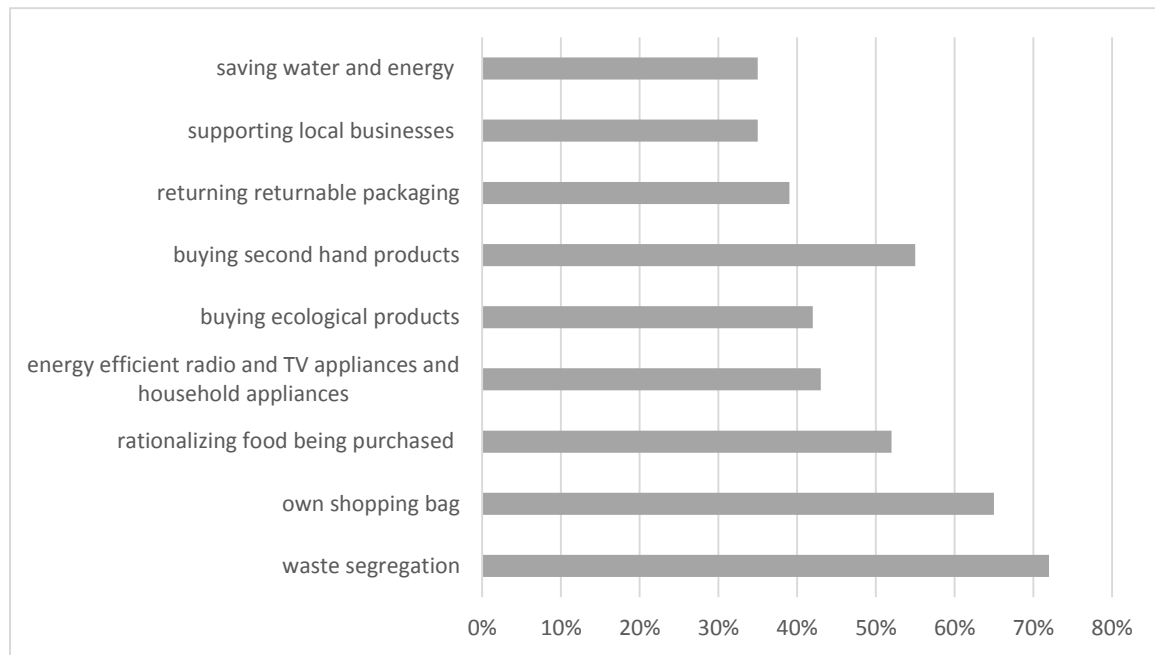


Figure 2. The implementation of the concept of sustainable consumption by respondents.

Source: own research.

In the course of the research the respondents were requested to specify behaviors that most accurately reflect sustainable consumption; the respondents most frequently listed the following: waste segregation (72%) and using their own shopping bags (65%). Those are the activities that do not require significant financial expenditure or changes in lifestyle which validates the thesis that the respondents are most eager to become engaged in environmental activities that are easy to implement and plausible. Other responses included: buying such quantities of products that the respondents are able to consume (52%), using energy efficient radio and television appliances as well as a household appliances (43%), saving water and energy (35%). On the other hand, the respondents were less eager to buy products marked as environmental, even though such products were important from the market perspective (less than 50% of the respondents). The above shows that there are still barriers, mostly those related to prices of and access to such products. As many as 64% of the respondents indicated a higher price as a major obstacle preventing them from pro-ecological purchases which, in turn, is the confirmation that the economic aspect remains to be a key obstacle in adopting an environmental attitude.

Some respondents stated that, as part of sustainable consumption, they return returnable packaging or buy second-hand clothing, compost waste or give things a second life by repairing or remodeling them or looking for their new applications. On the other hand, the respondents stated that they hardly use electric cars or support environmental campaigns.

5. Summary

The purpose of the research was to investigate consumer attitudes as regards pro-environmental behaviors and to determine factors that affect their buying decisions in the context of the protection of the natural environment. The analysis of the results of the research showed that the majority of the respondents had a high level of ecological awareness and were willing to engage in activities supporting sustainable growth.

Mostly the consumers are intrinsically motivated by values such as the concern about the natural environment and health. Also demographic differences turned out to be important – women and persons with higher education are more environmentally active.

A high level of ecological awareness does not always result in specific buying decisions, while high prices and limited access to ecological products are major barriers.

Most frequently consumers become engaged in environmental activities that are habitual and effortless. The above proves that solutions are needed that will facilitate making ecological choices in daily life.

There is a particular evident need to intensify educational activities in the area of the protection of natural environment, especially in social groups that are less environmentally active such as younger people, men and persons with lower education.

References

1. Bylok, F. (2016). *Konsumpcja hedonistyczna a konsumpcja etyczna. Czy potrzebna jest społecznie odpowiedzialna konsumpcja* [Hedonistic consumption versus ethical consumption. Do we need socially responsible consumption?], *Studia i Prace WNEiZ US*, no. 44/2, pp. 39-55.
2. Bywalec, Cz. (2007). *Konsumpcja w teorii i praktyce gospodarowania* [Consumption in theory and practice of management]. Warszawa: PWN.
3. Dąbrowska, A., Ozimek, I. (2010). *Zrównoważona konsumpcja i produkcja jako atrybut współczesnych społeczeństw i gospodarek* [Sustainable consumption and production as an attribute of contemporary societies and economies. In: L. Woźniak, E. Strojny, E. Wojnicka (eds.), *Ekoinnowacyjność dziś i jutro – wyzwania, bariery rozwoju oraz instrumenty wsparcia* [Eco-innovativeness today and tomorrow - challenges, barriers to development and support instruments]. Warszawa: PARP.
4. Kiełczewski, D. (2005). *Style konsumpcji jako przejaw różnicowania poziomu życia*. [Consumption styles as manifestation of diversified standards of living.] *Gospodarka Narodowa*, 5-6, 87-100.

5. Kryk, B. (2011). *Konsumpcja zrównowazona a proekologiczne style życia* [Sustainable consumption versus pro-environmental lifestyles]. *Studies & Proceedings of Polish Association for Knowledge Management*, 51, 206-218.
6. Łuczka, W. (2016). *Zrównowazona konsumpcja i uwarunkowania jej rozwoju* [Sustainable consumption and conditions of its development]. *Handel Wewnętrzny*, 6(365), 136-145.
7. Mazurek-Łopacińska, K., Sobocińska, M. (2009). Ekologiczna płaszczyzna społecznej odpowiedzialności przedsiębiorstw [Ecological aspect of Corporate Social Responsibility]. In: T. Borys, B. Fiedor (eds.), *Ekonomia. Gospodarka a środowisko*, 5. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 79. Wrocław: Uniwersytet Ekonomiczny we Wrocławiu.
8. Neale, A. (2015). *Zrównowazona konsumpcja. Źródła koncepcji i jej zastosowanie* [Sustainable consumption. Sources of the concept and its application]. *Prace Geograficzne*, no. 141.
9. Ryszawska-Greszczak, B. (2007). Ekologiczny wymiar konsumpcji żywności [Ecological dimension of food consumption]. *Ekonomia i Środowisko*, no. 1(31).
10. www.iisd.ca, 11.04.2025.
11. Zalega, T. (2015). Innowacje a konsumpcja i zachowania konsumpcyjne – wybrane zagadnienia [Innovations versus consumption and consumer behaviours - selected issues]. In: R. Nestorowicz (ed.), *Oznakowanie produktów żywnościowych a zrównowazona konsumpcja* [Marking food products versus sustainable consumption] *Journal of Agribusiness and Rural Development*, 3(37), 487-493.
12. Zrałek, J. (2012). Dekonsumpcja jako przejaw proekologicznych zachowań konsumentów. [Deconsumption as a sign of pro-ecological consumer behaviors]. *Handel Wewnętrzny*, maj-czerwiec, vol. II.

GREEN QUOTAS IN PARTICIPATORY BUDGETS OF CITIES WITH COUNTY RIGHTS

Agnieszka ŻOŁĄDKIEWICZ-KUZIOLA

Nicolaus Copernicus University in Toruń, Faculty of Economic Sciences and Management;
a_zoladkiewicz@umk.pl, ORCID: 0000-0001-5475-4826

Purpose: The aim of this article is to identify cities with county rights in Poland that, within their participatory budgets for 2026, have allocated green quotas - funds intended for the implementation of pro-environmental projects.

Design/methodology/approach: To achieve the article's objective, an analysis was conducted of resolutions, ordinances, and regulations defining the functioning of participatory budgets in 66 cities with county rights in Poland.

Findings: The analysis revealed that only 9 out of 66 cities with county rights allocated green quotas in their participatory budgets, suggesting that this solution remains marginal and lacks national standardization. Among the cities that adopted this approach, there are significant differences in the percentage share of green quotas in the participatory budgets, as well as in per capita and per square kilometer allocations.

Research limitations/implications: The analysis is limited to cities with county rights, excluding smaller municipalities, which narrows the research perspective. The findings may serve as a starting point for a broader debate on the role of participatory budgets in implementing local pro-environmental projects.

Practical implications: Introducing a requirement to allocate green quotas in participatory budgets should be considered, as it may enhance the effectiveness of financing local pro-environmental initiatives.

Social implications: Mandating green quotas in participatory budgets could increase environmental awareness and strengthen community engagement in environmental protection efforts.

Originality/value: The originality of this study lies in the comprehensive analysis of resolutions, ordinances, and regulations governing participatory budgets in all 66 cities with county rights in Poland, specifically for the 2026 budget year.

Keywords: participatory budget, green quotas, pro-environmental initiatives, cities with county rights.

Category of the paper: Research paper.

1. Introduction

Climate change is one of the most serious challenges of the 21st century. Long-term climate observations indicate a continuous warming trend, manifested in the rise of the average global air temperature. According to the Intergovernmental Panel on Climate Change (IPCC), the global average temperature has increased by 1.1°C compared to the pre-industrial era (IPCC, 2023). Estimates suggest that if current levels of greenhouse gas emissions persist, the global temperature could rise by 3-5°C by the end of the 21st century (Państwowe Gospodarstwo Wodne Wody Polskie, 2025). As a result of rising global temperatures, a number of adverse changes in the natural environment are being observed, such as ocean warming, increasing acidification, glacier and ice sheet melting, and the thawing of permafrost in polar regions. Climate warming also contributes to the intensification of extreme weather events, including storms, hurricanes, tornadoes, squalls, and heavy rainfall leading to floods (Hajto et al., 2021). The consequences of climate change are not limited to environmental degradation but also include significant social, economic, and health impacts (Muras, 2018).

Due to the growing importance and multidimensional effects of climate change, various actions are being taken to mitigate it. These include the implementation of climate policies (Rozwadowska, 2023; Bera et al., 2025), the development of renewable energy sources (Gayen, Chatterje, Roy, 2024), the adaptation of infrastructure to new climate conditions (Pamukcu-Albers et al., 2021), and the promotion of sustainable lifestyles (Instytut Rozwoju Myśli Ekologicznej, 2024).

Climate action can take place at the global, national, regional, and local levels. Increasingly, society is being engaged in initiatives aimed at combating climate change. One of the tools that enables residents to actively participate in such efforts is the participatory budget, within which funds can be allocated for pro-environmental initiatives – so-called green quotas.

The aim of this article is to identify cities with county rights in Poland that, within their participatory budgets for 2026, have allocated green quotas – resources designated for the implementation of pro-environmental projects. Achieving this goal will allow for an assessment of the extent to which local governments incorporate environmental issues into the process of social participation.

2. The essence of participatory budgeting

Participatory budgeting aligns with the philosophy of local government functioning as a community of authorities and residents of a given territorial unit. It is a tool that allows residents to co-decide on the allocation of a portion of the municipal budget for specific

purposes. On one hand, participatory budgeting activates society; on the other, it helps tailor city management more closely to residents' needs. The main goal of introducing participatory budgeting is to involve various social groups in managing local affairs, build social bonds through the implementation of shared ideas, and rebuild citizens' trust in authorities (Rzeńca, 2018).

The idea of participatory budgeting first emerged in the Brazilian city of Porto Alegre in the late 1980s (Krenjova, Raudla, 2013). The concept was developed by urban movements opposing the authorities and was primarily intended to empower society and remove part of local governance from military control. The essence of participatory budgeting was to conduct public consultations during which decision-makers and residents jointly determined the directions of urban investments. Ensuring a constant flow of information about the progress of implemented tasks was also important. The successful implementation of participatory budgeting in Porto Alegre was made possible by the simultaneous occurrence of three factors: grassroots initiative, strong support from local authorities, and approval from central authorities. The introduction of participatory budgeting in Porto Alegre proved to be a great success. By 2008, it had been implemented in about 200 Brazilian cities, covering over 44 million residents (Krasnowolski, 2020).

In Poland, the idea of introducing the first participatory budget appeared in Sopot in 2010, initiated by the Sopot Development Initiative¹. Initially, the idea did not gain much support among city officials. However, thanks to intensive educational and promotional efforts by the Sopot Development Initiative, the City Council eventually passed a resolution introducing the participatory budgeting mechanism (Szaranowicz-Kusz, 2014). Out of several hundred projects submitted by residents, a dozen or so were selected for each of Sopot's four districts, along with 22 city-wide projects. In the vote on the first edition of the participatory budget in Sopot, 2410 valid votes were cast out of over 32,000 eligible voters. As a result of this first edition, the following investments were implemented:

- design work for a bicycle path from 3 Maja Street to Ergo Arena,
- completion of investments near Łokietka Street 49-55,
- permanent installation of benches at the market on Polna Street,
- renovation of stairs from 23 Marca Street to the church,
- installation of new benches on the way to the church,
- construction of a multi-space parking lot near the kindergarten in Brodwinio.

Initially, the participatory budget in Sopot was treated as an experiment, which unexpectedly gained traction and quickly earned recognition in other cities. Just a year later, participatory budgeting began operating in Elbląg, Poznań, and Zielona Góra (Leśniewska-Napierała, 2017).

¹ The Sopot Development Initiative is an informal group working in Sopot to implement the demands of sustainable development and increase residents' participation in decisions that affect them.

Until January 30, 2018, there were no legal provisions defining or regulating the functioning of participatory budgets in Poland. Participatory budgets were created solely based on the general statutory powers of local government units. It was only with the adoption of the Act of 11 January 2018 (Ustawa z dnia 11 stycznia 2018 r.), which entered into force on 31 January 2018, that the principles of operation of the participatory budget were indicated in individual local government acts (Ustawa z dnia 8 marca 1990 r., art. 5a; Ustawa z dnia 5 czerwca 1998 r. o samorządzie powiatowym, art. 3d; Ustawa z dnia 5 czerwca 1998 r. o samorządzie województwa, art. 10a). According to the Act of March 8, 1990, on municipal self-government, cities with county rights are legally required to create a participatory budget annually. Moreover, in these cities, the participatory budget must amount to at least 0.5% of the expenditures listed in the most recent budget execution report (Ustawa z dnia 8 marca 1990 r., art. 5a, ust. 5). In other local government units, both the creation and the amount of the participatory budget are voluntary.

The participatory budgeting process typically includes several stages. The first involves determining the amount of funds and the rules for budget implementation. Next, residents submit their project proposals. These are then verified by the local administration, and a list of eligible projects is prepared. In the fourth stage, residents vote, and finally, the winning projects are included in the local government's budget plan (Dolewka, 2015).

Participatory budgets can fund any projects that fall within the responsibilities of the local government unit. For example, projects may concern the following areas (BO2025 podstawowe informacje, 2025):

- education – organizing workshops, preventive classes, purchasing books, games, educational aids,
- transport and traffic organization – building bike paths, sidewalks, road repairs,
- culture – organizing festivals, concerts, fairs, art classes, film screenings, theater performances, exhibitions,
- public space – purchasing benches, trash bins, bike racks, developing squares and green areas,
- sports and recreation – building sports fields, playgrounds, dog parks, outdoor gyms, organizing sports events and activities,
- health and social policy – organizing preventive health screenings, installing defibrillators, promoting social integration,
- greenery and environmental protection – planting trees and shrubs, installing air quality sensors, solar panels, managing rainwater.

In practice, participatory budget funds are divided into various types of pools. One criterion is territorial. For example, in Lublin, there are district and city-wide project pools. District projects serve the residents of a specific district, while city-wide projects address the needs of multiple districts or are not tied to a specific area (Zasady Budżetu Obywatelskiego..., 2025).

Another criterion is the project's value. In Leszno, for instance, funds are divided into small and large projects. A small project is an investment not exceeding 350,000 PLN, while a large one exceeds 350,000 PLN but does not surpass 800,000 PLN (Uchwała nr VII/117/2024). Funds can also be divided thematically. In Przemyśl, for example, projects are categorized into three types (Budżet Obywatelski 2026, 2025):

- category I – construction and modernization of neighborhood infrastructure,
- category II – social, cultural, educational, or sports activities,
- category III – community integration activities held exclusively within neighborhoods.

Within the thematic criterion, so-called green quotas can also be identified. The term green quotas, as used in this study, does not have a standardized definition in the existing literature. Therefore, for the purposes of this paper, green quotas are understood as a portion of participatory budget funds allocated specifically for the implementation of pro-environmental projects – that is, initiatives aimed at facilitating urban adaptation to climate change, improving the condition of the natural environment, and supporting the well-being of animals. Projects implemented with funds from green quotas may include, among others, the planting and maintenance of vegetation in urban green areas, the construction of rain gardens, as well as the renovation and modernization of existing green space development.

Green quotas are also referred to as green budgets, climate budgets within participatory budgeting, or simply funds for green projects. Green quotas within participatory budgets should not be confused with independent green budgets, which are separate financial instruments – their funds are not part of participatory budgets. Independent green budgets, functioning outside of participatory budgeting frameworks, exist in cities such as Lublin (W koronach drzew..., 2025) and Katowice (Zielony budżet, 2025).

3. Methods

To achieve the objective of this article, an analysis was conducted of resolutions, ordinances, and regulations defining the principles of participatory budgeting in selected local government units. The subject of the analysis included documents related to participatory budgets planned for implementation in 2026. The selection of cities whose documents were analyzed was based on the criterion of having the status of a city with county rights. This decision stemmed from Article 5a of the Act of March 8, 1990, on municipal self-government, which stipulates that cities with county rights are legally required to establish a participatory budget. The analysis covered documents from all 66 cities with county rights operating in Poland.

As a result of the research, the study identified which of these cities allocate green quotas within their participatory budgets, i.e., funds directly designated for the implementation of pro-environmental projects. Additionally, the following indicators were compiled:

- the share of green quotas resources in the total value of the participatory budget,
- the value of green quotas resources per person,
- the value of green quotas resources per square kilometer of city area.

4. Results

The allocation of green quotas in participatory budgets for 2026 remains a rarely used practice among cities with county rights. Based on the analysis of publicly available documents, only 9 out of 66 such cities (13.64%) decided to allocate funds specifically for pro-environmental activities within their participatory budgets. These cities are: Biała Podlaska, Chełm, Gdańsk, Gdynia, Jelenia Góra, Kalisz, Koszalin, Poznań, and Włocławek.

An analysis of the rules for creating participatory budgets in these cities shows that the projects submitted under green quotas primarily concern planting vegetation, establishing and maintaining flower meadows, and revitalizing parks, squares, and other green areas. In Gdańsk, Gdynia, Koszalin, Poznań, and Jelenia Góra, it is also possible to submit projects related to rainwater management, such as creating rain gardens or building retention reservoirs. Projects may also include animal welfare initiatives, such as sterilization and microchipping programs or creating habitats for birds and insects. These types of initiatives can be implemented under green quotas in Biała Podlaska, Koszalin, and Jelenia Góra. In Gdynia, Chełm, and Koszalin, it is also possible to submit educational and social projects aimed at shaping pro-environmental attitudes among residents. This indicates that green investments are treated not only as changes in urban space but also as tools for social impact. Additionally, in Gdynia, projects related to bicycle infrastructure that support CO₂ emission reduction, as well as the development of recreational infrastructure and small architecture, can be submitted – provided that their implementation aligns with environmental goals (Obwieszczenie Rady Miasta Biała Podlaska z dnia 4 marca 2025 r.; Regulamin Budżetu Obywatelskiego Miasta Chełm, 2025; Uchwała nr V/29/2019; BO2025 podstawowe informacje, 2025; Regulamin Jeleniogórskiego Budżetu Obywatelskiego na rok 2026, 2025; Regulamin Budżetu Obywatelskiego Miasta Kalisza na 2026 rok, 2025; Uchwała NR VII/67/2024; Uchwała Nr XVII/318/IX/2025; Uchwała Nr XXIV/100/2020).

The amount of funding allocated in 2026 for pro-environmental projects within participatory budgets in cities with county rights varies significantly (Table 1). To better illustrate this issue, it is useful to refer to the share of green quotas resources in the total participatory budget of each city with county rights.

Among the analyzed cities, the highest share of green quotas resources was recorded in Gdańsk, where it amounts to 22.63%, translating to over 5.6 million PLN allocated for pro-environmental projects. A relatively high share is also observed in Włocławek (16.05%), Jelenia Góra (13.92%), and Poznań (12.78%). In contrast, relatively low shares were recorded in Koszalin (5.98%), Biała Podlaska (4.74%), and Gdynia, where it is only 0.79%.

Table 1.

Value of participatory budgets and green quotas in cities with county rights in 2026

Cities with county rights	Participatory budget [in PLN]	Green quotas [in PLN]	Share of the green quotas in the participatory budget [in %]
Biała Podlaska	2 850 000.00	135 000.00	4.74%
Chełm	2 800 000.00	280 000.00	10.00%
Gdańsk	24 911 819.00	5 636 508.00	22.63%
Gdynia	12 637 621.00	100 000.00	0.79%
Jelenia Góra	4 310 000.00	600 000.00	13.92%
Kalisz	5 100 000.00	530 000.00	10.39%
Koszalin	5 020 000.00	300 000.00	5.98%
Poznań	31 300 000.00	4 000 000.00	12.78%
Włocławek	4 765 000.00	765 000.00	16.05%

Source: Author's own elaboration.

In analyzing green quotas in individual cities with county rights, it is also worth considering the value of funds allocated for pro-environmental projects per person (Figure 1). This indicator shows the extent to which local governments engage in environmental efforts per resident, which may reflect local priorities and concern for residents' quality of life.

Gdańsk is the clear leader in this ranking, allocating 11.53 PLN per person for pro-environmental projects. It is followed by Jelenia Góra (8.09 PLN), Włocławek (7.69 PLN), and Poznań (7.46 PLN). The lowest values were recorded in Koszalin (2.85 PLN), Biała Podlaska (2.51 PLN), and Gdynia – only 0.42 PLN per person.

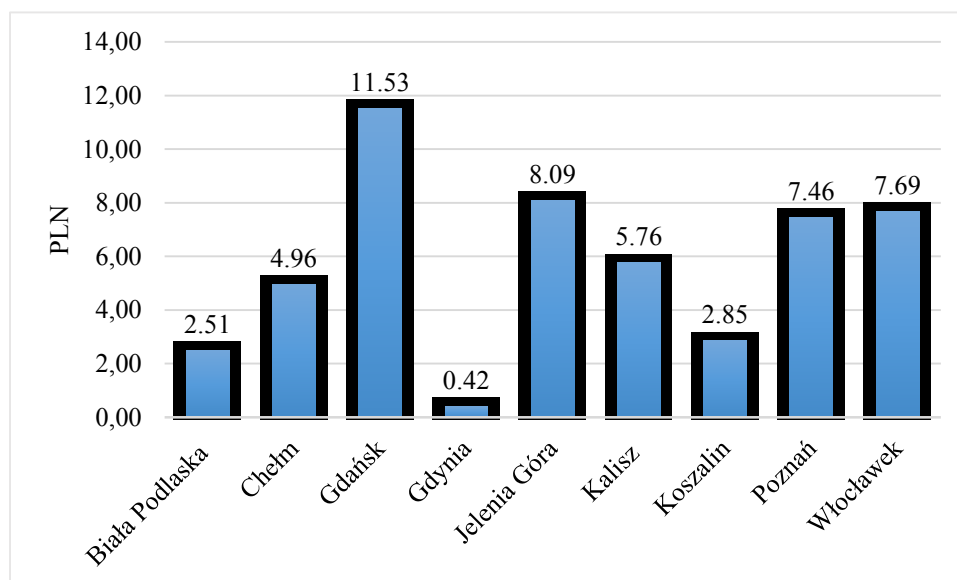


Figure 1. Value of green quotas resources per person in cities with county rights in 2026.

Source: Author's own elaboration.

Another important aspect of the green quotas analysis is the value of resources per square kilometer of city area (Figure 2). This indicator helps assess how pro-environmental funds are spatially distributed across urban areas. It complements per capita data by showing whether the territorial size of a city is reflected in the scale of green investments. It may turn out that large cities allocate relatively small amounts, which could indicate insufficient spatial coverage of residents' needs.

Calculations show that Poznań allocates the most green quotas resources per unit of area, with 15,267.18 PLN per km². Other cities high in the ranking include Włocławek (9,000.00 PLN/km²), Gdańsk (8,252.57 PLN/km²), and Kalisz (7,681.16 PLN/km²). The lowest values were recorded in Gdynia (255.75 PLN/km²), Biała Podlaska (2,755.10 PLN/km²), and Koszalin (2,830.19 PLN/km²).

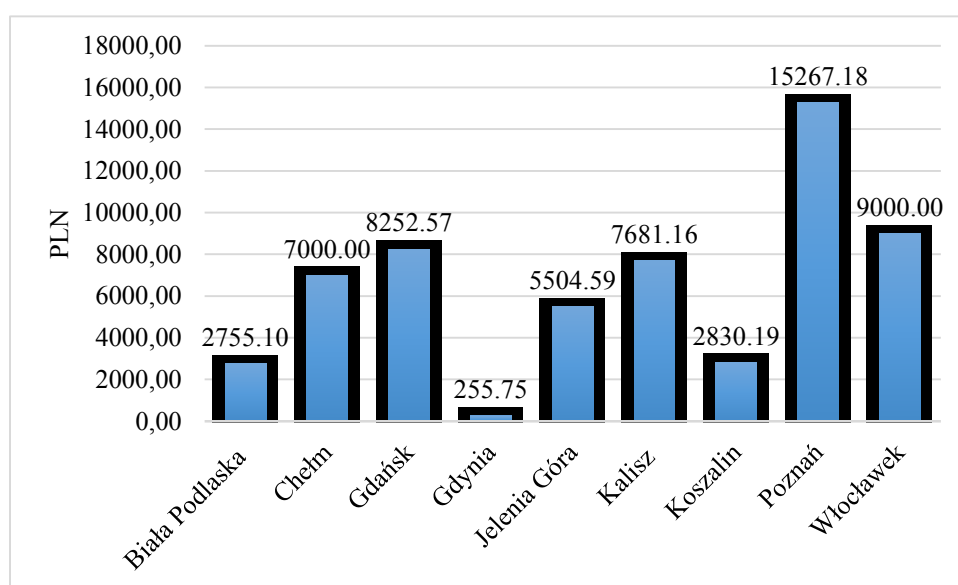


Figure 2. Value of green quotas resources per km² in cities with county rights in 2026.

Source: Author's own elaboration.

5. Discussion and conclusion

The analysis shows that green quotas in participatory budgets remain a rarely used solution among cities with county rights – those units that are legally required to establish participatory budgets. Only 9 out of 66 such cities have allocated green quotas. This indicates that a systemic approach to financing pro-environmental initiatives through participatory budgets is not yet a common practice among local governments. The absence of national standards and guidelines means that decisions to allocate funds for environmental projects within participatory budgets depend solely on the individual priorities of local authorities.

In the cities with county rights that have chosen to allocate green quotas – Biała Podlaska, Chełm, Gdańsk, Gdynia, Jelenia Góra, Kalisz, Koszalin, Poznań, and Włocławek – there are significant disparities in the share of green quotas in the total participatory budget, the value of green quotas per capita, and the value per square kilometer. For example, Gdańsk plans to allocate over 5.6 million PLN for pro-environmental projects in 2026, which constitutes 22.63% of its participatory budget – the highest percentage among all analyzed cities. However, Gdańsk does not achieve the highest value of green quotas per square kilometer, in this regard, it is surpassed by Poznań (15,267.18 PLN/km²) and Włocławek (9,000.00 PLN/km²). This shows that a high percentage of green quotas does not necessarily translate into a significant improvement in environmental conditions, especially if the city has a large area or population.

It is also worth noting that in some municipalities, green quotas are used more broadly than just for infrastructure investments. They also include educational and social projects, and in some cases, animal welfare initiatives.

Similar conclusions were reached by B. Martela, who in his analyses focused primarily on identifying cities that allocate green quotas within participatory budgets, the value of these funds, and the thematic scope of the implemented pro-environmental projects. The analysis covered cities with more than 5,000 inhabitants and encompassed the years 2020-2022. Based on the conducted research, it was established that out of 575 cities included in the study, 282 implemented a participatory budget, and among them, only 17 allocated green quotas. The share of these quotas in the total participatory budget ranged from 3.8% to nearly 41%, with the median value amounting to 10%. Furthermore, the research indicated that in most cities, pro-environmental projects were understood as tasks involving the creation and modernization of green areas as well as the maintenance and planting of vegetation. Less frequently, applications under green quotas concerned small-scale water retention and water management, organization of events, or animal care and protection (Martela, 2023).

Given the infrequent allocation of green quotas within participatory budgets – as confirmed by both the author's own research and external studies – as well as ongoing climate change and the growing need for local environmental protection efforts, it seems justified to consider the standardization of the practice of establishing green quotas within participatory budgeting frameworks. Introducing a requirement to allocate green quotas could significantly contribute to the systemic support of pro-environmental initiatives at the local level and help raise ecological awareness and strengthen community engagement in environmental protection efforts. However, it should be emphasized that implementing such a solution should be preceded by broad consultations with local governments and residents to ensure that diverse needs, socio-economic conditions, and the organizational capabilities of individual local government units are taken into account. Equally important would be the development of standards, criteria, and stages for introducing green quotas within participatory budgets. It would also be necessary to define guidelines regarding the minimum level of funding, eligible

thematic areas for pro-environmental projects, as well as examples of best practices and tools for monitoring and evaluating the effectiveness of implemented actions.

Only an approach based on cooperation among central government, local authorities, and civil society can lead to the successful implementation of sustainable mechanisms supporting balanced development. Strengthening public participation and citizen involvement in climate and environmental protection efforts should go hand in hand with ensuring transparent procedures, adequate resources, and institutional support for local initiatives. Such a system could become a permanent component of urban policy and a practical tool in counteracting the adverse effects of climate change.

References

1. Bera, M., Śpiewak-Szyjka, M., Oleńczuk-Paszal, A., Jankowska, M. (2025). Adapting to climate change – local challenges and constraints. *Scientific Papers of Silesian University of Technology, Organization and Management Series*, No. 223, pp. 9-22, doi: 10.29119/1641-3466.2025.223.1.
2. *BO2025 podstawowe informacje*. Retrieved from: <https://bo.gdynia.pl/bo-2025-podstawowe-informacje/>, 10.07.2025.
3. *Budżet Obywatelski 2026*. Retrieved from: <https://przemysl.pl/77373/3966/budzet-obywatelski-2026.html>, 10.07.2025.
4. Dolewka, Z. (2015). Budżet partycypacyjny w teorii i w praktyce [Participatory budgeting in theory and in practice]. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, No. 408, pp. 62-73, doi: 10.15611/pn.2015.408.04.
5. Gayen, D., Chatterjee, R., Roy, S. (2024). A review on environmental impacts of renewable energy for sustainable development. *International Journal of Environmental Science and Technology*, Vol. 21, pp. 5285-5310, doi: 10.1007/s13762-023-05380-z.
6. Hajto, M., Cichocki, Z., Kuśmierz, A., Borzyszkowski, J. (2021). *Zmiany klimatu i adaptacja do zmian klimatu w ocenach oddziaływania na środowisko*. Warszawa: Instytut Ochrony Środowiska - Państwowy Instytut Badawczy w Warszawie.
7. Instytut Rozwoju Myśli Ekologicznej (2024). *Zrównoważony styl życia, czyli jak żyć zdrowo, minimalizując degradację środowiska?* Retrieved from: <https://irme.pl/zrownowazony-styl-zycia-czyli-jak-zyc-zdrowo-minimalizujac-degradacje-srodowiska/>, 10.07.2025.
8. IPCC (2023). *Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change*. Retrieved from: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf, 10.07.2025.

9. Krasnowolski, A. (2020). *Budżety obywatelskie (partycypacyjne). Historia instytucji i jej funkcjonowanie w polskich samorządach*. Warszawa: Kancelaria Senatu.
10. Krenjova, J., Raudla, R. (2013). Participatory Budgeting at the Local Level: Challenges and Opportunities for New Democracies. *Halduskultuur – Administrative Culture, Vol. 14, No. 1*, pp. 18-46.
11. Leśniewska-Napierała, K. (2017). Budżet partycypacyjny jako narzędzie finansowania inwestycji w Łodzi [Participatory budget as a tool for financing investments in Łódź]. *Studia Miejskie, Vol. 25*, pp. 107-119, doi: 10.25167/sm2017.025.06.
12. Martela, B. (2023). Ocena zielonych pul w budżetach obywatelskich w perspektywie wyzwań klimatycznych [Assessment of green quotas in participatory budgeting in the context of climate change challenges]. *Annales Universitatis Mariae Curie-Skłodowska Lublin - Polonia, Vol. 30, No. 2*, pp. 179-200, doi: 10.17951/k.2023.30.2.179-200.
13. Muras, A. (2018) *Wpływ zmiany klimatu na zdrowie*. Warszawa: Polski Klub Ekologiczny Okręg Mazowiecki.
14. Obwieszczenie Rady Miasta Biała Podlaska z dnia 4 marca 2025 r. w sprawie ogłoszenia jednolitego tekstu uchwały w sprawie wymagań jakie powinien spełniać projekt budżetu obywatelskiego i trybu przeprowadzania konsultacji z mieszkańcami w sprawie budżetu obywatelskiego. *Dziennik Urzędowy Województwa Lubelskiego, Poz. 1514*.
15. Pamukcu-Albers, P., Ugolini, F., La Rosa, D., Gradinaru, S.R., Azevedo, J.C., Wu, J. (2021). Building green infrastructure to enhance urban resilience to climate change and pandemics. *Landscape Ecology, Vol. 36*, pp. 665-673, doi: 10.1007/s10980-021-01212-y.
16. Państwowe Gospodarstwo Wodne Wody Polskie (2025). *Zmiany klimatyczne: Lodowce i susze jako wskaźniki globalnego ocieplenia*. Retrieved from: <https://www.gov.pl/web/wody-polskie/zmiany-klimatyczne-lodowce-i-susze-jako-wskazniki-globalnego-ocieplenia>, 09.07.2025.
17. *Regulamin Budżetu Obywatelskiego Miasta Chełm*. Retrieved from: <https://chelm.budzet-obywatelski.org/wszystko-o-budzecie/zasady-ogolne>, 10.07.2025.
18. *Regulamin Budżetu Obywatelskiego Miasta Kalisza na 2026 rok*. Retrieved from: https://bo.kalisz.pl/pliki/additional_field2_8b66afb620f043a07a335f424dac18c7303667.pdf, 10.05.2025.
19. *Regulamin Jeleniogórskiego Budżetu Obywatelskiego na rok 2026*. Retrieved from: <https://jbo.jeleniagora.pl/add/file/1400861676-c607a5f4c41081e3ec571a74481edf8dfe523a85aa5ca9c070060fa58cd9a60f.pdf?v=0>, 10.07.2025.
20. Rozwadowska, K. (2023). Polityka klimatyczno-energetyczna UE a rozwój gospodarek europejskich [UE Climate and Energy Policy and the Development of European Economics]. *Studia Ekonomiczne, Prawne i Administracyjne, Vol. 2, No. 1*, pp. 51-59, doi: 10.24136/sepia.2023.005.

21. Rzeńca, A. (2018). Zielone budżety partycypacyjne. In: T. Bergier, J. Kronenberg (Eds.), *Międzysektorowa współpraca na rzecz zieleni w mieście* (pp. 119-127). Kraków: Fundacja Sendzimira.
22. Szaranowicz-Kusz, M. (2014). *Budżet partycypacyjny. Jak mieszkańcy mogą współdecydować o budżecie miasta?* Warszawa: Stołeczne Centrum Współpracy Obywatelskiej.
23. Uchwała Nr V/29/2019 Rady Miasta Gdańska z dnia 31 stycznia 2019 r. w sprawie określenia zasad i trybu przeprowadzania konsultacji społecznych budżetu obywatelskiego z mieszkańcami miasta Gdańska. Retrieved from: https://gdansk.ardvote.pl/niezbedne_dokumenty, 10.07.2025.
24. Uchwała Nr VII/117/2024 Rady Miejskiej Leszna z dnia 19 grudnia 2024 r. w sprawie określenia wymagań jakie powinien spełniać projekt Budżetu Obywatelskiego Miasta Leszna. *Dziennik Urzędowy Województwa Wielkopolskiego*, Poz. 473.
25. Uchwała Nr VII/67/2024 Rady Miejskiej w Koszalinie z dnia 19 sierpnia 2024 r. zmieniająca uchwałę w sprawie zasad i trybu przeprowadzania konsultacji społecznych dotyczących budżetu obywatelskiego. *Dziennik Urzędowy Województwa Zachodniopomorskiego*, Poz. 3983.
26. Uchwała Nr XVII/318/IX/2025 Rady Miasta Poznania z dnia z dnia 1 kwietnia 2025 r. w sprawie zasad i trybu Poznańskiego Budżetu Obywatelskiego 2026. *Dziennik Urzędowy Województwa Wielkopolskiego*, Poz. 3535.
27. Uchwała Nr XXIV/100/2020 Rady Miasta Włocławek z dnia 7 lipca 2020 r. w sprawie zasad Włocławskiego Budżetu Obywatelskiego. *Dziennik Urzędowy Województwa Kujawsko-Pomorskiego*, Poz. 3615.
28. Ustawa z dnia 11 stycznia 2018 r. o zmianie niektórych ustaw w celu zwiększenia udziału obywateli w procesie wybierania, funkcjonowania i kontrolowania niektórych organów publicznych (Dz.U. poz. 130 z późn. zm.).
29. Ustawa z dnia 5 czerwca 1998 r. o samorządzie powiatowym (Dz.U. z 2024 r. poz. 107 z późn. zm.).
30. Ustawa z dnia 5 czerwca 1998 r. o samorządzie województwa (Dz.U. z 2025 r. poz. 581).
31. Ustawa z dnia 8 marca 1990 r. o samorządzie gminnym (Dz. U. z 2024 r. poz. 1465 z późn. zm.).
32. *W koronach drzew! – nowa edycja Zielonego Budżetu*. Retrieved from: <https://lublin.eu/mieszkancy/partycypacja/zielony-budzet-obywatelski/informacje-ogolne/w-koronach-drzew-nowa-edycja-zielonego-budzetu,669,1945,1.html>, 04.08.2025.
33. *Zasady Budżetu Obywatelskiego (XII edycja na 2026 rok)*. Retrieved from: <https://decyduje.lublin.eu/pl/budzet-obywatelski-l/xii-edycja/>, 10.07.2025.
34. *Zielony budżet*. Retrieved from: <https://www.katowice.eu/dla-mieszka%C5%84ca/zaanga%C5%BCuj-si%C4%99/konsultacje-spo%C5%82eczne/zielony-bud%C5%BCet>, 04.08.2025.

REVIEWERS

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